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The Journal of the
TEXTILE INSTITUTE

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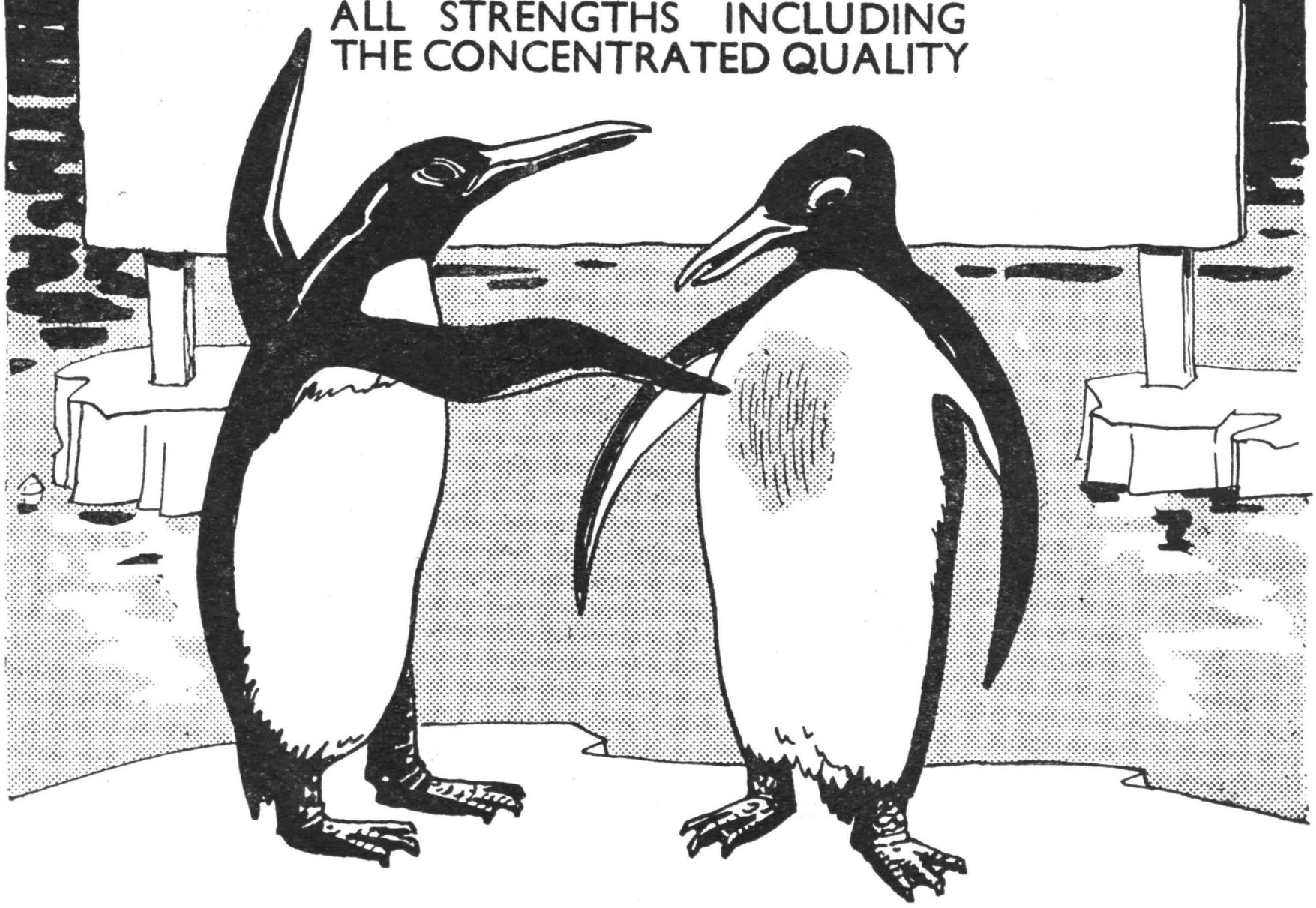

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Richard ARKWRIGHT
Spinning Machine

A.D. 1769

Richard Arkwright has been called "the father of the factory system" for it was due to his invention of the Spinning Machine, which increased the output of cotton to such a great extent that it industrialized areas almost overnight. This machine produced yarn from cotton flax or wool of a quality hitherto unknown, and patents were granted him in 1769 by George III. In that year also, Arkwright erected the first practical cotton mill in the world at Nottingham and in 1786 he was knighted for his contribution to Industry.

Drawings reconstructed from Patent No. 931 at H.M. Patents Office and from a model in the Science Museum, South Kensington, London, S.W.7. Reproduced by kind permission of the Controller of H.M. Stationery Office and the Director of the Science Museum.

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THE JOURNAL *of the* TEXTILE INSTITUTE

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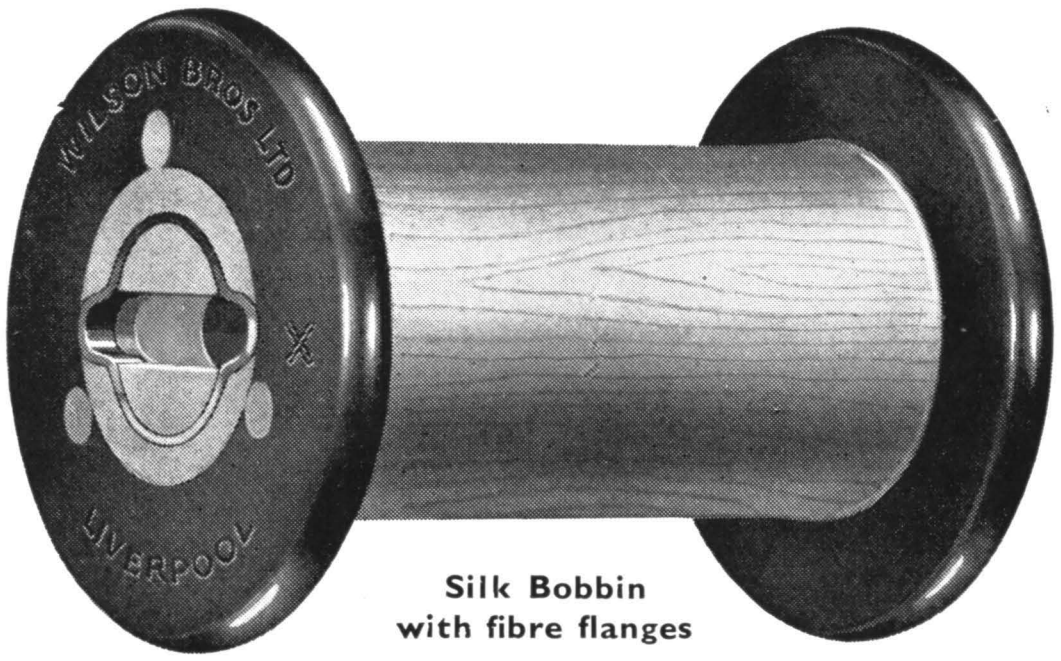
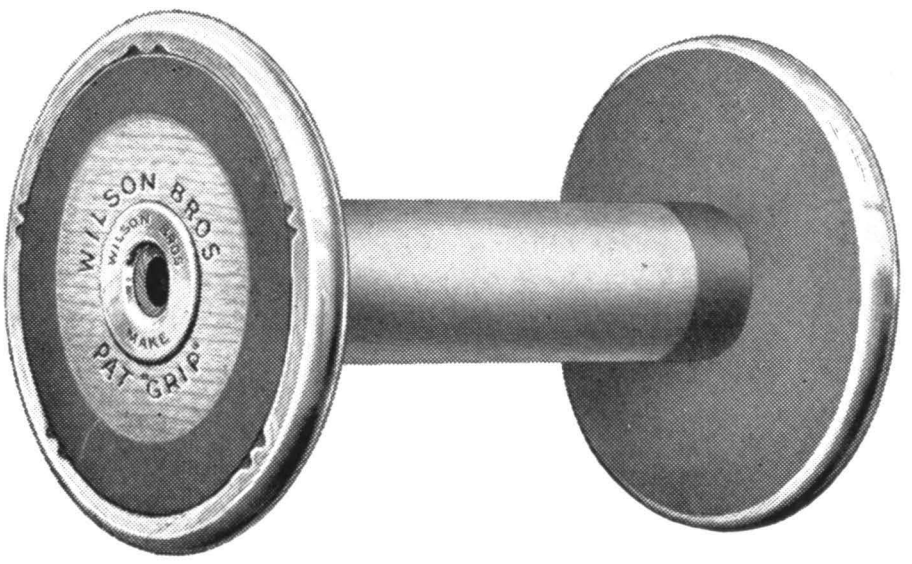
for COTTON, WOOL, SILK, ARTIFICIAL SILK etc

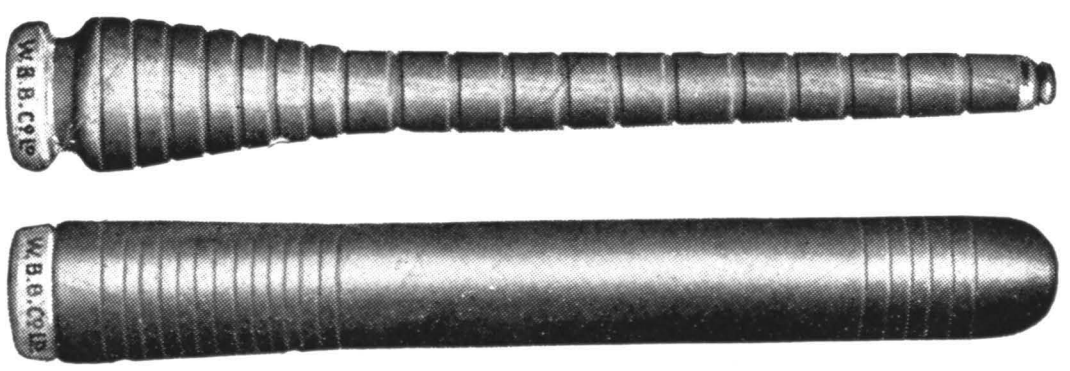


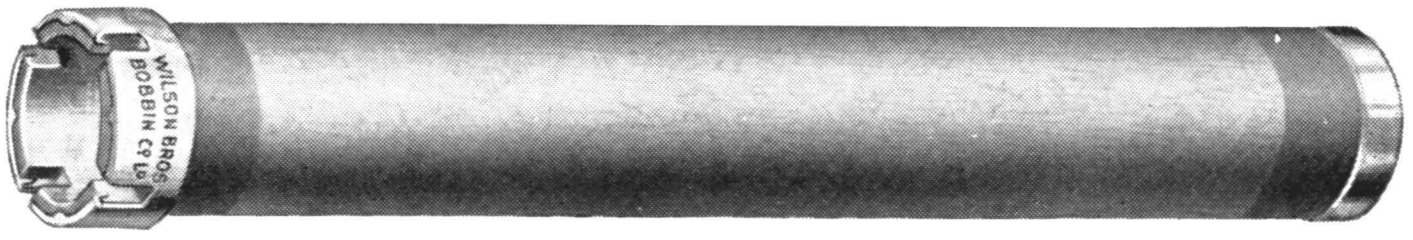
Silk Bobbin
with fibre flanges

TRADE MARK

CARDROOM TUBES
RING BOBBINS
WINDING BOBBINS
PIRNS etc







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NOTICES—INSTITUTE MEETINGS

Monday	30th January	*Leeds*—3.0 p.m. Meeting of Divisional Committee No. 5 at Leeds University.
Wednesday	1st February	*Manchester*—2.15 p.m. Meeting of Examination Board at Institute.
Wednesday	1st February	*Manchester*—3.0 p.m. Meeting of Diplomas Committee at Institute.
Friday	3rd February	*Manchester*—3.0 p.m. Meeting of Unification of Testing Methods Committee at Institute.
Tuesday	7th February	*Manchester*—3.0 p.m. Meeting of Publications Committee at Institute.
Wednesday	15th February	*Manchester*—12 noon. Meeting of Finance and General Purposes Committee at Institute.
Wednesday	15th February	*Manchester*—3.0 p.m. Meeting of Council at Institute.

YORKSHIRE SECTION

Thursday	2nd February	*Bradford*—7.30 p.m. Film—"Manufacture of Card Clothing"—English Card Clothing Co. Ltd., at Midland Hotel.
Thursday	9th February	*Bradford*—7.30 p.m. Lecture—"Recent developments in the deposition of rubber on textile fibres" by Dr. C. M. Blow at Great Northern Hotel (by invitation of Society of Dyers and Colourists).
Thursday	23rd February	*Bradford*—7.30 p.m. A.T.I. Evening at Midland Hotel.

MIDLANDS SECTION

Friday	10th February	*Leicester*—7.30 p.m. Lecture—"Laundering effects on Textile Fabrics with special reference to Knitted Materials" by T. C. Petrie Esq. at Victoria Hall.

LANCASHIRE SECTION

Thursday	2nd February	*Burnley*—7.30 p.m. Discussion on "An Examination of the Uniform List of Prices." Opening speaker H. Brookes, at Municipal College.
Wednesday	22nd February	*Manchester*—7.30 p.m. Lecture—"Colour" by J. Guild, at Literary and Philosophical Society Rooms

OTHER ORGANISATIONS

Batley and District Textile Society

Thursday	9th February	*Batley*—7.30 p.m. Lecture—"England through a View Finder", at the Technical College.

Blackburn Textile Society

Friday	10th February	*Blackburn*— Lecture—"The Manufacture and Use of Healds and Reeds", by H. Green.
Friday	24th February	*Blackburn*—Lecture—"Electrical Driving in Textile Mills", by F. B. Holt.
Saturday	25th February	Visit to Electricity Generating Station, Whitebirk, Blackburn.

Bolton and District Managers, Carders and Overlookers' Association

Friday	24th February	*Rochdale*—8.0 p.m. Lecture—"Juvenile Education and the School Leaving Age", by Councillor C. Crowther.

Bradford Textile Society

Monday	6th February	*Bradford*—7.30 p.m. Lecture—"The Fastness requirements of Tropical Suitings with particular reference to the use of Sighting Yarns", at the Midland Hotel.
Wednesday	8th February	*Bradford*. Visit to Messrs. Allied Industrial Services Ltd, Lidget Green, Bradford.

Burnley Textile Society

Thursday	16th February	*Burnley*—Lecture—"The Dyeing of Cotton Staple Fibre and Mixtures", by J. G. Grundy Esq. at the Mechanics' Institute.

Bury and District Textile Society

Friday	10th February	*Bury*—7.45 p.m. Lecture—"Before Carding", by Mr Whittle, at the Technical College.
Friday	24th February	*Bury*—7.45 p.m. Lecture—"The Population and its Economic Consequences", by H. F. Farrar, at the Technical College.

Colne and District Textile Society

Friday	3rd February	*Colne*—7.30 p.m. Lecture—"Scientific Management in Weaving Mills", by J. B. Aitken.

Cumberland Textile Society

Thursday	9th February	*Carlisle*—Lecture—"Manufactures and Chief Characteristics of Bemberg", by E. Higgs Esq.

Derby Textile Society

Wednesday	1st February	*Derby*—Lecture—"High Speed Rayon Warping", by H. Marsden, M.Sc., A.T.I., at the Technical College.

Design and Industries Associations

Friday	3rd February	*Manchester*—7.30 p.m. Lecture "Interior Surface Effects", by W. G. Sutherland, F.R.S.A., at the College of Technology.

Dewsbury Textile Society

Tuesday	7th February	*Dewsbury*—Film of the *Queen Mary*.

Guild of Calico Printers', Bleachers', Dyers' and Finishers' Foremen

Saturday	11th February	*Manchester*—Lecture—"The Factory Act 1937", 7.0 p.m., at the Old Rectory Club.
Friday	10th February	*Bolton*—Lecture—"Dyeing of Vat Colours by the Pigment Padding Method."
Wednesday	8th February	*Glossop*—Lecture—"Bridges and Bridge Building".
Friday	10th February	*Stockport*—Lecture by J. G. Grundy Esq.
Friday	10th February	*Radcliffe*—Lecture—"I.L.O.", by R. Hewitt Esq.
Saturday	4th February	*Rochdale*—Lecture by Mr. Jas. Kiernan.
Friday	10th February	*Accrington*—Lecture by F. Heyes Esq.

Halifax Textile Society

Monday	13th February	*Halifax*—7.30 p.m. Lecture—"Fluctuations in Wool Prices."
Monday	27th February	*Halifax*—7.30 p.m. Lecture—"Salesmanship", by Mr. G. Gledhill M.P. (Halifax).

Huddersfield Textile Society

Monday	6th February	*Huddersfield*—7.30 p.m. Lecture—"Coloured Worsted Spinning", by A. Whitehead.
Monday	20th February	*Huddersfield*—7.30 p.m. Lecture—"Raw Materials for the Woollen Industry", by H. Hardy Esq.

Keighley Textile Society

Monday	13th February	*Keighley*—7.30 p.m. Lecture—"Discussion on Rayon Developments."

Leicester Textile Society

Friday	10th February	*Leicester*—7.30 p.m. Lecture—"Laundry Effects on Textile Fabrics—with Special reference to Knitted Materials", by T. C. Petrie Esq.

Manchester Chemical and Allied Societies

Thursday	9th February	*Manchester*—7.15 p.m. Lecture—"What happens to Motor Oil and what happens to the Engines", by C. J. Kelly, at the Engineers' Club.

Morley and District Textile Society

Tuesday	21st February	*Morley*—Lecture by J. W. Radcliffe, "On the Road with Textiles."

Nelson Textile Society

Thursday	16th February	*Nelson*—7.30 p.m. Lecture—"Water as it affects the Engineer", by A. H. Cockcroft Esq.

Oldham Technical Association

Tuesday	21st February	*Oldham*—Lecture—"Concrete Practice."

Rochdale Textile Society

Tuesday	14th February	*Rochdale*—Lecture—"The Progress of Fibro", by H. Ashton Esq.
Tuesday	21st February	*Rochdale*—Lecture—"Modern Ring Frame", by N. Hooper.

Shipley Textile Society

Thursday	9th February	*Shipley*—Visit Messrs. Charles Walker & Co. Leeds

Association of Managers, Carders and Overlookers

Thursday	16th February	*Oldham*—7.30 p.m. Lecture—"Wool—The Raw Materials and their Characteristics", by Dr. Wilding.

THE JOURNAL OF THE
TEXTILE INSTITUTE

Vol. XXX JANUARY 1939 No. 1

PROCEEDINGS

NOTES AND ANNOUNCEMENTS

Election of Council of the Institute

A list of vacancies which arise on the Council of the Institute at the end of the current session has been approved for publication in this issue. Ten of the thirty Ordinary Members of Council retire annually, but are eligible for re-election unless specially disqualified. In the February issue, Nomination Forms will be inserted for the use of members wishing to nominate candidates for the 1939 vacancies.

1939	1940	1941
Bromiley, H. (F.T.I.)	Barnes, H. C. (A.T.I.)	Chamberlain, J. (F.T.I.)
Crompton, W. B. (F.T.I.)	Chadwick, F. (F.T.I.)	Dalton, J. E.
Dilks, H. L.	Davis, Wm.	Goodall, J. R. S. (F.T.I.)
Gee, N. C. (A.T.I.)	Greenwood, H. (F.T.I.)	Greg, H. G.
Gowie, A.	Howarth, Wm.	Haigh, G. (F.T.I.)
Kendall, F. (F.T.I.)	Nisbet, H. (F.T.I.)	Lord, R. (F.T.I.)
Kershaw, S. (F.T.I.)	Porter, F. C. (F.T.I.)	Morton, W. E. (F.T.I.)
Read, J. (F.T.I.)	Stevenson, A. W. (F.T.I.)	Richardson, H.
Slater, F. P. (F.T.I.)	Wildt, E. (F.T.I.)	Speakman, J. B. (F.T.I.)
Withers, J. C. (F.T.I.)	Wilkinson, W. (F.T.I.)	Thompson, G. H. (F.T.I.)

Annual Meeting, 19th April 1939

Among a number of interesting items on the Agenda for the Council Meeting this month was the arrangements for the 1939 Annual Meeting. As already announced this is to be held in Leicester on Wednesday, 19th April. A Special Committee of Leicester members has been set up and the programme planned by this Committee was considered by Council. Apart from a slight reduction in the variety of entertainment offered, this programme was unanimously adopted and the local Committee thanked for its efforts. Completion of arrangements is now to be pressed forward and it is hoped to issue a preliminary notice with the February issue of the *Journal*. As it is planned to arrange for a special coach to be attached to trains from Leeds, London and Manchester, members are asked to reserve this date and to make a very special effort to attend.

Associateship and Fellowship—Regulations

In the November and December issues of the *Journal* attention was drawn to the revision of the Regulations governing election to the Associateship and Fellowship of the Institute, now in progress. From applications already received for and inquiries made relating to recognition of Diplomas and Certificates it is believed that some misunderstanding exists as to the subjects in regard to which such application may be made. The Sub-committee concerned wishes it to be made clear that application for recognition of Certificates in any textile subject may be submitted. By textile subject is meant spinning, weaving, knitting, lace-making, bleaching, dyeing, finishing, or design. The last date for receipt of such applications has been extended to 28th February.

Textile Institute Diplomas

Elections to Fellowship and Associateship have been completed as follows since the appearance of the previous list (December issue of this *Journal*)—

FELLOWSHIP

HARWOOD, Frank Courtney (London)
PRITCHARD, William (Derby)

ASSOCIATESHIP

EDWARDS, William Alfred (Loughborough)

Employment Register

The following announcements are taken from entries in our Register of Members whose services are on offer. Employers may obtain full particulars on application—

No. 198—A.T.I., 26 years of age, desires position as Assistant Chemist or Technologist in Dyeing and Printing works. City and Guilds First Class Finals in Textile Printing, Silk and Rayon Dyeing. Nottingham University Diploma in Textiles. Desires to go abroad, especially the Antipodes. Patentee. Knowledge of Screen Printing.

No. 199—Young man, 30 years of age, A.T.I., desires position of responsibility in Wool Textile Industry. City and Guilds Full Tech. Certificate in Science, Chemistry, etc. and the Diploma in Woollen and Worsted Manufactures. Extensive mill experience in Design, Cloth Structure etc., and in most modern methods of management, welfare, costings and salesmanship.

Institute Membership

At the *January* meeting of Council, the following applicants were elected to Membership of the Institute—

Ordinary

A. A. New, "Hergiswil", 77 Footscray Road, Eltham, London, S.E.9 (Chief Chemist, Standard Telephones and Cables Ltd.).

A. D. Anderson-Scott, 7 High Glove, Welwyn Garden City, Herts. (Engineer),

R. A. Bailey, 3 Woodplumpton Road, Burnley (Invoice and Particulars Clerk, Messrs. Edmondson Ltd., Rosegrove).

T. S. Boswell, The Azam Jahi Mills Ltd., Warangal, Deccan, India (Mill Manager).

Miss K. Broadhead, Derrymore, Cookridge, Horsforth, Leeds (Designer).

T. Fraser, 1 Alexandra Street, Dunfermline, Scotland (Disponant and Designer).

H. Hammad, Director of Government Spinning Factory, Delta-Barrage, Egypt (Director of Cotton Spinning Factory).

J. A. Kirby, 815 Rochdale Road, Slattocks, Rochdale, Lancs. (In charge of Experimental Dept., Arrow Mill).

J. E. Pritchard, 215 Briercliffe Road, Burnley (Loom Overlooker, Messrs. A. Edmondson Ltd., Rosegrove).

L. S. Ram, Delhi Cloth and General Mills Co. Ltd., Delhi, India (Business and Banking).

Junior

F. J. Alexander, 37 Haydock Street, Burnley (Student).

J. Findlay, 38 Well Street, Paisley, Scotland (Textile Chemist).

W. Stedman, Springvale, Doagh, Co. Antrim, N. Ireland (Student Chemist).

MEETINGS

Lancashire Section

DINNER DANCE

This event was held at the Manchester Limited Café on 16th December 1938. The President and Mrs. Nasmith together with Mr. and Mrs. W. Howarth, Chairman of the Lancashire Section, welcomed the guests. The presence of the U.S. Consul for the Manchester district, Mr. G. Tait and Mrs. Tait made the occasion memorable. There was a good attendance though far from the numbers the Lancashire Section Committee would like to see. After the reception, dinner was served and this was followed by dancing. The dance programme was in the hands of Mr. J. H. Lester and Mr. H. P. Curtis and was interrupted shortly after ten o'clock for an exhibition of ballroom dancing by Miss Margaret Cadman and her partner. This item was much enjoyed. The evening was generally regarded as a real success and members of the Lancashire Section are asked to note that early steps are being taken to reserve a date for a similar event this year of which full notice will be given as soon as possible.

Yorkshire Section

On Tuesday, 6th December 1938, at the Midland Hotel, Bradford, Dr. C. H. Clarke delivered an address on "Detergency Problems in relation to Textile Standardisation." He described the work of the Rinso Washability Bureau at Port Sunlight and exhibited the apparatus developed there for the determination of the shrinkage of fabrics on laundering. Dr. Clarke was supported by Mr. F. P. Thompson, M.Sc. (Tech.) A.I.C. of Lever Bros., Port Sunlight, who answered questions in the discussion carried on after Dr. Clarke's departure.

The Chair was taken by Mr. W. E. King, F.T.I.

"NEW METHODS OF DYEING AND FINISHING MATERIALS COMPOSED OF WOOL AND CELLULOSE FIBRES"*

Dr. Nusslein said that he proposed to consider under this title what developments of the new artificial fibres are likely as regards the replacement of wool by rayon or its use in conjunction with wool. There are numerous good reasons for the substitution of wool by artificial silk in many types of fabrics. It is difficult to foresee developments but there are admittedly grave difficulties in attempting to replace wool entirely by synthetic fibres. Natural cellulosic fibres are fairly easily substituted by artificial silk since their properties are more nearly akin to those of cellulose fibres than to those of wool. Incidentally, many of the so-called regenerated cellulose fibres would be more correctly described as degenerated.

Much attention is now being paid to the chemistry of substances of very high molecular weights and the tests in this field will undoubtedly lead to great industrial developments. Economic conditions in some countries are limiting the consumption of the natural fibres and are forcing the application of the discoveries of research on these substances. Insistent demands in these days for rapid changes in fashion also stimulate progress in this direction. This factor may be psychological but it is of far reaching importance.

The development of the various types of artificial silk has proved definitely that there are numerous avenues in which they may be employed and the great established branches of the textile industry have already grappled successfully with some of the problems. A new and more difficult problem arises, however, in the making of heavy durable fabrics for men's suitings, cloths for uniforms, etc. This is not easy when the fabric consists of wool and rayon in roughly equal proportions. It becomes many more times difficult when the fabric consists entirely of synthetic materials and yet has to aim at possessing the properties

* Abstract of a lecture by Dr. Nusslein of the I. G. Farbenindustrie A.-G. The Textile Institute, Yorkshire Section, attended by invitation of the Cartwright Club, Tuesday, 8th November 1938.

of an all-wool cloth. In some respects the position is parallel to that of 30 years ago. Rayon was produced with the idea of substituting real silk. Actually it caused the consumption of real silk to increase and it found its own proper sphere. It should not be regarded as a competitor of natural silk.

As the synthetic fibres first developed in great quantities were of the regenerated cellulose types these only were used in the first trials as wool substitutes. In the great number of experiments made it was inevitable that many should be unsuccessful. But gradually the best conditions for mixing given materials were discovered and the modifications necessary in the machines for processing were made. The methods for finishing were likewise altered where necessary or new ones were found. There is no doubt whatever that some fabrics of very high quality have been produced and that they can only with difficulty be distinguished from all-wool cloths.

The problems that arise in dyeing fabrics containing different kinds of fibres are too well known to all to require emphasis. Amongst the most outstanding properties of the various kinds of synthetic materials are their different affinities for dyestuffs. Much success has been achieved in Germany by blending wool and rayon which had been previously dyed separately in the loose state. The processing of fabrics composed of yarns containing wool and rayon both in the undyed state is a field in which there is as yet but little accumulated knowledge. The difficulty will ultimately be overcome just as those of spinning blends of various fibres have been solved in the past.

The dislocation of the olive oil market in consequence of the Spanish War created difficulties and problems for the worsted industry of Yorkshire and led to the trial of possible substitutes. In Germany, owing to the economic conditions, the available supplies of olive oil had already been reserved for edible purposes. The production of olive oil substitutes suitable for spinning and the problems of their removal in the scouring operation had therefore already received some attention. To-day there are no greater difficulties resulting from the use of improved emulsified mineral oils than there are with olive oil or arachis oil. The chemical industry has co-operated closely with the textile industry in this respect. Research on scouring has proved that the idea of the necessity for prolific lathering is a fallacy. It has been shown that, using certain agents, an acid scour is possible and that by avoiding alkali as far as possible invisible damage to the wool may be largely avoided. This is of the greatest importance if the cloths contain casein rayon which is readily attacked by alkali. With acid scouring, rinsing is an easier problem and more quickly effected than with alkali.

Some of the difficulties arising in dyeing fabrics containing wool and rayon have been solved by "animalising" the cellulosic rayon. The object of this process is solely to alter the affinity for dyestuffs. The fibres are not converted into synthetic wool but retain the properties of cellulose. Thus they do not mill or felt like wool and they are sensitive to the action of strong acids. Casein rayon should be similarly regarded for it does not possess the peculiar characteristics of wool. In order to make the rayon dye like wool, substances such as casein and fish albumen have been incorporated in the viscose. Attempts have been made to introduce synthetic highly organised bases capable of forming coloured lakes with acid dyes or chrome colours. Experience has taught that dyestuffs cannot be considered apart from the fibre on which they are deposited. Affinity, shade and fastness often differ when the same dyestuffs are dyed on to different fibres. Further, the resistance to processes such as scouring, steam blowing, etc. may be altered.

The problems are not yet fully solved and before wool can be extensively replaced by rayon much more research and testing will be necessary. For cloths of certain types wool remains the ideal material.

Dr. Nusslein exhibited swatches of patterns of fabrics containing rayon up to 50 per cent. He showed a film illustrating detergent action which demonstrated in a remarkable manner the efficiency of some of the new detergents now on the market.

London Section

The London Section of the Textile Institute met on Thursday, 15th December 1938 in the Lecture Theatre of the Royal Society of Arts, John St., Adelphi. Professor R. Whiddington, M.A., D.Sc., F.R.S., Cavendish Professor of Physics in the University of Leeds, delivered a lecture on "Light and Colour". Mr. E. W. Goodale, M.C., who was in the chair, was instrumental in securing the Society's Lecture Theatre for this event. The lecture was profusely illustrated with beautiful experiments. The chairman of the London Section, Mr. C. H. Colton, proposed the vote of thanks.

Professor Whiddington dealt with the subject of "Light and Colour" from the physical point of view rather than from that of the dyer and colourist. Strictly speaking there is no colour in nature since colour is a sensation and a matter of interpretation by the eye and the brain of stimuli produced by light waves. The well known colour triangle was briefly explained and experiments were performed to demonstrate that the sensation of blue, for instance, is produced by the combined sensations of green and violet. There is no completely satisfactory theory of colour vision, though the main facts can be described by the trichromatic theory which assumes three fundamental stimuli only, red, green and violet.

Colour sensations can be produced from ordinary white light in various ways. The blue of the sky is produced by the scattering and polarising actions of fine particles and perhaps even molecules and atoms of gases in the upper atmosphere and the absorbing action of the lower layers of the air. Optically active substances rotate the plane of polarisation of the various constituents of white light to different degrees and thus produce very beautiful colour effects.

The importance of the effect of the various kinds of illuminant on the appearance of dyed materials is too well known to need stressing. In purchasing coloured goods it is wise to make the decision in daylight or in ordinary artificial light according to the conditions under which the garments made from the materials will be worn. Very striking examples of this effect were exhibited by means of small tubes of fluorescent substances which appear to have rather drab colours in ordinary light but which shine with beautiful brilliant colours when irradiated with ultra-violet light.

GENERAL ITEM

THE PERKIN MEDAL OF THE SOCIETY OF DYERS AND COLOURISTS

The Society of Dyers and Colourists has recently recommended the award of the Perkin Medal to Mr. J. Baddiley of Imperial Chemical Industries Ltd. (Dyestuffs Group) and to Dr. Henry Dreyfus, Chairman and Managing Director of British Celanese Ltd. On the 19th January 1939, at a meeting in Bradford, the medal was presented to Dr. Dreyfus by Professor F. M. Rowe, D.Sc., F.I.C., of the Department of Colour Chemistry and Dyeing, Leeds University.

This very highly coveted distinction has been awarded on ten previous occasions since its institution in 1908. As is well known, the suggestion that the Society should award a medal with which the name of Perkin should be associated, came from the late Mr. S. Hickson. Mr. Hickson attended the celebrations in honour of the Jubilee of Sir William Henry Perkin's discovery of the first coal tar dyestuff. He was the delegate of the Society of Dyers and Colourists, on whose behalf he presented a congratulatory address.

Dr. Henry Dreyfus and Mr. Baddiley thus enter the very distinguished company which includes such world famous names as Professor Adolph von Bayer, M. le Comte Hillaire de Chardonnet, Professor A. G. Green and Mr. C. F. Cross. The omission of the names of the other recipients in no way detracts from the brilliance of their achievements.

The presentation to Mr. Baddiley will take place in Manchester later in the year.

CORRESPONDENCE

To the Editor of the "Journal of the Textile Institute"

SIR

As we may now look upon the Textile Institute as being firmly established and having in all probability a long and useful life before it, it will be well in the interests of historical accuracy to put on record how it came into being, whilst so many who helped in its early stages are happily still living.

Our President, Mr. Frank Nasmith, was also evidently of this opinion when at the meeting in Halifax on 27th April 1938, he gave his interesting address on the "Textile Institute in Retrospect and Prospect". In the issue of the *Journal* for the following October Professor Alfred F. Barker put forward his views as to what led to the formation of the Institute. May we add to these some further information bearing on the formation of the Institute?

The seeds of the Institute were sown at the Fourth Congress of the International Association for Testing Materials, held at Brussels in 1906, and which we, the undersigned, attended as delegates. Our experience at this Congress led us to discuss the desirability of establishing an Institute for the Textile Industry—every section of it—the object being "To bring Science and Practice together" for the benefit of the industry in general. Soon after we returned to Manchester we met frequently to discuss the matter and got a further impetus from the Fifth Congress of the International Association for Testing Materials which was held in Copenhagen in 1908 and to which we were again delegates.

In the interval between the Brussels Congress of 1906 and the sending out of our invitation to the leading professors of textiles early in 1909 to join us in our project, we two met together 50 times to prepare the foundation of an Institute broad enough for a superstructure which should embrace all sections of the Textile Industry in all countries.

Previous to 20th July 1909, when a meeting was held at the Victoria Hotel, Manchester, neither of us was aware of any earlier attempt having been made to form such an Institute. At that meeting Sir William Mather told us of an earlier attempt, regarding which, however, he could neither give us date nor details. Many years after, we heard of the movement with which Mr. B. H. Thwaite was associated and which is chronicled in the *Journal of the Society of Dyers and Colourists*, but the information is scanty and the movement collapsed.

From the very first of our conversations we were careful to claim nothing more than this—that the establishment of a Textile Institute was inevitable in view of the existence and good work of other scientific and technical institutions and societies, which were already applying the benefits of science to practice.

The Iron and Steel Institute, the Society of Dyers and Colourists, the Society of Chemical Industry, and many others, were helpful to us and we made use of their propaganda about applying the benefits of science to industry. Most of our earlier efforts were devoted to studying the organisation of the above named and similar societies and of getting promises of support from leaders of every important section, cotton, wool, silk, linen and jute.

We have no recollection of any "disturbing elements" and the "house divided against itself" mentioned by Professor Barker, though it is true that one of our pencilled memoranda records the objections that there was "no need for such an Institute"; that it would "degenerate into an opportunity for picnics"; that existing institutions were "getting old, fat and comfortable", etc. But no one took any serious notice of the dear old eccentric gentleman who made these prophecies.

After our invitation to the professors of textiles we next invited to our aid the editors of the textile periodicals (our present President, Mr. Nasmith, was one who attended) and a few leading industrialists of the type who were already seeking to increase the scientific interest of their workpeople. We were aware

of the work that was being done in various localities by textile societies, and no doubt the seed of the Textile Institute, when it found such an agreeable, prepared soil, flourished as it otherwise might not have done.

We have perhaps said enough to show the genesis of the Textile Institute. We are afraid of trespassing further on your space, much as we would like to do so. The early supporters of the Textile Institute deserve all honour and praise.

MANCHESTER (*Signed*) GEORGE MOORES
1st January 1939 J. H. LESTER

To the Editor of the "Journal of the Textile Institute"

SIR

In the November issue of the *Journal of the Textile Institute*, you published a review of the *Textile Recorder Year Book*, 1938 by "T".

The reviewer has several complimentary things to say about the Year Book which are very welcome, but no less so are the constructive criticisms he has to make. It is clear that "T" appreciates the difficulties of producing a book of this scope, and his point that sections should be periodically "overhauled" is obviously essential to the book's value. I should add that it is one which we have tried to adopt. The particular section to which he refers is even now under revision, and will, I hope, add to the attractiveness of the next issue.

One or two of "T's" criticisms, however, are not quite so happy. The calculation error to which he draws attention can obviously be laid at the door of the printer, and, while the example might possibly have been more logically stated, the meaning intended would be grasped by 100 per cent. of readers.

"T's" remaining criticism is a difficult one to appreciate. He says "In a few respects progress has really been neglected. Under twist designation should be given in these days the 'S' and 'Z' system, in addition to the 'Twist' and 'Weft' which most people devoutly hope will soon disappear." This is a serious criticism, but how is it justified? The reader will find on pages 199 and 200 of the Year Book, summarising the section 'The Principles of Twist Insertion', the following—

> " (3) Twist-way twist, also termed 'right' and 'regular', forms a right-hand spiral, in which (if the thread is placed vertically) the diagonal lines forming the spiral go upwards from left to right, or in the same direction as the middle stroke of the letter 'Z', hence the term 'Z twist'.
>
> (4) Weft-way twist, also termed 'left' and 'reverse', forms a left-hand spiral, in which the diagonal lines go upwards from right to left, or in the same direction as the middle portion of the letter 'S', for which the term 'S twist' has been suggested."

Presumably "T" will willingly withdraw his criticism on this point? He has given abundant evidence of his desire to be just, and it is obviously very easy for a reviewer to miss such details in a treatise about which he himself says that the description "A textile library in brief" is so far true that in order to deal adequately with the work, a reviewer would need extremely extensive knowledge.

MANCHESTER (*Signed*) W. HUBBALL
30*th December* 1938 *Managing Director "Textile Recorder"*

NOTE—The Editor can assure Dr. Hubball that the reviewer hastens to withdraw his remark regarding "Twist Designation" and regrets overlooking the excellent treatment of the question of twist on pages 199 and 200 of the *Textile Recorder Year Book*.

JOURNAL CONTENTS: THIS ISSUE

In the Transactions Section of this number of the *Journal of the Textile Institute* will be found two papers by L. J. Jolley, Ph.D., A.R.C.S., entitled "The Dissolution of Chemically Modified Cotton Cellulose in Alkaline Solutions. Part IV. The Solvent Action of Cuprammonium Solutions. Part V. The Solvent Action of Solutions of Cupric Hydroxide in Aqueous Ethylenediamine." The following paragraphs, quoted from a Shirley Institute publication, give a brief explanation and summary of these papers.

Solutions of ammonia and of ammonia derivatives such as ethylenediamine dissolve copper hydroxide to form strong complex bases, and the resulting solutions have, as is well known, the rare property of dissolving cellulose. This property has naturally engaged the attention of chemists, and numerous investigations have been made to discover the mechanism of the dissolution process. Cuprammonium solutions always contain a large excess of free ammonia in addition to the complex base, and since it was believed that a saturated solution of copper hydroxide in aqueous ethylenediamine contained only a single complex base and no free diamine, the use of cupri-ethylenediamine solutions instead of cuprammonium in these investigations has often been preferred as a simplification of the problem. The results of these earlier studies have led to some understanding of the reactions between cellulose and cuprammonium or cupri-ethylenediamine, but there were still many unsatisfactory features in the theories proposed. In continuation of the work already done at the Shirley Institute on the dissolution of modified cellulose in alkalis, an investigation has now been made of the solvent action of cuprammonium and cupri-ethylenediamine solutions on cellulose, and the results obtained are described and discussed in the papers.

The results support the conclusions of previous investigators that the dissolution of cellulose in cuprammonium or cupri-ethlenediamine depends on the formation of complexes between cellulose and the copper-containing bases, but it has not been found possible to define completely the composition of these complexes. Examination of the system ethylenediamine-copper hydroxide—water has shown that it is not as simple as previous investigators have believed, and some of their conclusions about the nature of the cellulose-copper complex are thereby invalidated. The use of cupri-ethylenediamine solutions is found to introduce serious difficulties that are not present when cuprammonium is used, but it nevertheless allows certain information to be obtained that is not obtainable with cuprammonium. The solubility relations of cellulose in cuprammonium and cupri-ethylenediamine solutions are much more complicated than those found with caustic soda, but on the basis of views developed in the study of the dissolution of modified celluloses in the simple strong alkalis it has been possible to analyse the solubility data in an illuminating way and hence to explain many of the complications.

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THE JOURNAL OF THE
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TRANSACTIONS

1—NOTE ON TOP AND NOIL YIELD IN WOOL COMBING

By S. KERSHAW, F.T.I.
Head of the Textile Department, Halifax Municipal Technical College

Some time ago the writer made a note on the effect which the system of combing had on top and noil yields. To the uninitiated many of the terms used and the methods enployed in top making require explaining.

The work of wool buying embraces—

(*a*) The right estimation of the wool quality both in bulk and in off-sorts, and a correct forecast of the character of tops to be made.

(*b*) The correct estimate of the amount of impurities present in the wool, and their nature. The more objectionable wool impurities, such as paint, tar, and vegetable matter are most especially noticed.

(*c*) An estimate of the proportion of long and short fibres in the wool from the standpoint of the type of top it is desired to make, or the system of combing to be adopted, and the top and noil ratio.

All this is necessary before the wool buyer can fix a price or say what the wool is worth. Wool is usually bought by auction and becomes the property of the highest bidder. Only very expert men can buy wool successfully, and the above estimations have to be made, and made quickly, and the price worked out at current values.

It is not intended to deal at this stage with wool quality or scouring yields. These have received attention from other writers, and while the last word has not been said on these important matters, the focus is now on the effect which the system of combing has on the top and noil yields. There is a difference between clean scoured content and top and noil yield. The former is based on the amount of clean wool at the standard regain obtained from greasy wool, and is usually expressed as a percentage. The top and noil yield is the amount of top, noil and burrs, at standard regain, with or without oil, obtained from a given quantity of greasy wool, and usually expressed as a percentage.

It will be realised that all top and noil yields cannot be the same because of the oil content and the different regain percentages allowed for the varied classes of tops. It will also be seen that the top and noil yield will vary—(i) with the tear (top and noil ratio), by reason of the different regain percentages of top and noil; (ii) with the system of combing, i.e., in oil or dry-combed, as there are different regain percentages for tops made on these

two systems; (iii) with the type of comb used, as there is a difference in the regain percentages of the noils made on one machine as compared with the others. (Schlumberger noils have a regain of 16 per cent. compared with the Noble and Lister noils regain of 14 per cent. The former are combed out without heat and therefore retain more moisture, hence the higher percentage of regain standard.)

None of the last-named effects has anything to do with the clean scoured content of the wool; they relate to the top and noil yield only. As this aspect of the wool buyer's work appears to have escaped attention up to the present, it is desired to record it for the benefit of the trade, for those who are on the threshold of a textile career, and for those to whom this matter has not previously been clear. The following are important figures in this connection—

British Standard Regains for Wool Goods

Tops combed in oil	19 per cent.
Top, dry-combed	18¼ ,, ,,
Schlumberger noils	16 ,, ,,
Noble and Lister noils	14 ,, ,,
Oil in tops and noils, combed in oil	3½ ,, ,,
Oil in tops and noils, dry-combed	0·634 per cent.

A few examples are here worked out to show the differences which result in top and noil yield when working up wool in varied ways in industry. The basis of comparison of each lot is 100 lb. of clean wool, absolutely dry.

Example 1—To show the different Top and Noil yields when the tear varies

(*a*) TEAR 7 TO 1.

Then Top is 87·5 lb.;	add 19% of moisture giving	104·125 lb.
and Noil is 12·5 lb.;	add 14% of moisture giving	14·25 lb.
	Total ...	118·375 lb.

(*b*) TEAR 3 TO 1.

Then Top is 75 lb.;	add 19% of moisture giving	89·25 lb.
and Noil is 25 lb.;	add 14% of moisture giving	28·50 lb.
	Total ...	117·75 lb.

Example 2—To show the different Top and Noil yields when the System of Combing varies

(*a*) TOP IN OIL, TEAR 7 TO 1.

Then Top is 87·5 lb.; add 19% moisture and 2·866% of oil	giving	106·64 lb.
and Noil is 12·5 lb.; add 14% moisture and 2·866% of oil	giving	14·62 lb.
	Total ...	121·26 lb.

(*b*) DRY-COMBED TOP, TEAR 7 TO 1.

Then Top is 87·5 lb.; add moisture 18·25%	giving	103·47 lb.
and Noil is 12·5 lb.; add moisture 14%	giving	14·25 lb.
	Total ...	117·72 lb.

Example 3—To show the different Noil yields when Wool is combed on different machines

(*a*) SCHLUMBERGER COMBED, TEAR 4 TO 1.
Then Noil is 20 lb.; add moisture 16% giving ... 23·2 lb.

(*b*) NOBLE COMBED, TEAR 4 TO 1.
Then Noil is 20 lb.; add moisture 14% giving ... 22·8 lb.

The corrected tears from the above examples are as follows. In the first example, the 7 to 1 tear becomes 104·125/14·25 or 7·31 to 1; and the 3 to 1 tear becomes 89·25/28·50 or 3·13 to 1.

In the second example the 7 to 1 (top in oil) tear becomes 106·64/14·62 or 7·29 to 1, and the 7 to 1 (dry-combed) tear becomes 103·47/14·25 or 7·26 to 1.

Top and Noil from 100 lb. Absolutely Dry Wool in Different Methods of Combing

Estimated Tear	From 100 lb. dry wool reckoning 2 lb. burrs		Combed in Oil				Dry Combed (Not Schlumberger)				Dry Combed (Schlumberger)			
	Top (lb.)	Noil (lb.)	Actual Top (lb.)	Actual Noil (lb.)	Total Top, Noil and Burrs (lb).	Corrected Tear	Actual Top (lb.)	Actual Noil (lb.)	Total Top, Noil and Burrs (lb.)	Corrected Tear	Actual Top (lb.)	Actual Noil (lb.)	Total Top, Noil and Burrs (lb).	Corrected Tear
11/1	89 ·83	8·17	109·48	9·55	**121·03**	11·46/1	106·22	9·31	**117·53**	11·41/1	106·22	9·48	**117·70**	11·20/1
8/1	87·11	10·89	106·17	12·73	**120·90**	8·34/1	103·08	12·41	**117·49**	8·31/1	103·08	12·63	**117·71**	8·16/1
5/1	81·67	16·33	99·53	19·09	**120·62**	5·21/1	96·57	18·62	**117·19**	5·19/1	96·57	18·94	**117·51**	5·10/1
3/1	73·50	24·50	89·57	28·63	**120·20**	3·13/1	86·91	27·93	**116·84**	3·11/1	86·91	28·42	**117·33**	3·06/1
2/1	65·33	32·67	79·62	38·18	**119·80**	2·09/1	77·25	37·24	**116·49**	2·07/1	77·25	37·90	**117·15**	2·04/1

Received 8/9/38

2—THE DISSOLUTION OF CHEMICALLY MODIFIED COTTON CELLULOSE IN ALKALINE SOLUTIONS

PART IV—THE SOLVENT ACTION OF CUPRAMMONIUM SOLUTIONS

By L. J. Jolley, Ph.D., A.R.C.S.
(The British Cotton Industry Research Association)

INTRODUCTION

The earlier papers of this series[1,2,3] have dealt with the dissolution of chemically modified cotton cellulose in solutions of the alkali (Li, Na, K) hydroxides and of tetramethylammonium hydroxide. The solvent action of these solutions is in general restricted to a range of alkali concentrations in the region 2 to 4*N*, and at 15° C. attains its maximum with 3·3*N* lithium hydroxide, 3·0*N* sodium hydroxide and 2·5*N* tetramethylammonium hydroxide. Below these concentrations the solvent action falls rapidly, being in all cases negligible in 1*N* solutions.

Cuprammonium hydroxide solutions*, which are better solvents for cellulose than any of the above-mentioned alkalis, also contain a strong base (usually assumed to be tetramminocupric hydroxide), and their solvent action might be supposed to represent a further instance of a property common to solutions of all strong bases, were it not for the fact that the dissolution of cellulose in cuprammonium solutions presents special features that suggest a fundamentally distinct mechanism. Cuprammonium solutions are capable of completely dissolving cottons so slightly modified that alkali hydroxides exert no appreciable solvent action on them at any concentration. More highly modified cottons, which dissolve to a considerable extent in alkali hydroxide solutions at their most favourable concentration in the neighbourhood of 3*N*, can be dissolved to a comparable extent by cuprammonium solutions at concentrations of the order of 0·1*N* in the cuprammonium base. That this difference is not due simply to the difference in the valency of the cations concerned is shown by the fact that barium hydroxide solutions have no solvent action on cellulose in the concentration range around 0·1*N*.

The most generally accepted view of the interaction between cellulose and solutions of the cupric ammine bases is that cellulose reacts with copper to form a complex anion, and that this reaction is responsible for the dissolution of the cellulose. This theory is based principally on the investigations of Hess and Traube and their co-workers; much of the evidence is derived from the study of the action of solutions of cupric hydroxide in ethylenediamine, and a detailed discussion of this evidence, with references to the literature, is contained in the following paper (Part V of this series).

The present paper describes an investigation of the solubilities of a modified (oxidised) cotton and an unmodified cotton in cuprammonium solutions, particularly the effect on the solubility of the ratio of cellulose to solvent, and the composition of the solvent, at constant temperature (15° C.). The views developed by Davidson from a study of solubility relations in the cellulose-sodium hydroxide system are used in an analysis of the experimental results.

---

* For brevity these will be referred to as cuprammonium solutions.

Owing to the inferior solvent power of the alkali hydroxides, previous papers in this series have necessarily dealt chiefly with chemically modified cottons, but the terms "modified" and "unmodified" are recognised to be purely relative, and an unmodified cotton is to be regarded merely as a cotton in which the degree of modification is limited to that which arises from a careful purification treatment.

DESCRIPTION AND DISCUSSION OF RESULTS

(a) Effect of Ratio of Cellulose to Solvent on Fractional Solubility

Davidson showed that when a modified cotton was submitted to the swelling and solvent action of a cold sodium hydroxide solution, the concentration of cellulose in solution at equilibrium increased with the weight of cotton extracted per 100 c.c. of solvent, in spite of the fact that dissolution was incomplete even with the lowest weights. On the other hand, the weight of cotton dissolved by the alkali was a constant percentage of the amount extracted (constant "fractional solubility") provided the amount extracted was not too great. This behaviour differs from that of a homogeneous substance, and was satisfactorily explained by Davidson on the theory that cotton cellulose and the products of its chemical modification are composed of mixtures of chain-molecules, differing in length, such mixtures only being capable of complete description by a frequency distribution. When the smallest weights of modified cotton are extracted with a fixed volume of the sodium hydroxide solution a fraction comprising all chain-molecules below a certain length is dissolved, but the solution is not saturated with respect to this soluble portion, so that when the weight of modified cotton is increased the same fraction of the available material is dissolved.

Whatever may be the mechanism of the dissolution of cotton cellulose in cuprammonium solutions, a similar effect of its heterogeneity on the quantitative solubility relations might be expected. The much enhanced solvent power of cuprammonium solutions, compared with that of sodium hydroxide, might then enable the methods of investigation used by Davidson for work on more or less modified cottons to be extended to an investigation of carefully purified (unmodified) cotton. For this purpose it is evidently necessary to employ cuprammonium solvents effecting only partial dissolution of the celluloses examined, that is, solutions of lower copper concentrations (2 to 5 grams per litre) than those ordinarily present in cuprammonium solutions to be used as cellulose solvents. The composition of a cuprammonium solution involves two concentration variables, those of copper and ammonia. In the work to be described, the concentration of ammonia, unless otherwise stated, has been kept constant, and high (200 grams per litre).

When various weights of cotton are extracted with equal volumes of a given cuprammonium solution under the same conditions, the observed behaviour is not that of a homogeneous substance, and it is more complicated than that recorded by Davidson for sodium hydroxide solutions. As the weight of cotton is increased, the concentration of cellulose in solution may increase or decrease, and the fractional solubility is not constant, but decreases rapidly. The effect of the ratio of total cellulose to solution on the fractional solubility of an oxidised cotton is illustrated in Fig. 1 by a number of curves corresponding to various concentrations of copper in the original cuprammonium solvent. These and other similar data recorded in this paper show no evidence of an approach to a constant fractional solubility less than

100 per cent. even at the lowest ratios of cellulose to solution. Results given by Sakurada[4] for the sodium hydroxide-cuprammonium-cellulose system show that the fractional solubility increases as the ratio of cellulose to solvent diminishes, though this author's data suggest the attainment of a constant fractional solubility at low values of the ratio.

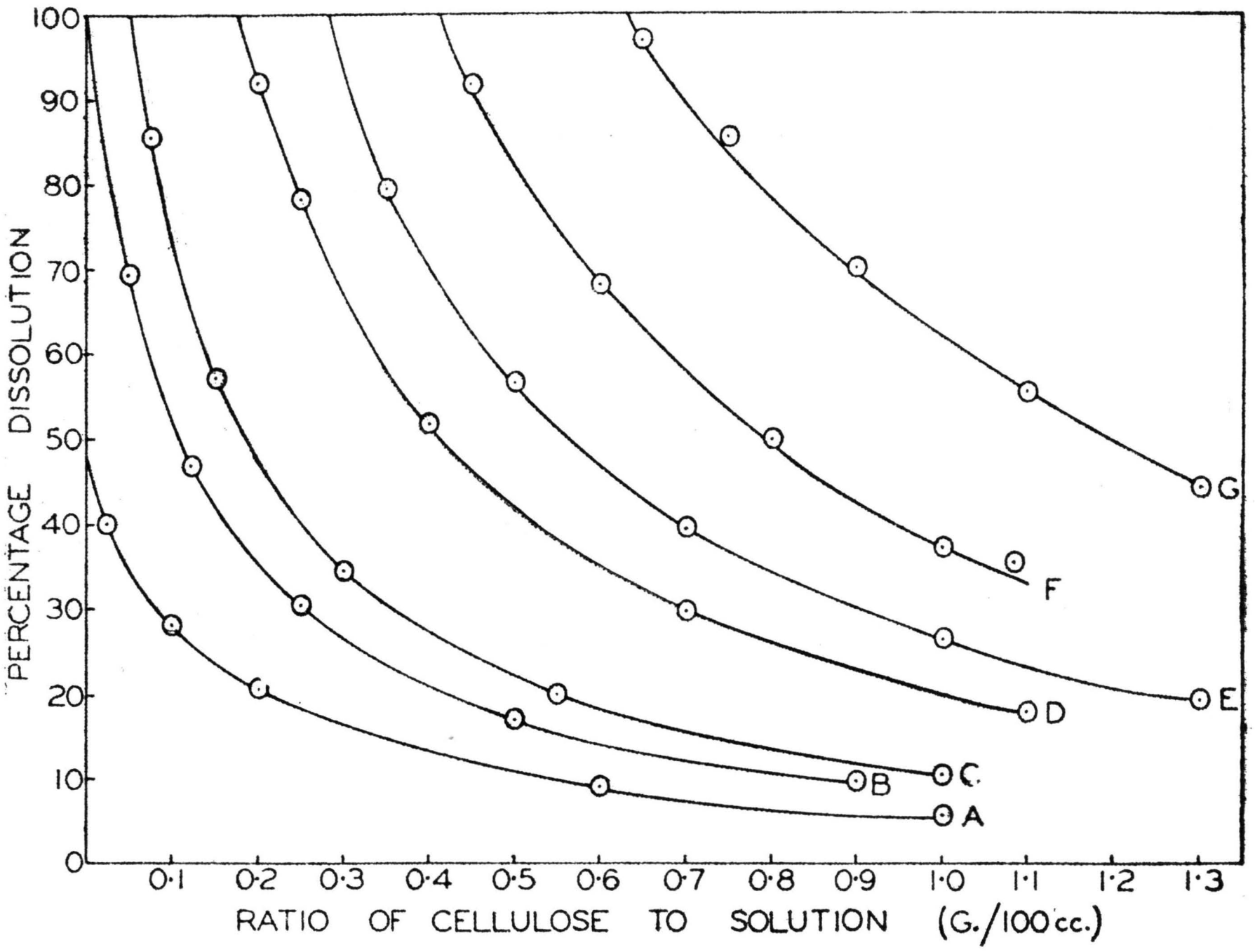

FIG. 1

Relation between ratio of cellulose to solution and the percentage dissolution at 15° C. of an oxycellulose (OL6/B, fluidity 45·4) in cuprammonium solvents containing 200 g. ammonia per litre and of the following copper concentrations—

Curve A—0·0285*M* or 1·81 g. Cu/Lit. Curve D—0·0402*M* or 2·56 g. Cu/Lit.
,, B—0·0316*M* or 2·01 ,, ,, E—0·0443*M* or 2·82 ,,
,, C—0·0338*M* or 2·15 ,, ,, F—0·0506*M* or 3·22 ,,
Curve G—0·0610*M* or 3·88 g. Cu/Lit.

(b) Effect of the Ratio of Cellulose to Solvent on Equilibrium Copper Concentration

The first explanation of this behaviour that naturally presents itself is based on the observation that the concentration of copper in the equilibrium solution is lower than that in the pure solvent on account of a preferential absorption of copper by the undissolved fraction of the cellulose (cf. Sakurada[4]). The greater the weight of cotton per 100 c.c. of solvent the greater is the weight of the undissolved fraction, and the greater is the effect on the concentration of the solution caused by the extraction of copper by the solid. The equilibrium concentration of copper in the solution thus falls as the ratio of cellulose to solvent increases, and on this account alone the fractional solubility of the cellulose would be expected to decrease with increasing values of the ratio. When the cellulose dissolves completely the copper concentration in the solution must equal that in the solvent, the slight change

in the volume of the liquid being neglected, but as the fractional dissolution falls below 100 per cent., corresponding to higher ratios of cellulose to solvent, increasing amounts of copper are absorbed by the solid, and the copper concentration in the solution steadily diminishes. This effect is shown in Fig. 2 for the same series of experiments as that to which Fig. 1 refers, the curves being lettered to correspond. The various initial copper concentrations in the cuprammonium solvents are given for each curve by its intercept with the horizontal line representing 100 per cent. dissolution, and the curves show the fall in the copper concentration of the solution as the fractional dissolution falls in consequence of increasing ratio of cotton to solvent.

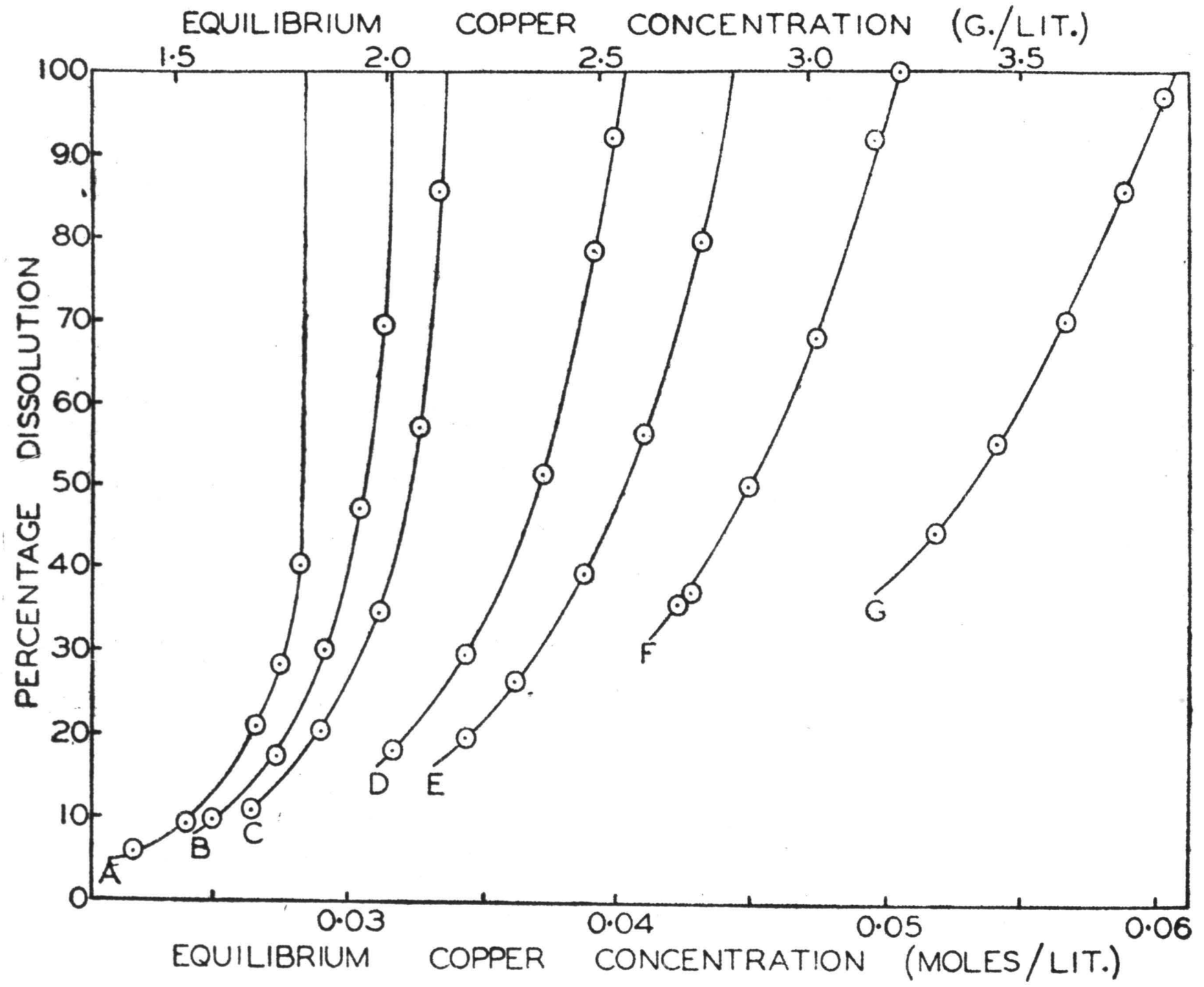

FIG. 2

Relation between equilibrium copper concentration and the percentage dissolution at 15° C. of an oxycellulose (OL6/B, fluidity 45·4) in cuprammonium solvents containing 200 g. ammonia per litre and of the following copper concentrations—

Curve A—0·0285*M* or 1·81 g. Cu./Lit.
,, B—0·0316*M* or 2·01 ,,
,, C—0·0338*M* or 2·15 ,,
Curve D—0·0402*M* or 2·56 g. Cu/Lit.
,, E—0·0443*M* or 2·82 ,,
,, F—0·0506*M* or 3·22 ,,
Curve G—0·0610*M* or 3·88 g. Cu/Lit.

If the variation of fractional solubility with the ratio of cellulose to solvent were purely a result of the preferential absorption of copper by the solid, a unique relation should be obtained between fractional solubility and equilibrium concentration of copper irrespective of the copper content of the original solvent. All the points in Fig. 2 should fall on a single curve instead of forming the family of curves actually obtained, and some further analysis of the experimental results is therefore required before they are capable of theoretical explanation.

(c) Effect of Formation of a Copper Complex by the Dissolved Cellulose

It will be assumed that the dissolved cellulose is not present in the solution as such, or as a simple cellulose ion, but that it is combined with copper in the form of a complex cupri-cellulose, as for example that postulated by the theory of Traube and Hess. The equilibrium concentration of total copper in a cellulose solution would not then be a simple quantity, but the sum of copper present as cupri-cellulose and that present in the cuprammonium complex. The state of equilibrium between the solid and the solution could only be defined in terms of the concentrations of dissolved copper existing in the two separate forms of combination, and not uniquely in terms of total copper concentration. It will be shown that a theoretical analysis of the experimental results on this basis, and a test of the validity of the assumptions, can be made with the aid of the views developed by Davidson from a study of simpler systems.

The solvent activity of a cellulose solvent at a constant temperature can be defined by the fraction of a given modified cellulose that it is capable of dissolving; according to theory, this would be some measure of the size of the longest cellulose chain-molecule that can be dissolved by the solvent. Defined in this way, the solvent activities of the sodium hydroxide solutions studied by Davidson are, within limits, unaffected by the presence of cellulose in them since the initial concentration of the alkali determines uniquely the fractional solubility of the cellulose over a wide range of solute to solvent ratios. Fig. 2 shows that in the cellulose-cuprammonium system at equilibrium there is a large number of solutions of different copper contents but of the same solvent activity, these copper contents being represented by the intercepts with the individual curves of a horizontal line corresponding to any given constant fractional solubility. It is reasonable to assume that in all these solutions there is a constant concentration of copper combined in the form characteristic of the effective solvent—which may be called "cuprammonium copper"—and that the differences in the *total* equilibrium copper contents reflect merely differences in concentration of cupri-cellulose. Further, whatever may be the nature of the cupri-cellulose complex, its composition must be constant when it is in equilibrium with a constant concentration of "cuprammonium copper". Hence the concentration of copper combined in the form of cupri-cellulose is proportional to the concentration of cellulose in solution for all solutions of constant solvent activity.

(d) Linear Relation between Equilibrium Concentrations of Dissolved Cellulose and Copper

Suppose the concentration of copper in the initial solvent to be c_1. In the cellulose-cuprammonium system, when dissolution of the cellulose is incomplete, this concentration is reduced by preferential absorption of copper by the undissolved solid to c_2—the equilibrium copper concentration. When the fractional solubility is constant, it follows from the above argument that c_2 can be expressed as the sum of a constant "cuprammonium copper" concentration c_3, and a concentration proportional to that of the cellulose. If, at a given fractional solubility, the constant ratio of copper to cellulose in the dissolved cupri-cellulose complex is called k, the concentration of copper in this form of combination is kC, where C is the cellulose concentration and $c_2=c_3+kC$. Thus, for a constant fractional solubility, the relation between the equilibrium copper concentration c_2 and the cellulose concentration C should be a linear one. The intercept of the line with the axis

of zero cellulose concentration would then give the concentration of "cuprammonium copper" c_3, and the slope of the line the ratio k of copper to cellulose in the dissolved cupri-cellulose complex.

The data for testing this conclusion are readily obtained by interpolation from Figs. 1 and 2. For example, the intercepts of the 50 per cent. dissolution line in Fig. 2 with the individual curves yield a number of values of equilibrium copper concentration. The intercepts of the 50 per cent. dissolution line with the individual curves of Fig. 1 yield the corresponding weights of total cotton per 100 c.c. of solution, or (by halving these values) the corresponding concentrations of cellulose in the solution. When the two sets of data are plotted against one another the curve C of Fig. 3 is obtained,

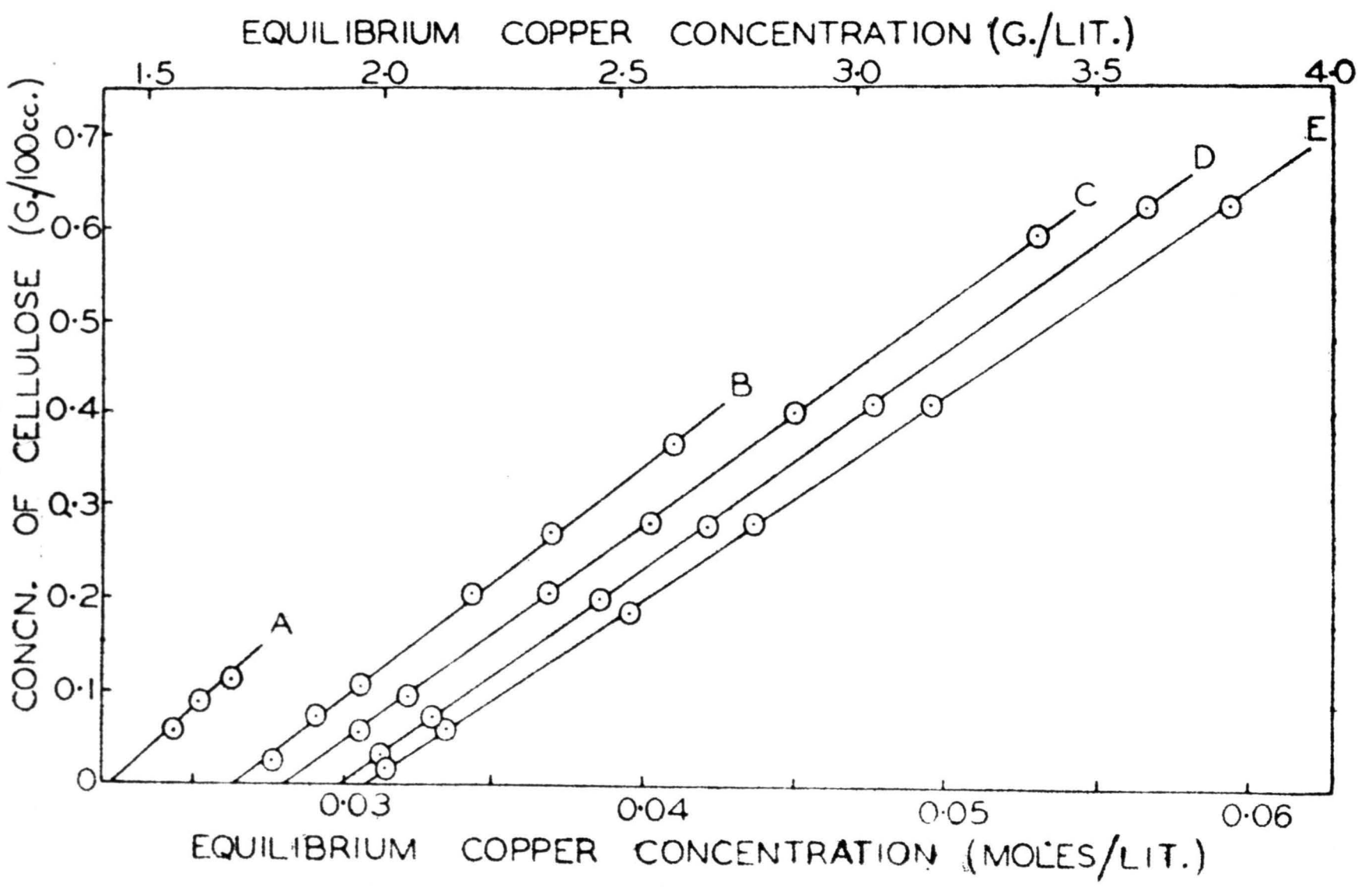

FIG. 3

Relation between equilibrium copper and cellulose concentrations in solutions corresponding to various constant percentage dissolutions of an oxycellulose (OL6/B, fluidity 45·4) at 15° C. in cuprammonium solvents of different copper concentrations containing 200 g. ammonia per litre.

Curve A—10% dissolution. Curve C—50% dissolution.
,, B—30% ,, ,, D—70% ,,
Curve E—90% dissolution.

whilst the curves A, B, D and E are obtained in a similar way for other constant values of fractional solubility. These curves are straight lines within the experimental errors, and to this extent they support the validity of the method employed for the analysis of the experimental results.

(e) The Limiting Relation between Fractional Solubility and Copper Concentration when the Ratio of Cellulose to Solvent is very small

When the "cuprammonium copper" concentrations c_3 corresponding to curves A to E, and given by their intercepts on the copper concentration axis, are plotted against the corresponding fractional solubilities, Curve A in Fig. 4 is obtained. This is the most fundamental curve representing the

relation between solvent activity and solvent concentration for the oxidised cotton examined. It is a limiting curve showing the relation between fractional solubility and copper concentration in the solvent when the ratio of cellulose to solvent is so small that the effects of the complicating factors discussed in the foregoing paragraphs can be neglected.

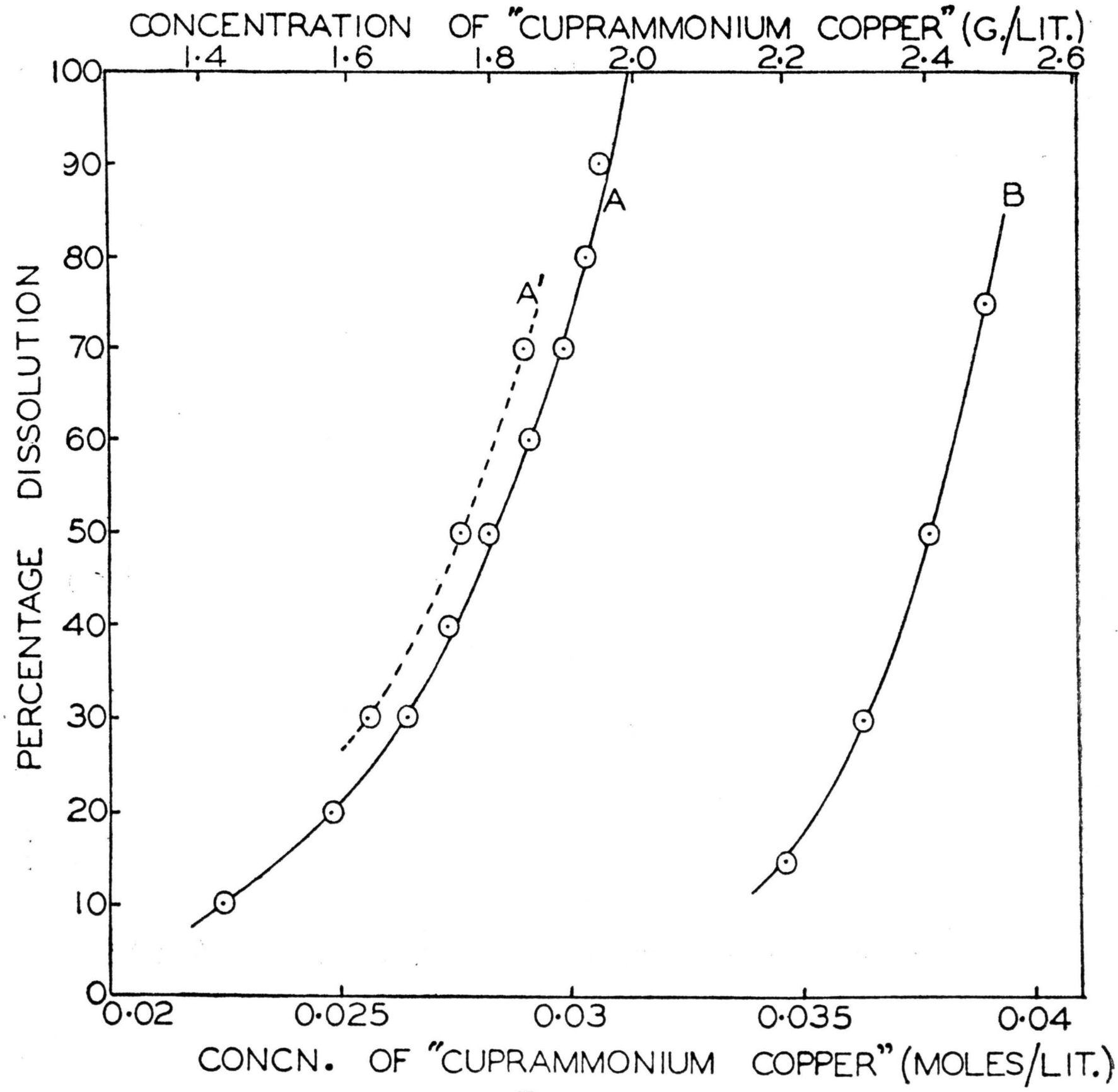

FIG. 4

Relation between concentration of "cuprammonium copper" and percentage dissolution of modified and unmodified cottons at 15° C. in cuprammonium solvents containing 200 g. ammonia per litre.

Curve A—Oxycellulose OL6/B (fluidity 45·4).
,, A'— ,, OL10/B (fluidity 43·4).
,, B—Unmodified cotton No. 327 (fluidity 5·6).

The curve A in Fig. 1 shows the relation between the ratio of total cellulose to solution and the fractional solubility for a solvent originally 0·0285 *M*. in copper. If this curve is extrapolated to a zero value of the ratio, it intersects the axis at a point representing 50 per cent. dissolution. This pair of values (0·0285 *M*. copper and 50 per cent. dissolution) yields a point on curve A of Fig. 4. In a similar way, Curve B of Fig. 1 yields the point (0·0316 *M*. copper, 100 per cent. dissolution), and Curve A of Fig. 4 could theoretically be constructed in this way without the determination of equilibrium copper concentrations if results similar to those in Fig. 1 were available for a range of copper concentrations between 0·02 and 0·03 *M*. The accuracy of the

necessary extrapolation is, however, so low that this method would not prove suitable in practice.

An unmodified cotton has been investigated by the same methods as those described above for an oxycellulose, and similar results obtained; in particular the equilibrium copper concentration was linearly related to the cellulose concentration at constant fractional solubility (Fig. 5). The

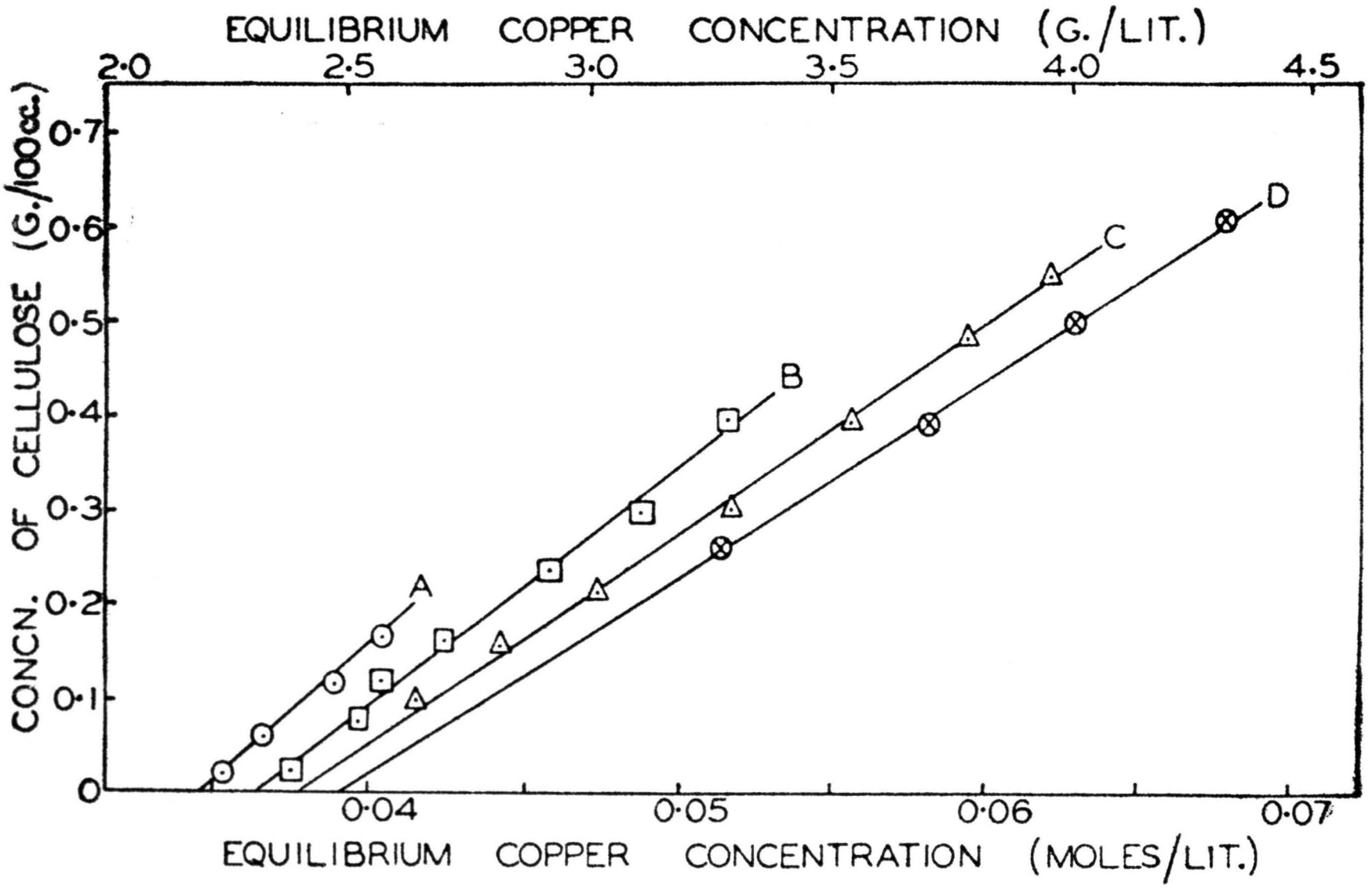

FIG. 5

Relation between equilibrium copper and cellulose concentrations in solutions corresponding to various constant percentage dissolutions of an unmodified cotton (No. 327, fluidity 5·6) at 15° C. in cuprammonium solvents of different copper concentrations containing 200 g. ammonia per litre.

Curve A—15% dissolution. Curve C—50% dissolution.
,, B—30% ,, ,, D—75% ,,

relation between fractional solubility and concentration of "cuprammonium copper" is shown for the unmodified cotton by Curve B in Fig. 4. It will be seen, and was to be expected, that a higher concentration of "cuprammonium copper" is required to dissolve a given fraction of the unmodified cotton than to dissolve the same fraction of the oxycellulose. A concentration of approximately 0·031 *M*. corresponds to complete dissolution of the modified cotton, but to less than 10 per cent. dissolution of the unmodified; more than 90 per cent. by weight of the unmodified cotton is thus composed of chain molecules exceeding in length the longest in the modified cotton.

(f) The Composition of the Dissolved Cupri-cellulose Complex

The ratio of copper to cellulose in the dissolved complex, given by the slope of the straight lines in Figs. 3 and 5, are recorded in Table 1 for the modified and the unmodified cotton. As the concentration of "cuprammonium copper" rises, the proportion of copper in the dissolved cupri-cellulose increases, and, for the same composition of the dissolved complex, the concentration of "cuprammonium copper" is lower with the modified, than with the unmodified, cotton.

Table I

Relation between Percentage Dissolution of Cellulose, Concentration of "Cuprammonium Copper", and Ratio of Copper to Cellulose in the dissolved Cupri-cellulose Complex

Oxycellulose (OL6/B)			Unmodified Cotton (No. 327)		
Percentage dissolution	"Cupram-monium copper" (Moles/Litre)	Molar ratio $Cu/C_6H_{10}O_5$ in dissolved complex	Percentage dissolution	"Cupram-monium copper" (Moles/Litre)	Molar ratio $Cu/C_6H_{10}O_5$ in dissolved complex
10	0·0224	0·54	15	0·0346	0·56
20	0·0248	0·60	30	0·0363	0·65
30	0·0264	0·64	50	0·0378	0·73
40	0·0273	0·67	75	0·0390	0·78
50	0·0282	0·68			
60	0·0291	0·70			
70	0·0299	0·70			
80	0·0304	0·71			
90	0·0307	0·75			

(g) Comparison with the Cellulose-Sodium Hydroxide System

The dissolution of modified cottons in sodium hydroxide solutions must be due to some interaction between the cellulose and the alkali, most probably to salt formation, which must exert some influence on the concentration of the effective solvent; the preferential absorption of sodium hydroxide by the solid phase in this system has long been recognised. At first sight, therefore, it might appear that the necessity would arise for taking both these factors into account in an analysis of the solubility relations in the cellulose—sodium hydroxide system, as it does in the cuprammonium system. The difference between the two that simplifies the relations in the sodium hydroxide system is the circumstance that the concentrations of the sodium hydroxide solutions of chief interest are much higher than those of the cuprammonium solutions. If the ratio of total weight of cotton to volume of solvent is one gram per 100 c.c., the molar ratio of alkaline hydroxide to $C_6H_{10}O_5$ is of the order of 50 in the sodium hydroxide, and of the order of unity in the cuprammonium systems investigated. As a result of the very large excess of sodium hydroxide the influence of preferential absorption, or of reaction in the liquid phase, on the effective solvent concentration is negligibly small for ratios of cellulose to solvent such as those employed in Davidson's work.

(h) Effect of Ammonia Concentration and of the Presence of Sucrose on the Solvent Action of Cuprammonium Solutions

The solvent action of cuprammonium solutions at constant initial copper concentration increases with increasing ammonia concentration as illustrated by the curves in Fig. 6. Treatment of these and other results by the methods already described shows that the effect of a decrease in the ammonia concentration is to displace the values of the concentration of "cuprammonium copper" corresponding to a given percentage dissolution towards higher copper concentrations. For example, for 30 per cent. and 50 per cent. dissolution of a modified cotton the "cuprammonium copper" concentrations were 0·0256 *M* and 0·0276 *M* respectively when the ammonia concentration was 11·7 moles (200 g.) per litre, and 0·0359 *M* and 0·0384 *M* respectively when the ammonia concentration was 8·8 moles (150 g.) per litre.

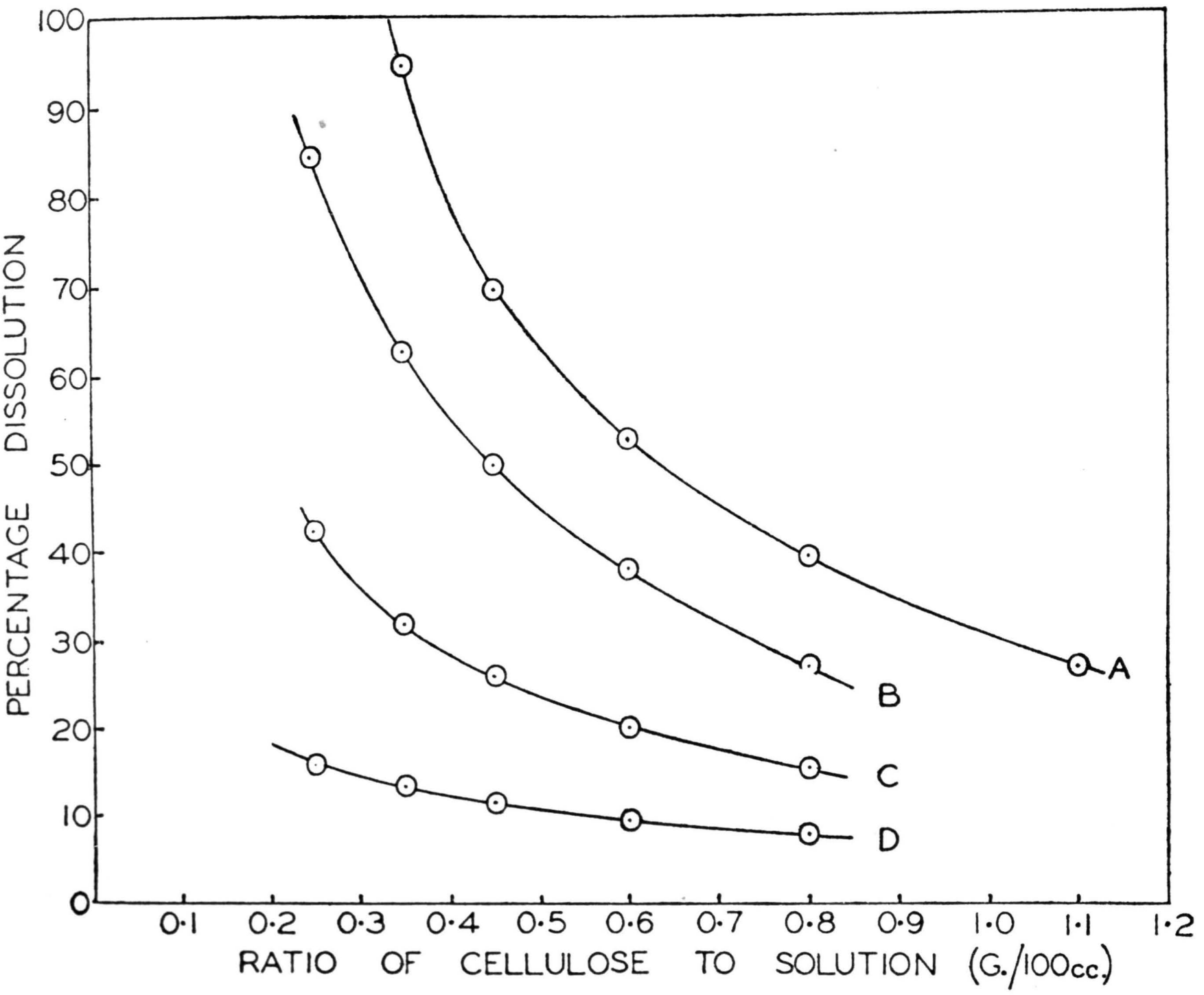

FIG. 6

Relation between ratio of cellulose to solution and percentage dissolution at 15° C. of an oxycellulose (OL10/B, fluidity 43·4) in cuprammonium solvents containing 2·81 g. of copper per litre (0·0442*M*), and of the following ammonia concentrations—
Curve A—11·7*N* or 200 g. NH_3/Lit. Curve C—8·81*N* or 150 g. NH_3/Lit.
,, B—10·45*N* or 178 ,, ,, D—4·46*N* or 76 ,,

If cellulose in cuprammonium solution forms a complex with part of the copper present, and so reduces the effective concentration of copper, a similar effect may be expected when other polyhydroxylic compounds capable of forming copper complexes are added to the solution. It was concluded by Messmer[5] from polarimetric measurements on cuprammonium solutions containing sucrose that a complex was formed analogous to that formed by cellulose. Addition of sucrose to cuprammonium solution should therefore reduce the solvent action on cellulose.

The result of extracting an oxycellulose with a series of cuprammonium solutions containing various concentrations of sucrose is shown in Table II. The effect is as predicted.

Table II

Effect of Sucrose on Solvent Action of Cuprammonium

0·5 g. Oxycellulose (OL10/B) extracted with 100 c.c. of cuprammonium solutions containing 0·0502 moles (3·19 g.) of copper per litre, 11·7 moles (200 g.) of ammonia per litre and various concentrations of sucrose, at 15° C

Concentration of sucrose (g./100 c.c.)	0	0·10	0·20	0·50
Cellulose dissolved (g./100 c.c.)	0·443	0·371	0·306	0·126
Percentage of cellulose dissolved	88·6	74·2	61·2	25·2
Equilibrium concentration of copper (moles/litre)	0·0491	0·0479	0·0469	0·0453

(j) The Composition of the Solid Complex

The dissolution of cellulose in cuprammonium can be regarded as the result of a primary reaction between the solid cellulose and the cuprammonium hydroxide as a result of which a copper complex is formed by a certain proportion of the glucose units in the cellulose chain-molecules.

$$n\ [Cu(NH_3)_4](OH)_2 + m\ \text{Cellulose} \rightleftharpoons [Cu]_n\ [\text{Cellulose}]_m$$

The proportion of the glucose units which react should, for equilibrium with a given concentration of "cuprammonium copper", be approximately the same for all the cellulose chain-molecules. This primary reaction is followed by the dissolution of all the cellulose molecules below a certain chain-length. It follows that not only the dissolved, but also the undissolved, portion of the cellulose should be combined with a certain proportion of copper defined by, and increasing with, the concentration of "cuprammonium copper" in the solution.

The assumption can be made that the copper preferentially absorbed from the solution by the undissolved residue is equal to that combined in the solid complex. The validity of this assumption is in doubt since the possibility has to be considered, among others, that the undissolved, but highly swollen, cellulose may be associated with a certain proportion of solution in which the copper concentration is lower than in the external solution as a result of water absorption. The results of calculating the molar ratio of copper to cellulose from preferential absorptions are, however, contained in the experimental section—for example, in the last columns of Tables III and IV, which relate to the modified and unmodified cotton, respectively. It can be seen from inspection of the tables that the ratio increases with the solvent activity of the solution as expressed by the percentage cellulose dissolution (or the derived value of the "cuprammonium copper" concentration). This qualitative effect is the same as that observed for the dissolved part of the cellulose and already illustrated in Table I. On the other hand, a graphical representation of the results, which has not been considered necessary here, shows that the ratio of combined copper to cellulose calculated for the solid phase in the manner described is not uniquely defined by the solvent activity of the solution. A systematic drift is observed in a direction such that for a given percentage dissolution of cellulose the calculated ratio diminishes as the initial concentration of copper in the solution increases.

The results for the solid phase are thus not amenable to a simple theoretical treatment, though certain features are of interest. For the unmodified cotton, it can be shown that as the percentage dissolution of cellulose increases from 10 per cent. to 50 per cent. the calculated ratio of copper to cellulose in the solid, although not completely defined, increases roughly from 0·4 to 0·6, whilst Table I shows that for the same range of solvent activity the molar ratio of copper to cellulose in the dissolved fraction of the unmodified cotton increases from about 0·55 to 0·75. Similarly, for the modified cotton (oxycellulose OL6/B), and for the same range of solvent activity, the ratio increases from about 0·15 to 0·25 in the solid fraction, and from about 0·55 to 0·7 in the dissolved fraction. In both cases, the solid fraction contains a smaller proportion of combined copper than the dissolved fraction in equilibrium with a solution of given solvent activity, but the difference is much greater for the modified, than for the unmodified, cotton.

A possible explanation of this is that upon dissolution a cellulose chain-molecule becomes more accessible to reaction with the cuprammonium solution, since this reaction involves the substitution of cellulose-copper linkages for the lateral linkages between neighbouring chain-molecules. A close approach to equality in the extent of complex formation in the solid phase and in solution is only to be expected if the number of lateral linkages necessary to retain a cellulose chain in the fibre structure is small compared with the total number of glucose units in the chain. It is impossible to say *a priori* whether this condition is likely to be fulfilled, but a closer approach to its fulfilment is to be expected the greater the length of the chains, or the less modified the cotton.

EXPERIMENTAL

(1) Materials

The cottons used were (i) an unmodified cotton linters (No. 327), mechanically cleaned, scoured by boiling under pressure with 2 per cent. sodium hydroxide solution, and lightly bleached, and (ii) an oxycellulose (OL6/B) prepared by treatment of bleached cotton linters with hypochlorite solution at *p*H 8·4, followed by an alkaline boil. The fluidities of the unmodified cotton and the oxycellulose in cuprammonium (0·5 g. cellulose per 100 c.c., 20° C.) were 5·6 and 45·4, respectively. In some experiments a similar oxycellulose (OL10/B) of fluidity 43·4 was employed.

The cuprammonium solutions used were prepared from stock solutions containing approximately 15 grams of copper and 200 grams of ammonia per litre. These were made by the oxidation of metallic copper in the presence of aqueous ammonia as described by Clibbens and Geake[6]. The solutions prepared by this method contain traces of nitrite (less than 0·5 g. of nitrous acid per litre) and traces of sucrose and its oxidation products. The amount of sucrose added in the preparation of the stock solution is 1 g. per litre, and the amount of organic matter actually present in the stock solution used, determined by oxidation with chromic acid and calculated as sucrose, was 0·50 g. per litre. In order to find whether these impurities had any significant influence on the solvent power for cellulose, a quantity of cuprammonium solution was prepared by dissolving cupric hydroxide in ammonia solution containing 200 g. of ammonia per litre. The preparation of this solution was carried out in an atmosphere of nitrogen and with exclusion of light, and undissolved cupric hydroxide was removed by filtering the solution through a fritted glass filter. The cupric hydroxide used was prepared by Dawson's method[7], and contained 98·3 per cent. $Cu(OH)_2$ and 0·14 per cent. of alkalis and other metals (calculated as NaOH); it was free from acid radicals. The cuprammonium solution so prepared contained 7·4 g. of copper and less than 0·04 g. of nitrous acid per litre. It was found that solutions prepared by the dissolution of cupric hydroxide in aqueous ammonia and by the method of Clibbens and Geake behaved very similarly towards cellulose, but that the former were slightly better solvents than the latter. This is in agreement with the observations already recorded in Table II which show that sucrose reduces the solvent action of cuprammonium solutions on cellulose.

The stock cuprammonium solutions were stored in blackened bottles under nitrogen, and the solutions used for solubility measurements were made by diluting the stock solutions with the appropriate volumes of ammonia solution (200 g./litre) and water.

(2) Analysis of Solutions

(*a*) *Ammonia*—A measured volume of the solution was run into excess of standard sulphuric acid, and an aliquot portion of the solution titrated with standard alkali, methyl red being used as indicator. The titration value represents the total base, i.e. ammonia and copper hydroxide, and in calculating the ammonia concentration allowance was made for the copper present.

(*b*) *Copper*—The copper concentration of the cuprammonium solutions was determined iodimetrically, potassium thiocyanate being added to the solution towards the end of the titration, as recommended by Foote and Vance[8]. This method gives a sharp end-point with 0·1*N* or 0·025*N* thiosulphate solutions and the presence of precipitated cellulose does not interfere. Before the solution was titrated the bulk of the ammonia present was evaporated off, the solution acidified, and any nitrite present destroyed by adding urea solution and allowing to stand overnight. It was shown by experiments in which nitrite was added to the copper solution that this treatment was completely effective.

(3) Estimation of Cellulose Dissolved in Cuprammonium Solution

Cellulose was estimated by oxidation with chromic acid, as described by Birtwell and Ridge[9]. The quantity of dichromate solution used for the oxidation of 10 c.c. cellulose solution was 10 c.c. of *N*/4, 10 c.c. of *N*, or 25 c.c. of *N*, according to the concentration of cellulose; the amounts of sulphuric acid and water were adjusted to make the solution 8·5 *N*, 7 *N* and 7 *N* in sulphuric acid, respectively. The back-titration of the residual chromic acid was carried out with 0·1 *N* ferrous ammonium sulphate, with *o*-phenanthroline ferrous sulphate or N - phenylanthranilic acid as internal indicator.

Before oxidation the solutions of cellulose in cuprammonium were given the treatment described above to remove nitrite. Blank determinations showed that the addition of urea had no significant effect on the results. The sucrose and its oxidation products contained in the cuprammonium were allowed for by blank determinations on solutions free from cellulose.

In calculations of fractional solubility, and of preferential absorption, from concentration changes in solution, the corrections for the change in volume of the liquid phase by reason of the dissolution of cellulose are so small that they have been neglected.

(4) Determination of the Solubility of Cellulose

With each of a number of cuprammonium solutions of known composition a series of solubility determinations was made covering a range of values of the ratio of cellulose extracted to solvent used, the lowest ratio in each series corresponding to nearly complete dissolution. The extraction of the cellulose samples with the solvent was carried out in stoppered bottles so constructed that the contents could be centrifuged when required, and containing about 40 c.c. Since solutions of cellulose in cuprammonium can absorb oxygen, with consequent degradation of the cellulose, the extraction was carried out with the bottles completely filled with the solution. For this purpose they were fitted with capillary stoppers (of the specific gravity bottle type), closed during the extraction with a rubber cap. The capacity of the bottles was measured to 0·01 c.c. Agitation during the extraction was effected by frequent shaking, assisted by the presence of 1 c.c. of mercury added before filling with cuprammonium. The calculated weights of cotton to give the required ratios of cellulose to solvent (the values of which are calculated

on the dry weight of cotton) were weighed out in the air-dry condition, and the cuprammonium solution, previously cooled to the temperature of extraction, added. Air bubbles were removed by stirring with a glass rod, the bottle filled to the top with cuprammonium, and the stopper inserted.

Table III

Dissolution of Oxycellulose OL6/B in Cuprammonium Solutions containing 11.7 Moles (200 g.) Ammonia per Litre, at 15° C.

Initial copper concentration (c_1)		Ratio of cellulose to solution (g./100 c.c.)	Concentration of dissolved cellulose (g./100 c.c.)	Percentage of cellulose dissolved	Equilibrium copper concentration (c_2) (Moles/litre)	Molar ratio $Cu/C_6H_{10}O_5$ in solid phase
(Moles/litre)	(g./litre)					
0·0285	1·81	0·025	0·0100	40·0	0·0282	—
		0·100	0·0283	28·3	0·0275	0·23
		0·200	0·0419	20·9	0·0266	0·19
		0·600	0·0548	9·1	0·0240	0·13
		1·000	0·0579	5·8	0·0221	0·11
0·0316	2·01	0·050	0·0346	69·2	0·0313	—
		0·120	0·0563	46·9	0·0304	0·31
		0·250	0·0752	30·1	0·0292	0·22
		0·500	0·0862	17·2	0·0274	0·16
		0·900	0·0887	9·8	0·0251	0·13
0·0338	2·15	0·075	0·0640	85·3	0·0334	—
		0·150	0·0855	57·0	0·0326	0·30
		0·300	0·1033	34·4	0·0311	0·22
		0·550	0·1114	20·2	0·0290	0·18
		1·000	0·1072	10·7	0·0264	0·13
0·0402	2·56	0·200	0·184	92·0	0·0398	—
		0·250	0·195	78·0	0·0390	0·35
		0·400	0·205	51·3	0·0370	0·27
		0·700	0·207	29·6	0·0343	0·19
		1·100	0·198	18·0	0·0316	0·15
0·0443	2·82	0·350	0·278	79·5	0·0430	—
		0·500	0·281	56·2	0·0409	0·25
		0·700	0·276	39·4	0·0387	0·21
		1·000	0·264	26·4	0·0362	0·18
		1·300	0·255	19·6	0·0343	0·16
0·0506	3·22	0·450	0·412	91·7	0·0496	—
		0·600	0·407	67·8	0·0473	0·28
		0·800	0·399	49·9	0·0449	0·23
		1·000	0·370	37·0	0·0427	0·20
		1·083	0·384	35·4	0·0422	0·19
0·0610	3·88	0·650	0·630	97·0	0·0603	—
		0·750	0·641	85·5	0·0589	0·31
		0·900	0·629	69·9	0·0566	0·26
		1·100	0·608	55·3	0·0541	0·23
		1·300	0·578	44·5	0·0518	0·21

The extraction was carried out in a thermostat at 15° C. (± 0·1° C.) for four hours. It was shown that after three hours the concentration of dissolved cellulose was constant, and that extraction for longer periods up to twenty hours had no further effect. At the end of the extraction the contents of the bottles were centrifuged at 2000 r.p.m. for ten minutes; centrifuging for longer periods had no effect on the cellulose content of the solution.

Ten-c.c. samples of the solutions were analysed for copper and cellulose, as described above.

The losses of ammonia involved in handling the cuprammonium solutions do not amount to as much as 1 g. of ammonia per litre. The effect of variation of ammonia concentration on the solvent action of the solutions is not sufficiently marked for losses of this magnitude to introduce any appreciable error into the solubility results.

Table IV

Dissolution of Unmodified Cotton No. 327 in Cuprammonium Solutions containing 11.7 Moles (200 g.) Ammonia per Litre, at 15° C.

Initial copper concentration (c_1)		Ratio of cellulose to solution (g./100 c.c.)	Concentration of dissolved cellulose (g./100 c.c.)	Percentage of cellulose dissolved	Equilibrium copper concentration (c_2) (Moles/litre)	Molar ratio $Cu/C_6H_{10}O_5$ in solid phase
(Moles/litre)	(g./litre)					
0·0393	2·50	0·100	0·0206	20·6	0·0365	0·57
		0·200	0·0162	8·1	0·0346	0·41
		0·250	0·0167	6·7	0·0335	0·40
		0·300	0·0140	4·7	0·0328	0·37
0·0470	2·99	0·200	0·122	61·0	0·0437	0·69
		0·400	0·061	15·3	0·0369	0·48
		0·700	0·045	6·4	0·0330	0·35
		1·000	0·038	3·8	0·0316	0·26
0·0503	3·20	0·260	0·212	81·5	0·0483	0·68
		0·300	0·174	58·0	0·0453	0·64
		0·350	0·136	38·9	0·0421	0·62
		0·400	0·132	33·0	0·0404	0·60
		0·650	0·071	10·9	0·0352	0·42
		1·000	0·062	6·2	0·0332	0·30
0·0548	3·48	0·400	0·231	57·8	0·0487	0·58
		0·500	0·176	35·2	0·0440	0·54
		0·600	0·146	24·3	0·0415	0·47
		0·800	0·110	13·8	0·0382	0·39
		1·000	0·094	9·4	0·0365	0·33
0·0627	3·99	0·500	0·399	79·8	0·0591	0·58
		0·600	0·317	52·8	0·0528	0·57
		0·700	0·248	35·4	0·0475	0·54
		0·700	0·265	37·9	0·0486	0·53
		0·800	0·231	28·9	0·0457	0·48
		0·900	0·202	22·4	0·0434	0·45
		1·000	0·196	19·6	0·0426	0·41
		1·000	0·181	18·1	0·0420	0·41
0·0687	4·37	0·600	0·549	91·5	0·0670	0·54
		0·700	0·463	66·1	0·0606	0·55
		0·800	0·377	47·1	0·0545	0·54
		0·900	0·323	35·9	0·0509	0·50
		1·000	0·287	28·7	0·0482	0·47
0·0753	4·79	0·800	0·604	75·5	0·0681	0·60
		1·000	0·458	45·8	0·0577	0·53
		1·200	0·399	33·3	0·0531	0·45
0·0785	4·99	0·900	0·705	78·4	0·0719	0·55
		1·000	0·598	59·8	0·0653	0·53
		1·000	0·585	58·5	0·0648	0·54
		1·100	0·525	47·7	0·0608	0·50
		1·200	0·496	41·3	0·0580	0·47

(5) Results

The detailed results of the determinations of the solubility of the unmodified and modified cottons are given in Tables III - VI. Those in Tables III and IV have been discussed in detail in the previous section, and have been represented graphically in Figs. 1 and 2 (experimental results from Table III), 3, 4 and 5 (interpolated results from Tables III and IV).

Table V

Dissolution of Oxycellulose OL10/B in Cuprammonium Solutions (free from Nitrite and Sucrose), containing 11.7 Moles (200 g.) Ammonia per Litre, at 15° C.

Initial copper concentration (c_1)		Ratio of cellulose to solution (g./100 c.c.)	Concentration of dissolved cellulose (g./100 c.c.)	Percentage of cellulose dissolved	Equilibrium copper concentration (c_2) (Moles/litre)	Molar ratio $Cu/C_6H_{10}O_5$ in solid phase
(Moles/litre)	(g./litre)					
0·0233	1·48	0·050	0·0075	15·0	0·0228	—
		0·100	0·0116	11·6	0·0224	0·16
		0·150	0·0149	9·9	0·0222	0·13
		0·250	0·0195	7·8	0·0214	0·13
		0·400	0·0237	5·9	0·0204	0·12
0·0305	1·94	0·025	0·0206	82·4	0·0304	—
		0·050	0·0330	66·0	0·0302	0·29
		0·100	0·0498	49·8	0·0297	0·26
		0·200	0·0668	33·4	0·0286	0·23
		0·400	0·0772	19·3	0·0270	0·18
0·0373	2·37	0·200	0·177	88·5	0·0369	—
		0·300	0·181	60·4	0·0351	0·30
		0·400	0·180	45·0	0·0339	0·25
		0·600	0·187	31·2	0·0321	0·20
		0·800	0·185	23·1	0·0306	0·18
0·0441	2·80	0·350	0·330	94·3	0·0438	—
		0·450	0·313	69·5	0·0416	0·30
		0·600	0·317	52·8	0·0397	0·25
		0·800	0·315	39·4	0·0376	0·22
		1·100	0·294	26·7	0·0351	0·18
0·0505	3·21	0·500	0·460	92·0	0·0496	0·36
		0·700	0·466	66·7	0·0466	0·27
		0·900	0·460	51·1	0·0447	0·21
		1·100	0·425	38·6	0·0418	0·21
		1·300	0·393	30·2	0·0399	0·19
0·0563	3·58	0·700	0·564	80·6	0·0537	0·31
		0·800	0·573	71·6	0·0523	0·29
		0·900	0·575	63·9	0·0510	0·26
		1·100	0·551	50·1	0·0484	0·23
		1·300	0·522	40·2	0·0462	0·21

Table V records a series of measurements with cuprammonium solutions prepared by dissolving cupric hydroxide in aqueous ammonia, and they are intended for comparison with the series in Table III for which the cuprammonium solutions were prepared by oxidation of metallic copper in the presence of aqueous ammonia, such solutions also containing low concentrations of nitrite, sucrose and its oxidation products. Unfortunately, the modified cottons used were not identical in the two series (OL6/B and OL10/B) but in the essential respect of extent of modification as measured by fluidity in cuprammonium solution (45·4, 43·4) they are almost identical.

Table VI

Dissolution of Oxycellulose OL10/B in Cuprammonium Solutions (free from Nitrite and Sucrose) of different Ammonia Concentrations, at 15°C.

Ammonia concentration		Initial copper concentration (c_1)		Ratio of cellulose to solution (g./100 c.c.)	Concentration of dissolved cellulose (g./100 c.c.)	Percentage of cellulose dissolved	Equilibrium copper concentration (c_2) (Moles/litre)	Molar ratio $Cu/C_6H_{10}O_5$ in solid phase
(Moles/litre)	(g./litre)	(Moles/litre)	(g./litre)					
4·46	76	0·0442	2·81	0·250	0·0397	15·9	0·0418	0·18
				0·350	0·0470	13·4	0·0410	0·17
				0·450	0·0519	11·5	0·0402	0·16
				0·600	0·0580	9·7	0·0392	0·15
				0·800	0·0642	8·0	0·0381	0·13
8·81	150	0·0372	2·36	0·050	0·0169	33·8	0·0367	—
				0·100	0·0253	25·3	0·0361	0·24
				0·300	0·0468	15·6	0·0343	0·19
				0·500	0·0544	10·9	0·0331	0·15
8·81	150	0·0442	2·81	0·250	0·106	42·4	0·0419	0·26
				0·350	0·112	32·0	—	—
				0·450	0·116	25·8	0·0396	0·22
				0·600	0·120	20·0	0·0385	0·19
				0·800	0·123	15·4	0·0372	0·17
8·81	150	0·0563	3·58	0·400	0·320	80·0	0·0547	0·32
				0·600	0·318	53·0	0·0517	0·26
				0·900	0·325	36·1	0·0485	0·22
				1·200	0·309	25·8	0·0458	0·19
10·45	178	0·0442	2·81	0·250	0·211	84·4	—	—
				0·350	0·220	62·9	0·0418	0·30
				0·450	0·224	49·7	0·0406	0·26
				0·600	0·226	37·7	0·0390	0·23
				0·800	0·215	26·9	0·0371	0·20

The comparison between the two series is best made graphically as in Fig. 4, where the dotted line A′ represents the results of Table V, the full line A those in Table III. As can be seen, and has already been stated, the cuprammonium solutions free from nitrite and sucrose are slightly the better solvents; the small difference in the extent of modification of the two oxycelluloses for which curves A and A′ were obtained is in the wrong direction to account for the relative positions of the two curves.

Table VI (with Table V) shows the effect on solvent activity of varying the ammonia concentration at constant copper content of the cuprammonium solutions, results that have already been discussed, and in part represented graphically by Fig. 6.

SUMMARY

1—When cotton or modified cotton is treated with a cuprammonium solution that effects only partial dissolution of the cellulose, the fraction dissolved falls rapidly as the ratio of cellulose to solvent increases. The equilibrium concentration of copper in the cellulose solution is appreciably lower than that in the original solvent on account of preferential absorption by the undissolved fraction, and it also falls as the ratio of cellulose to solvent increases.

2—The relation between fractional solubility, ratio of cellulose to solvent, and equilibrium concentration of copper, has been studied for a number of cuprammonium solvents of various copper concentrations, but with the same high ammonia concentration. It is found that for a constant fractional solubility a linear relation exists between the cellulose and the equilibrium copper concentrations in the solution.

3—These results have been satisfactorily interpreted in the light of views developed by Davidson from a study of the simpler system, cellulose—sodium hydroxide, on the assumption that the cellulose dissolves in cuprammonium solutions in the form of a copper-containing complex. The equilibrium copper concentration is the sum of the concentration of copper combined with cellulose and of that not so combined, called the "cuprammonium copper" concentration. A constant fractional solubility defines a constant concentration of "cuprammonium copper", and a constant composition of the dissolved cupri-cellulose complex. Thus, of the two quantities whose sum yields the equilibrium copper concentration at a given fractional solubility, one is constant and the other is proportional to the cellulose concentration.

4—The "cuprammonium copper" concentration corresponding to a given fractional solubility is obtained by a linear extrapolation. It is the limiting value of the copper concentration in solvents that produce the given fractional solubility, when the ratio of cellulose to solvent approaches zero, and the effect of copper complex formation by the cellulose becomes negligible.

5—The proportion of copper to cellulose in the dissolved complex increases with the concentration of "cuprammonium copper" in the solution. It is assumed that the undissolved fraction of the cellulose also forms a copper-containing complex, and the attempt is made to calculate its composition from measurements of the preferential absorption of copper from the solution, but results obtained in this way are not susceptible to rigid theoretical treatment. They appear to show that, of the dissolved and undissolved complexes in equilibrium with the same solution, the former contains a higher proportion of copper than the latter, the difference being much greater for a modified, than for an unmodified, cotton.

6—At a constant copper concentration, increase of ammonia concentration increases the solvent activity of cuprammonium solutions, whilst the addition of a soluble polyhydroxy compound such as sucrose diminishes it.

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PART V—THE SOLVENT ACTION OF SOLUTIONS OF CUPRIC HYDROXIDE IN AQUEOUS ETHYLENEDIAMINE

INTRODUCTION

The preceding paper of this series (Part IV) showed that a general relation between the composition of cuprammonium solutions and their solvent action on cotton cellulose could be established only by assuming a partial conversion of the cellulose into a complex containing copper. The molar ratio of copper to cellulose in the complex could be estimated for the dissolved fraction of the cellulose by a graphical treatment of the solubility data, and for the undissolved fraction by measurements of preferential absorption of copper from the solution, when it was necessary to assume, however, that the absorption of water was relatively unimportant.

The object of the work described in the present paper was to obtain further information on the nature of the complex, the existence of which has been deduced by Traube, Hess and others, and for which a number of different constitutions have been proposed. For this purpose, the system formed by cellulose and solutions of cupric hydroxide in aqueous ethylenediamine* appeared to be a more favourable subject of study than the cellulose-cuprammonium system. The molar ratio of ethylenediamine to cupric hydroxide in saturated solutions is always in the neighbourhood of 2, and the solutions approximately correspond therefore in composition to the complex $CuEn_2(OH)_2$.† In contrast to this, the molar ratio of ammonia to cupric hydroxide in saturated solutions depends on the concentration of ammonia, but is never much below 50, and is thus far in excess of the simple stoichiometric proportion demanded by the corresponding ammonia complex $Cu(NH_3)_4(OH)_2$. The system formed by cellulose and cupri-ethylenediamine solutions offers the possibility of estimating the ratio of amine, as well as copper, to combined cellulose in the complex, by measurement of the concentration changes in solution, whilst the very great excess of ammonia, and the consequent relatively small changes in its concentration, preclude a similar estimation in the cuprammonium system.

The views developed by Traube and Hess, regarding the nature of the reaction between cellulose and the cupric ammine bases have been accepted, sometimes with modifications, by most other recent workers. A brief account of them is given below.

THE THEORIES OF TRAUBE AND HESS

The views of Traube[1-6] on the nature of the reaction underlying the dissolution of cellulose in cupri-ethylenediamine and cuprammonium solutions have been developed from investigations of the copper complexes formed by simpler polyhydric alcohols such as glycerol, mannitol and dulcitol. Solutions of these substances in aqueous potassium hydroxide are able to dissolve cupric hydroxide, a property which Traube ascribed to the formation of a complex anion containing copper. When he found that the addition of glycerol to an ethylenediamine solution saturated with cupric hydroxide conferred on the solution the power of dissolving additional cupric hydroxide, he concluded that an analogous salt, with a complex

* These will be called solutions of cupri-ethylenediamine.

† The symbol En is used for the ethylenediamine molecule, $NH_2{\cdot}CH_2{\cdot}CH_2{\cdot}NH_2$.

anion containing copper and a cupri-di-ethylenediamine cation, was formed according to the equations—

(1) $2\ CH_2OH{\cdot}CHOH{\cdot}CH_2OH + CuEn_2(OH)_2 \rightleftharpoons [CuEn_2][OCH_2{\cdot}CHOH{\cdot}CH_2OH]_2 + 2\ H_2O$

(2) $[CuEn_2][OCH_2{\cdot}CHOH{\cdot}CH_2OH]_2 + Cu(OH)_2 \rightleftharpoons [CuEn_2][(OCH_2{\cdot}CHOH{\cdot}CH_2O)_2Cu] + 2\ H_2O$

Equation (1) represents alcoholate or salt formation between the weak acid, glycerol, and the base $CuEn_2(OH)_2$, and equation (2) the dissolution of cupric hydroxide with the formation of the complex anion. Later, as the result of obtaining evidence of the presence of free ethylenediamine in solutions of glycerol in aqueous cupri-ethylenediamine, he was led to the conclusion that in the reaction between glycerol and cupri-ethylenediamine in the absence of excess cupric hydroxide the stage represented by equation (1) was followed by the following reaction—

(3) $[CuEn_2][OCH_2{\cdot}CHOH{\cdot}CH_2OH]_2 + CuEn_2(OH)_2 \rightleftharpoons [CuEn_2][(OCH_2{\cdot}CHOH{\cdot}CH_2O)_2Cu] + 2\ En + 2H_2O.$

According to this mechanism, the simple ion first formed abstracts copper from the cupri-ethylenediamine complex, thus liberating ethylenediamine. It is this free diamine which is responsible for the dissolution of additional cupric hydroxide, and this "secondarily dissolved" copper is taken to represent the amount of copper combined in the complex anion.

Traube found that cellulose behaved in a similar manner to glycerol. He showed that saturated solutions of cupric hydroxide in aqueous ethylenediamine acquired the power of dissolving additional cupric hydroxide when cellulose was dissolved in them, and that after this "secondary" dissolution of copper the solution was able to dissolve a further quantity of cellulose. Hence the amount of cellulose that could be brought into solution was much greater in the presence, than in the absence, of solid cupric hydroxide. He also showed that the "secondary" dissolution of cupric hydroxide increased with the ethylenediamine concentration, approaching a limiting value of 1 Cu per 2 $C_6H_{10}O_5$ units. From this evidence, and from that provided by the composition of the precipitate obtained by the addition of ethyl alcohol to cupri-ethylenediamine-cellulose solutions, as well as from the analogy with simpler polyhydric alcohols, he concluded that the interaction of cellulose with cupri-ethylenediamine is expressed by the following equations—

(4) $2C_6H_{10}O_5 + CuEn_2(OH)_2 \rightleftharpoons [C_6H_9O_5]_2[CuEn_2] + 2H_2O$

(5) $[C_6H_9O_5]_2[CuEn_2] + CuEn_2(OH)_2 \rightleftharpoons [(C_6H_8O_5)_2Cu][CuEn_2] + 2En + 2H_2O$

The equilibrium in (4), which represents the very slight degree of salt formation between a strong base and the feebly acidic cellulose, lies far to the left, whereas Traube's data indicate that, on this interpretation, reaction (5) is nearly complete in a solution 1·25 *M* in copper. The formation of a complex with copper must therefore cause a very marked increase in the acidic properties of cellulose.

Hess and Messmer[7] concluded from polarimetric measurements on cuprammonium solutions of cellulose, with and without sodium hydroxide as an additional component, that the cellulose is present as the complex

anion $(C_6H_7O_5Cu)^-$, the cation being cuprammonium or sodium. The high optical activity of these solutions was attributed to this anion. Investigation of the system cellulose-cuprammonium-sodium hydroxide under conditions producing incomplete dissolution of the cellulose led Hess and Trogus[8] to the conclusion that the solid phase contained a complex anion in which the molar ratio of cellulose to copper was double that in the anion assumed to be formed when the cellulose goes into solution.

Trogus and Sakurada[9] obtained similar results to those of Traube for the "secondary" dissolution of cupric hydroxide by cupri-ethylenediamine-cellulose solutions, but concluded that it was not possible to decide on the basis of these results whether the complex anion has the composition (C_6) Cu or $(C_6)_2Cu$.

Results consistent with Traube's explanation of the reaction in the cupri-ethylenediamine-cellulose system were obtained by Takamatsu and Horie[10], who found that the progressive addition of ethylenediamine to cupri-ethylenediamine-cellulose solutions caused an increase in electrical conductivity and a decrease in the optical rotatory power, with ultimate precipitation of the cellulose. These effects are to be expected if the equilibrium is as represented by equation (5) and if the optical rotatory power and the solvent action on cellulose depend on the formation of a copper-cellulose anion.

Conclusions about the nature of the complexes formed by cellulose with the cupric ammine bases have recently been drawn by Lieser[11] from an examination of the precipitates obtained by the addition of methyl and ethyl alcohols to cuprammonium and cupri-ethylenediamine solutions containing dissolved cellulose. Lieser considers that the solutions contain cellulose micelles, and that only the glucose units in the micellar surface—assumed to be approximately half the total glucose units—are involved in complex formation. He regards the cellulose-cupri-ethylenediamine complex as an addition compound in which the molar ratio of ethylene diamine to copper is two to three—

$$(C_6H_{10}O_5)\left[C_6H_7O_2\begin{matrix}OH\\OH\\OH\end{matrix}\begin{matrix}\cdots Cu(OH)_2\\\cdots \underline{CuEn_2(OH)_2}\\\qquad\quad 2\end{matrix}\right]$$

In this formula the C_6 units in round and square brackets represent respectively the glucose units in the interior and the surface of the micelles. The cellulose-cuprammonium complex is formulated in an analogous manner.

The system formed by cupric hydroxide and aqueous ethylenediamine in the absence of cellulose was assumed by Traube to be of a very simple kind. He concluded from analyses of saturated solutions[12] that they contain the diamine and the metal in the exact molar ratio of two to one, and that the only cation present in the solution is the complex cupri-di-ethylenediamine ion $(CuEn_2)^{++}$. According to this view, which postulates great stability of the $(CuEn_2)^{++}$ ion, the saturated solutions contain no free diamine, and no complex ion containing a lower proportion of diamine to copper, such as the cupri-mono-ethylenediamine ion $(CuEn)^{++}$. The matter is of some importance because the validity of Traube's conclusions on the composition of the copper-cellulose complex, as deduced from the "secondary" dissolution of cupric hydroxide in cellulose-cupri-ethylenediamine solutions, becomes doubtful if the cupric hydroxide-ethylenediamine equilibrium is less simple

than he supposed. An examination of the analytical results given by Traube[12] shows that the assumed molar ratio of 2 for diamine to copper in the saturated solutions is only approximately confirmed. A further study of these solutions was made by Hoffmann and Bruch[13] by a partition method, and these authors concluded that the solutions contained, besides the ion (CuEn)$^{++}$, free ethylenediamine and other complex cations such as (CuEn)$^{++}$ and ($CuEn_3$)$^{++}$; Rosenblatt[14] also deduced the existence of the ion (CuEn)$^{++}$ in saturated solutions. From the evidence of light-absorption measurements, Rosenblatt[15] concluded that the cupri-di-ethylenediamine complex existed in solution as the di-aquo ion $[CuEn_2(H_2O)_2]^{++}$, in which the copper atom exhibits a covalency of six.

DESCRIPTION AND DISCUSSION OF RESULTS

(a) The System Cupric Hydroxide-Ethylenediamine-Water

As a preliminary to the examination of systems containing cellulose, it was thought desirable to examine in more detail the reaction between cupric hydroxide and aqueous ethylenediamine solutions. The molar ratio of ethylenediamine to copper was determined in a series of saturated solutions of cupric hydroxide at concentrations of total ethylenediamine varying from 0·01 to 3·5 *M*, and at temperatures varying from 0° C. to 35° C. (Table I). The proportion was in all cases significantly smaller than the simple stoichiometric ratio of 2, and the excess of copper is presumably present as the complex $CuEn(OH)_2$. In 0·1 *M* ethylenediamine solution, the ratio is approximately 1·8, and this would correspond to a proportion of one mole of $CuEn(OH)_2$ to about 4·5 moles of $CuEn_2(OH)_2$ if no other complexes or free ethylenediamine were present in the solution.

Within the limits examined, no effect of temperature could be established with certainty on the ratio of diamine to copper in the saturated solutions, but the ratio varied slightly with the concentration of the ethylenediamine, the observed range being from 1·89 to 1·78.

The solubility of cupric hydroxide in ethylenediamine solutions was found to be markedly enhanced by the presence of sodium hydroxide (Table II). Thus, for a 0·1 *M* solution of ethylenediamine that was also 0·1 *M* in sodium hydroxide the molar ratio of diamine to copper at saturation was 1·72, and fell to 1·48 when the sodium hydroxide concentration was raised to 0·9 *M*, although sodium hydroxide itself at these concentrations has no appreciable solvent action on cupric hydroxide. The presence of the sodium hydroxide clearly affects the equilibrium in the cupric hydroxide-ethylenediamine system, and appears to favour the formation of the $CuEn(OH)_2$ complex at the expense of the CuEn $(OH)_2$. These observations indicate the necessity for some caution in the interpretation of experimental results obtained from the more complicated system formed by cellulose and cupri-ethylenediamine in the presence of sodium hydroxide.

(b) Effect on the Solvent Action of Cupri-ethylenediamine Solutions of the Ratio of Ethylenediamine to Copper

Even a preliminary examination of the solvent action of cupri-ethylenediamine solutions on cellulose reveals the striking effect of an excess of ethylenediamine over that present in a saturated solution of the same copper concentration. The following example illustrates the effect. A solvent approximately 0·2 *M* in copper (about 12 g./litre) and saturated with cupric hydroxide had a molar ratio of ethylenediamine to copper equal to 1·85, and dissolved at 15° C. 92 per cent. of an unmodified cotton present

in the proportion of 0·7 g. to 100 c.c. of solvent. When, with the same copper concentration, the ethylenediamine concentration was increased so that the ratio possessed the exact stoichiometric value 2, only 14·5 per cent. of the same cotton was dissolved under otherwise the same conditions, whilst at slightly higher values of the ratio the copper solution lost its solvent property almost completely (Table III). An effect of this kind has already been recorded in the literature[9,10] and has been explained[10] as a result of excess ethylenediamine on the equilibrium (5) in Traube's formulation of the reaction mechanism.

The behaviour of the corresponding cuprammonium system is qualitatively quite different. A solvent approximately 0·2 *M* in copper and saturated with copper hydroxide has a molar ratio of ammonia to copper in the neighbourhood of 50, far in excess of any simple stoichiometric ratio, and it was shown in the preceding paper that an increase in the ratio results in increased solvent power—the opposite effect to that observed with cupri-ethylenediamine solutions.

The very large effect of slight variations in the ethylenediamine concentration on the solvent action of nearly saturated cupri-ethylenediamine solutions has not hitherto been sufficiently emphasised, and it introduced unforeseen difficulties in the projected study of the dissolution of cellulose in this solvent. In a description of the effect of solvent concentration on cellulose solubility, it is necessary to define with great accuracy, not only the copper concentration, but also the ethylenediamine concentration (or the ratio) in the solvent. In the cuprammonium system, on the other hand, the solubility of cellulose need only be related to an approximately defined ammonia concentration, and slight variations in this factor, such as might be difficult to control experimentally, are of little importance.

In a series of measurements designed to determine the effect of solvent concentration with cupri-ethylenediamine solvents, the attempt has been made in this work to vary the copper concentration systematically, whilst maintaining the ratio of diamine to copper constant at a value near the saturation value. For this purpose, a series of solvents was prepared by dilution with water of a concentrated solution 1 *M* in ethylenediamine and saturated with copper hydroxide. Since, however, the solutions suffer slow decomposition on keeping, with deposition of cuprous oxide, it was necessary to make several fresh concentrated preparations during a series of measurements, and although these were prepared in identical manner, the ratio of diamine to copper varied slightly about a mean value of 1·78, the extreme variation being from 1·77 to 1·79. Even this small variation is sufficient to produce an appreciable effect on the percentage dissolution of cotton at constant copper concentration, and rendered a correction of the experimental values desirable.

The above detail is given in order to illustrate the fact that the cellulose-cupri-ethylenediamine system is in some respects less, rather than more, easy of experimental investigation than the cellulose-cuprammonium system.

(c) Solvent Action of Cupri-ethylenediamine Solutions on Cotton Cellulose

The solvent action has been determined at 15° and 23° C. of solutions of cupri-ethylenediamine having a molar ratio of diamine to copper equal to 1·78 (nominally saturated) in a range of concentrations effecting only partial dissolution of a modified (oxidised) cotton cellulose (Tables IV and

V). As with cuprammonium, the fractional dissolution of the cellulose was found to depend on the initial ratio of cellulose to solvent, and the data have therefore been examined in a manner similar to that described for cuprammonium solutions in the preceding paper. By interpolation from the experimental values, curves have been constructed showing the relation between the equilibrium copper and cellulose concentrations for a series of different constant values of percentage dissolution. These curves are shown in Fig. 1 for an oxycellulose which, in a similar plot for cuprammonium

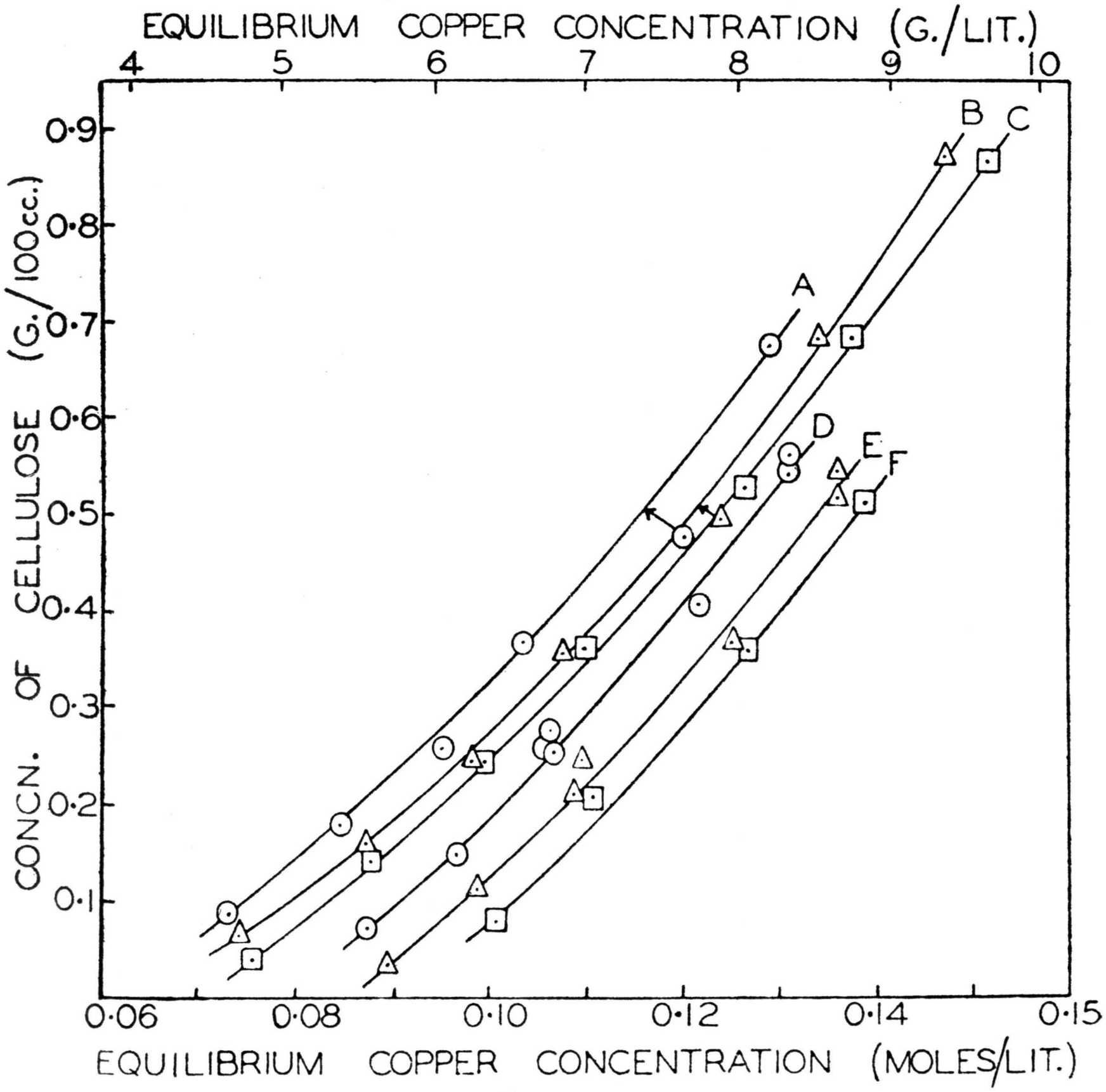


FIG. 1

Relation between equilibrium copper and cellulose concentrations in solutions corresponding to various constant percentage dissolutions of an oxycellulose (OL6/B, fluidity 45·4) at 15° C. and 23° C. in cupri-ethylenediamine solvents of different copper concentrations, the molar ratio of diamine to copper being 1·780.

Curve A—40% dissolution at 15° C. Curve D—40% dissolution at 23° C
" B—60% " " " E—60% " "
" C—80% " " " F—80% " "

solutions, yielded the curves of Fig. 3 in the preceding paper. While the curves show a general similarity in the two systems, the relation between cellulose and copper concentration is not linear for the cupri-ethylenediamine solutions. This makes extrapolation to a zero ratio of cellulose to solution less certain than in the case of cuprammonium solutions, but the extrapolated values for a given fractional dissolution probably still provide the best means for quantitatively describing the solvent activity. Thus, from

these curves and those in the previous paper the following values are obtained for the copper concentration required to dissolve 60 per cent. of the oxycellulose used under the limiting conditions of an infinitely small ratio of cotton to solution—

Cupri-ethylenediamine (saturated) at 23° C.	0·085 *M*	Copper
,, ,, ,, 15° C.	0·065 *M*	,,
Cuprammonium (200 g. ammonia per litre) at 15° C.	0·029 *M*	,,

These results show that a cuprammonium solution containing 200 g. of ammonia per litre is a better solvent than a saturated cupri-ethylenediamine solution of the same copper concentration at the same temperature, and that the solvent power of the latter increases with falling temperature.

A further discussion of the relation between equilibrium copper and cellulose concentrations at constant fractional solubility for cupri-ethylenediamine solutions will be given in a later paragraph.

(d) Molar Ratio of Ethylenediamine to Copper in the Undissolved Cellulose-Copper Complex

The preferential absorptions of both copper and ethylenediamine by the undissolved fraction of the cellulose were determined from the differences between the concentrations of these components in the initial and equilibrium solutions. From the values of the preferential absorptions, the ratio of ethylenediamine to copper combined with the undissolved cellulose could be calculated. Since no assumption regarding the magnitude of the absorption of water by the swollen cellulose is necessary in calculating this ratio, the results can be interpreted with less theoretical ambiguity than those obtained by calculating the ratio of copper, or diamine, to cellulose combined in the undissolved fraction.

Over a range of ethylenediamine concentrations varying from 0·1 to 0·3 *M*, and from solutions saturated or slightly unsaturated with respect to cupric hydroxide, the molar ratio of ethylenediamine to copper preferentially absorbed by the undissolved fraction was found to be unity within the limits of experimental error (Table VI). In the experiments recorded, the value of the ratio in the solvent varied from the minimum of 1·78 for a saturated solution up to a degree of unsaturation corresponding to a ratio of 2·02. Thus, preferential absorption by the solid not only lowers the copper and diamine concentrations of the solvent, but also alters the ratio of diamine to copper in it. This alteration is in the direction of increasing the proportion of diamine to copper, and, in a typical example, a saturated solvent in which the copper concentration was 0·1355 *M*, and the ratio 1·78, when treated with an unmodified cotton of which 92 per cent. remained undissolved, yielded a solution in which the copper concentration was lowered to 0·1143 *M*, and the ratio raised to 1·93. It should be noted that both these changes correspond in direction to a lowering of solvent activity.

(e) The Non-linear Relation between Copper and Cellulose Concentrations at Constant Fractional Dissolution of Cellulose

The investigations of the solid phase just described show that complex formation with cellulose has a two-fold effect on the solvent activity of the solution, and this presumably applies to the dissolved, as well as to the undissolved, cellulose complex. This consideration has an important bearing on the relation plotted in Fig. 1 between the equilibrium concentrations of cellulose and copper at a constant fractional dissolution of cellulose.

In the cuprammonium system, this relation was linear (cf. Fig. 3 of the preceding paper), and was explained in the following way. A constant

fractional dissolution of cellulose defines a constant solvent activity, and a constant composition of the dissolved, copper containing, cellulose complex. The total equilibrium concentration of copper is equal to the constant concentration required for a given fractional dissolution when the effect of complex formation is negligible, called the concentration of the "cuprammonium copper", plus a concentration of copper proportional to the cellulose concentration. In this explanation, it has not been necessary to consider the effect of complex formation on the ammonia concentration, although an analogous action must be assumed to that deduced in the cupri-ethylenediamine system; a certain amount of ammonia must presumably be associated with the copper in the cellulose complex, but the excess of ammonia in the solution is so great that the effect of the complex formation on the uncombined ammonia concentration, or on the ratio of uncombined ammonia to copper, must be negligibly small.

In a solution of cellulose in cupri-ethylenediamine it is not permissible to equate the total equilibrium concentration of copper to a certain concentration necessary for a given fractional dissolution when the effect of complex formation is negligible, plus an amount of copper rendered inactive as a solvent by complex formation with cellulose and proportional to the cellulose concentration. A further quantity of copper must be added to this—in the nature of a correction—which compensates for the unfavourable effect on solvent activity of the change in the ratio of ethylenediamine to copper caused by the complex formation. When the cellulose concentration is increased this "correction" must be increased, but it is not proportional to the cellulose concentration, and the relation between cellulose and total copper concentrations for a constant solvent activity is therefore not linear, as shown by the curves in Fig. 1. The concentrations of ethylenediamine and copper present in the solution, and not combined with the cellulose, bear a different ratio to one another at different points on any one of the curves in Fig. 1, and therefore the curve, although representing a constant fractional solubility, does not correspond to a constant composition of the dissolved cellulose complex; the constant fractional solubility is achieved as a result of a continuous mutual adjustment between two concentration variables. The point of intersection of a curve with the horizontal axis, obtained by extrapolation, gives the concentration of copper in an ethylenediamine solution saturated with cupric hydroxide necessary to produce a given fractional dissolution of the cotton when the disturbing effects of complex formation are negligibly small. Such extrapolated values are not very accurate, but they give a rational quantitative basis for comparing the solvent activity of solutions of cupric ammine bases in terms of copper concentration.

The results again show that the superficial simplicity of the cupri-ethylenediamine solutions, compared with cuprammonium solutions, is illusory. On theoretical grounds, the analysis of the results should be simplified if the solubility measurements were made in ethylenediamine solutions saturated with, *and in the presence of*, solid cupric hydroxide. The presence of the solid would prevent the changes in the ratio of the concentrations of ethylenediamine to copper responsible for the curvilinear relation in Fig. 1. As has been seen, these changes are unfavourable to solvent activity, so that a better solvent action should be observed in the presence of solid cupric hydroxide than in its absence, and this is confirmed by experiment. Unfortunately, the attempt to make reliable solubility measurements in the

presence of both solid cellulose and solid cupric hydroxide encountered experimental difficulties that could not be overcome.

(f) Molar Ratio of Ethylenediamine to Copper in the Undissolved Cellulose-Copper Complex when Sodium Hydroxide is present as an Additional Component

It has been shown that the undissolved fraction of the cellulose in equilibrium with a cupri-ethylenediamine solution contains combined ethylenediamine and copper in the exact molar ratio of unity. For reasons to be mentioned later, it was considered of interest to determine the effect on this ratio of sodium hydroxide added to the solution in increasing amounts. A definite effect was observed in the direction of a decreasing ratio of diamine to copper in the undissolved solid as the concentration of sodium hydroxide in the solution was increased. The results are shown in Table VII, and this table also illustrates the fact that a progressive increase in the sodium hydroxide concentration produces first an increase and then a decrease in the solubility of cellulose in cupri-ethylenediamine solutions. A similar effect of sodium hydroxide on the solubility of cellulose in cuprammonium solutions has been observed by Hess and Trogus[8].

(g) The Nature of the Reaction

The results described in this paper justify the following conclusions—

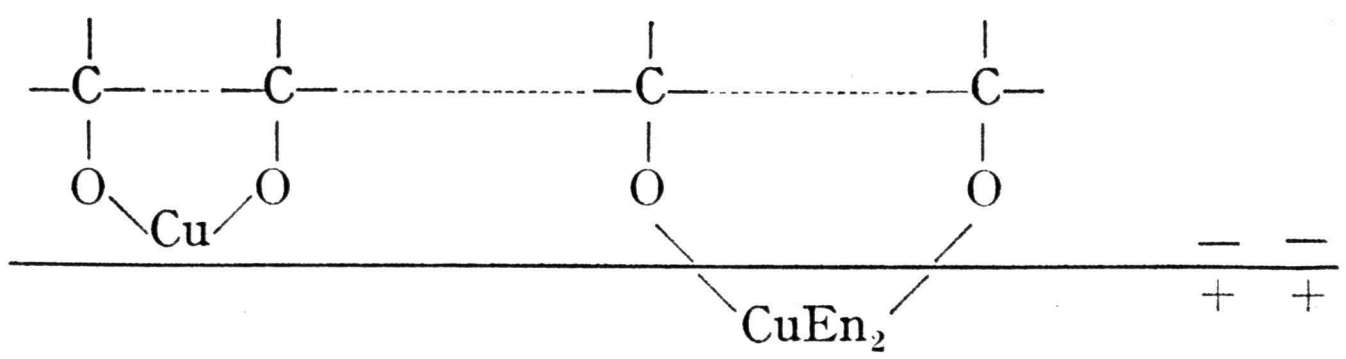
(1) The dissolution of cellulose in cupri-ethylenediamine solutions is accompanied by the formation of a compound containing cellulose, copper and the diamine.

(2) The solvent activity of cupri-ethylenediamine is very sensitive to the molar ratio of diamine to copper in the solution.

(3) The value of this ratio in the cellulose compound is unity, its value in the solvent being always greater than unity.

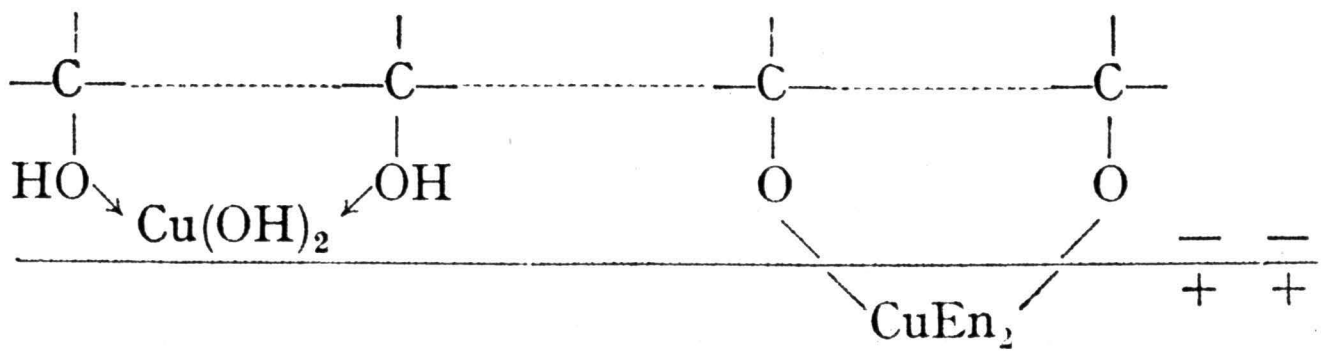
The so-called "secondary dissolution" of cupric hydroxide in cellulose solutions, and the known effect of solid cupric hydroxide in increasing the solvent action of a saturated cupri-ethylenediamine solution, are necessary consequences of (1), (2) and (3) whatever may be the nature of the cellulose-copper-diamine compound, and they must not be regarded as independent experimental confirmation of any particular reaction mechanism.

According to Traube's view, the compound partakes of the nature of a salt in which the cation is the cupri-ethylenediamine ion, and the anion contains copper in complex combination with cellulose. This copper may consist of a copper atom bound to hydroxylic oxygen, as in alcoholates—



I

or it may consist of cupric hydroxide bound by co-ordinate links to hydroxyl groups



II

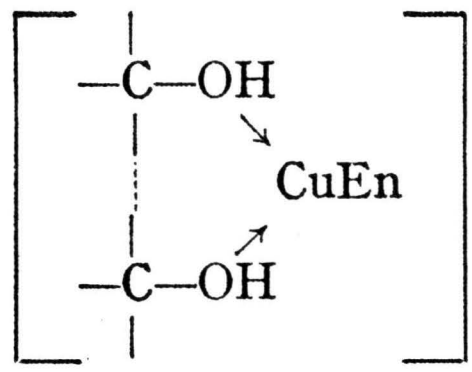
A formulation of type I or II agrees with the experimental observation that the molar ratio of diamine to copper in the compound is equal to unity. The effect of excess ethylenediamine on the solubility of cellulose is explained by a shift in the equilibrium as a result of which the copper in complex combination with cellulose is partially reconverted into cupri-ethylenediamine ion. In addition, there exists strong evidence that cellulose in the presence of alkali is capable of forming complex compounds with copper or copper hydroxide. This can be shown most conclusively in the following way—Clear solutions of a modified cotton in a sodium hydroxide solution of optimum concentration can be prepared by methods described in earlier papers of this series. If such a solution is shaken with solid cupric hydroxide the cellulose is completely precipitated from the solution as a blue gel, although the solubility of the cupric hydroxide in alkali of the concentration used is extremely low, so that the precipitation cannot be ascribed to a general electrolyte "salting-out" effect. The cellulose is presumably precipitated as the sodium salt of the cupricellulose anion, of which I or II represents the cupri-ethylenediamine salt. It is difficult, however, to understand why this sodium salt should be insoluble, since the basis of Traube's theory is that the solubility of cellulose in cuprammonium and cupri-ethylenediamine solutions is a result of the formation of the complex cupri-cellulose anion. This anomaly has been recognised by Traube[3].

The effect of the presence of sodium hydroxide, as an additional component, on the composition of the solid complex has been determined with the object of attempting to obtain further confirmation of Traube's formulation. If the solid complex consists of the cupri-ethylenediamine salt of a cupricellulose anion, the addition of sodium hydroxide should partially convert it into the corresponding sodium salt, replacing $CuEn_2$ by Na. In the presence of increasing concentrations of sodium hydroxide the molar ratio of diamine to copper in the complex should therefore decrease progressively from the value of unity observed when no sodium hydroxide is present. Potentiometric titration with the glass electrode shows that cupri-ethylenediamine hydroxide is a strong base comparable in this respect with sodium hydroxide, and the ratio of $CuEn_2$ to anionic copper in the complex should therefore be proportional to the concentration ratio $2[CuEn_2]/2[CuEn_2] + [Na]$ in the solution. Thus, for a solution of equal molar concentrations in the two strong bases, the molar ratio of cationic to anionic copper in the cellulose complex would be 2 to 3, and the molar ratio of diamine to total copper 0·8 (4 to 5). Similarly, for a solution in which the molar concentration of sodium hydroxide is twice that of the copper base, the molar ratio of diamine to copper in the solid complex should be 0·67 (2 to 3).

The actual results obtained (Table VII) show that the addition of sodium hydroxide to the system is accompanied by a decrease in the ratio, an effect in the direction predicted by the above calculations from Traube's theory. The concentration of sodium hydroxide necessary to produce a given change in the ratio is however much higher than that calculated; for a solution in which the molar concentration of sodium hydroxide was twice that of copper base, the effect on the ratio was, for example, scarcely significant in relation to the experimental error. These calculations do not therefore support the view that the complex contains salts of a simple ionic character derived from a cupricellulose anion.

Attention is naturally directed towards the possibility that the active solvent constituent of cupri-ethylenediamine solutions may be cupri-mono-ethylenediamine hydroxide or a corresponding ion, which contains the same molar ratio of diamine to copper as the cellulose complex. This possibility was dismissed by Traube partly in the mistaken belief that no evidence existed for the presence of any complex other than $CuEn_2(OH)_2$ in ethylenediamine solutions of cupric hydroxide. The effect of an excess of ethylenediamine in diminishing the solubility of cellulose in saturated cupri-ethylenediamine solutions, and of low concentrations of sodium hydroxide in increasing the solubility, could, however, be simply explained in terms of the theory that the active solvent is $CuEn(OH)_2$. Excess of ethylenediamine must increase the concentration of the di-, at the expense of that of the mono-, ethylenediamine complex, whilst the addition of sodium hydroxide has been shown from solubility measurements in the cupric hydroxide-ethylene-diamine-water system to exert the opposite effect.

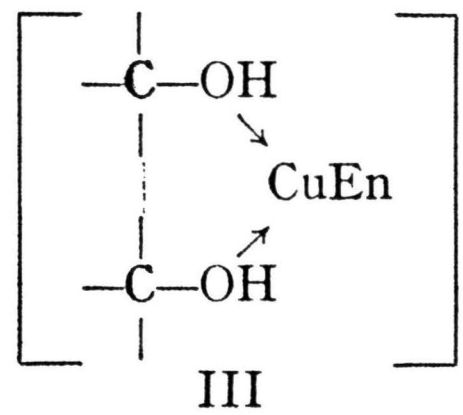
For the cellulose-copper-diamine compound a formulation of the following type can be suggested—



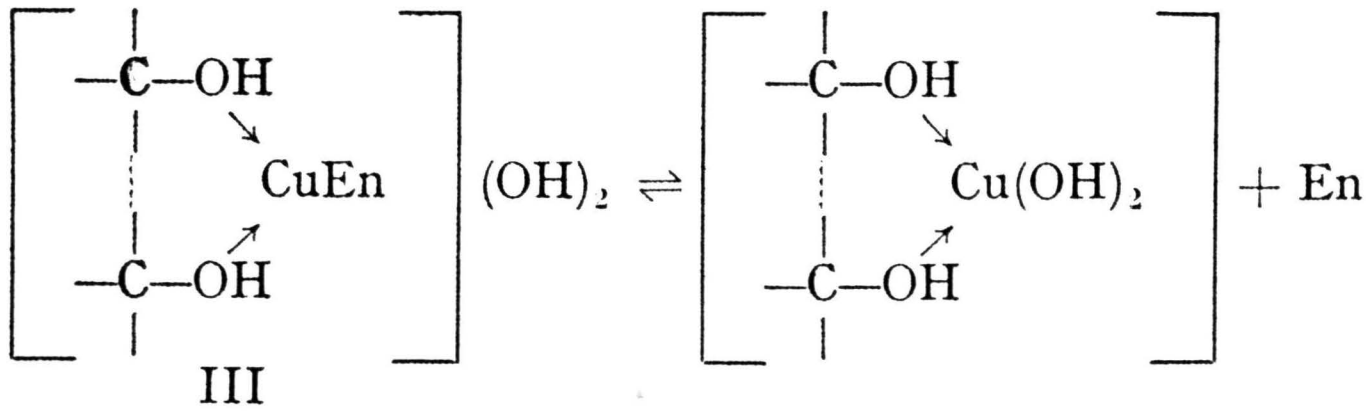
III

in which the cellulose, copper and diamine are all present in a complex cation formed by the co-ordination of a copper atom with two hydroxyl groups in the cellulose and one molecule of the diamine. On the assumption that the copper retains a covalency of four in all its complex combinations, the following series of equilibria can be postulated—

(*a*) $[CuEn_2]\ (OH)_2 \rightleftharpoons [CuEn(OH)_2] + En$

(*b*) Cellulose + $[CuEn(OH)_2] \rightleftharpoons$  $(OH)_2$

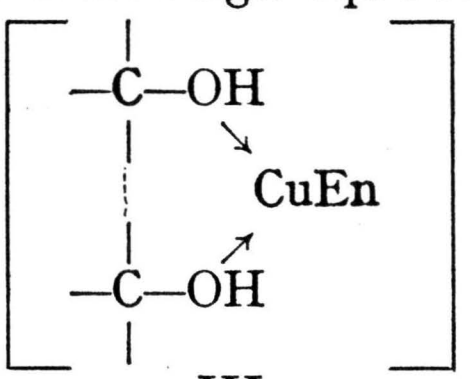
III

(*c*)  $(OH)_2 \rightleftharpoons$ + En

III

The system (*a*) represents the equilibrium between cupri-di-ethylenediamine hydroxide, cupri-mono-ethylenediamine hydroxide, and free ethylenediamine, the symbols within square brackets representing undissociated 4-co-ordinate complexes. The effect of increasing the hydroxyl ion concentration by the addition of sodium hydroxide to this system would be to displace the equilibrium in favour of the undissociated cupri-mono-ethylenediamine complex. The system (*b*) is the one suggested above as fundamental to the

dissolution of cellulose in cupri-ethylenediamine solutions; it represents the displacement of two hydroxyl groups by a cellulose unit in the mono-ethylenediamine co-ordination complex. The system (*c*) is strictly analogous to system (*a*), and involves the formation of a cupricellulose free from diamine of the type already shown by formula II in the form of a corresponding salt. In the system cellulose-cupric hydroxide-ethylenediamine-water, the combination of (*a*) and (*b*) results in the single equilibrium—

(*d*) Cellulose + $[CuEn_2](OH)_2 \rightleftharpoons$  $(OH)_2 + En$

III

in which the compound III is represented as being formed directly by the replacement of one ethylenediamine molecule in the cupri-di-ethylenediamine complex by a cellulose unit. This equilibrium would be unaffected by hydroxyl ion concentration if both the hydroxides were strong bases, and the effect of the addition of sodium hydroxide to the system containing cellulose would be determined by its effect on the equilibrium (*c*). It would thus favour the formation of the cupricellulose II, depressing the ratio of diamine to copper in the solid complex in accordance with the experimental observations.

There is at present insufficient evidence to establish any proposed mechanism for the reaction between cellulose and the cupric ammine bases. The experimental work and theoretical considerations advanced by Traube represent very important progress towards an ultimate understanding of this difficult subject. The reaction mechanism proposed by him does not, however, appear capable of explaining some important experimental observations. No particular merit is claimed for the mechanism proposed above except that it explains these observations in a formal way, but there may be other reaction schemes for which this is true. It seems probable that the effect of sodium hydroxide in increasing the solubility of cupric hydroxide in aqueous ethylenediamine is fundamentally related to the known effects of sodium hydroxide in the system containing cellulose, but the reaction mechanisms proposed hitherto provide no explanation for such a relation.

No reason is, or has been, advanced to account for the effect on the solubility of cellulose of increasing the ammonia concentration in the cuprammonium system, which is the opposite of that accompanying an increase of ethylenediamine concentration in the cupri-ethylenediamine system. A satisfactory solution of all the problems raised by a study of the solubility of cellulose in solutions of the cupric ammine bases requires a more fundamental knowledge of the equilibria existing in these solutions in the absence of cellulose than is at present available.

EXPERIMENTAL

(a) Materials

The cottons employed were the unmodified cotton (No. 327) and the modified cottons (OL6/B and OL10/B) described in the preceding paper.

Cupric hydroxide was prepared by Dawson's method[16], which gave a bright-blue powder that did not darken on keeping for several months.

Analysis of this product (A), previously dried to constant weight over phosphorus pentoxide in a vacuum, gave by iodimetric titration a copper content corresponding to 98·3 per cent. of $Cu(OH)_2$, and the following amounts of impurities were found to be present—NaOH, 0·12 per cent; SO_4, <0·01 per cent; Fe_2O_3, 0·02 per cent. Other samples of cupric hydroxide obtained commercially darkened on keeping, and contained smaller proportions of copper and higher proportions of alkalis. The best of these samples (B), which was used in some experiments, contained 94·0 per cent. $Cu(OH)_2$, 0·1 per cent. SO_4 and 0·6 per cent. NaOH.

Ethylenediamine was obtained as 65–70 per cent. solutions. A sample was purified by partial dehydration with sodium hydroxide to approximately the composition of the hydrate $C_2H_8N_2,H_2O$ and distilled, a middle fraction of the constant-boiling mixture (B.P. 118·5° C.) being collected. This mixture has approximately the same composition as the hydrate, and the hydrate was prepared from it by fractional freezing. The purest fraction obtained melted at 10·60° C., the value given by Wilson[17] being 10·5° C. The solubilities of cupric hydroxide in solutions prepared from the original solution and the pure hydrate, respectively, were found to be identical, and the conclusion was therefore drawn that the original samples of ethylenediamine were of a sufficiently high degree of purity to be used without purification.

(b) Methods of Analysis

Copper was determined by iodimetric titration, as described in the preceding paper. Ethylenediamine was determined in solutions free from copper by titration with standard acid, the "4·5" indicator of British Drug Houses being used. It was shown by potentiometric titration with the glass electrode that the end-point with this indicator corresponds to complete neutralisation of both amino groups. Glass electrode titrations of cupri-ethylenediamine solutions showed the stability of the complex to be such that its decomposition was only complete at pH 3·5, for which no suitable indicator is available, and in experiments in which it was necessary to determine ethylenediamine directly in such solutions, the Kjeldahl method was employed. Both the direct titration and the Kjeldahl methods were checked by analyses on pure ethylenediamine hydrate. It was found that the change in volume resulting from the dissolution of cupric hydroxide in ethylenediamine solutions was extremely small, so that the concentration of the diamine in solutions up to 0·5 *M* in which cupric hydroxide had been dissolved was obtained by the application of a small correction to the concentration of the original solution.

Cellulose dissolved in cupri-ethylenediamine solutions was determined by oxidation with chromic acid, the procedure followed being a modification of that described in the preceding paper. Since ethylenediamine is slowly oxidised by chromic acid, the cellulose precipitated on acidifying the solution was washed free from ethylenediamine before performing the oxidation. The washing of the cellulose was effected in a centrifuge tube, by repeatedly filling up with water, stirring and centrifuging, the water being poured off from the cellulose through a fritted glass filter. The small quantity of cellulose fragments retained by the filter was dissolved in 75 per cent. sulphuric acid and added to the cellulose in the tube. The oxidation with chromic acid was carried out either in the centrifuge tube at 110° C., the tube being immersed in a bath at this temperature, or preferably the

whole of the cellulose was dissolved in 75 per cent. sulphuric acid and transferred to a conical flask, in which the oxidation was carried out under reflux in the usual way.

As in the corresponding cuprammonium system, the changes in volume of the liquid phase by reason of the dissolution of cellulose are too small to justify correction of the results on this account.

(c) Dissolution of Cupric Hydroxide in Ethylenediamine Solutions

The solubility of cupric hydroxide in ethylenediamine solutions was determined by stirring in a stoppered bottle immersed in a thermostat at the required temperature. Equilibrium was attained in one-half to three hours, according to the concentration. The solution was filtered through a fritted glass filter jacketed with water at the same temperature, and analysed. It was shown that centrifuging the solution gave the same concentration as filtration, and the conclusion was therefore drawn that the latter removed all the undissolved cupric hydroxide.

In its reaction with ethylenediamine solution cupric hydroxide does not behave as a completely homogeneous substance, in that the concentration of copper in a saturated solution depends on the ratio of cupric hydroxide to ethylenediamine taken. For example, when this ratio was varied in a series of experiments with sample B of cupric hydroxide and 0·1 *M* ethylenediamine solution a constant copper concentration was not attained until an 80 per cent. excess of cupric hydroxide was used. This proportional excess was used in the solubility measurements described below. With the purest sample of cupric hydroxide (A), the excess required to give the maximum copper concentration attainable was somewhat less, but the effect was still marked.

The molar ratio of ethylenediamine to copper in ethylenediamine solutions saturated with cupric hydroxide was determined at a number of ethylenediamine concentrations and temperatures. The results are given in Table I.

Table I

Molar Ratio of Ethylenediamine to Copper in Ethylenediamine Solutions saturated with Cupric Hydroxide (Sample B)

Temperature (° C.)	Molar ratio En/Cu						
	Concentration of ethylenediamine (moles/litre)						
	0·01	0·02	0·05	0·10	0·35	1·00	3·50
0	—	1·855	—	1·831	1·802	—	—
15	1·887	1·877	1·821	1·809	1·780	1·789	1·877
20	—	—	—	1·815	1·783	—	—
35	—	1·877	1·845	1·795	1·783	—	—

The effect on the solubility of cupric hydroxide produced by the addition of sodium hydroxide to an ethylenediamine solution is shown in Table II.

Table II

Molar Ratio of Ethylenediamine to Copper in Solutions containing 0·1018 Moles Ethylenediamine per Litre, various Concentrations of Sodium Hydroxide, and saturated with Cupric Hydroxide (Sample B) at 15° C.

Moles of sodium hydroxide per litre ...	0	0·05	0·10	0·89	1·98
Molar ratio En/Cu	1·798	1·761	1·725	1·484	1·288

Saturated solutions of cupric hydroxide in aqueous ethylenediamine decompose slowly on keeping, cuprous oxide being precipitated. This effect is not observed with unsaturated solutions, probably because any cuprous oxide formed is dissolved by the excess ethylenediamine. On account of this instability it was necessary to use freshly prepared solutions in experiments with cellulose.

(d) Solubility of Cellulose in Cupri-ethylenediamine Solutions

In the determination of the solubility of cellulose in cupri-ethylenediamine solutions the method of extraction of the cellulose with the solvent was identical with that used with cuprammonium solutions.

(*i*) *The effect of the ratio of ethylenediamine to copper in the solution*—Investigation of the effect of the ratio of ethylenediamine to copper in the cupri-ethylenediamine solution showed that for a given copper concentration the solvent action of the solution towards cellulose decreases rapidly with increasing ethylenediamine concentration. This effect is illustrated by Table III, which also shows that the depression of the solubility of the cellulose is accompanied by a parallel decrease in the molar ratio of copper to cellulose in the undissolved residue (calculated from the preferential absorption of copper).

Table III

Dissolution of an unmodified Cotton (No. 327) in Cupri-ethylenediamine Solutions of constant Copper Concentration (0·1887 mole/litre), and various Ethylenediamine Concentrations (0·7 g. Cotton extracted with 100 c.c. Solution at 15° C.)

Concentration of ethylenediamine (moles/litre)	Molar ratio En/Cu in solution	Percentage of cellulose dissolved	Equilibrium copper concentration (moles/litre)	Molar ratio $Cu/C_6H_1O_5$ in solid phase
0·349	1·849	91·8	0·1858	0·82
0·359	1·902	62·4	0·1772	0·71
0·369	1·956	30·7	0·1708	0·60
0·379	2·009	14·5	0·1698	0·51
0·399	2·115	4·5	0·1736	0·37

(*ii*) *Solubility of a modified cotton in solutions of various copper concentrations and constant ratio of ethylenediamine to copper*—In studying the solubility of cellulose in cupri-ethylenediamine solutions of varying copper concentration and constant ratio of copper to ethylenediamine, solutions were prepared by dilution of freshly made solutions of cupric hydroxide in 1 *M* aqueous ethylenediamine. Although the concentrated solution was prepared in an identical manner on each occasion, the molar ratio of ethylenediamine to copper varied slightly about a mean value of 1·780, the extreme values being 1·773 and 1·789. These variations were sufficient to produce an appreciable effect on the percentage dissolution of cotton extracted with the solutions, and for the purpose of an analysis of the results by the method described in the preceding paper it was necessary to correct the solubility data to correspond with a constant molar ratio En/Cu of 1·780. The appropriate corrections were derived from duplicate series of solubility determinations in solutions of identical copper concentration and slightly different ethylenediamine concentrations. The corrections applied are calculated on the assumption that the change in the percentage dissolution produced by a given small difference in the ratio En/Cu is proportional to this difference and is the same for different copper concentrations

at the same percentage dissolution. The maximum correction applied to the values of the percentage dissolution is approximately 5 per cent. The relation between the percentage dissolution and the equilibrium copper concentration, which is employed in the analysis of the solubility data, is not significantly altered by the slight variations of the ratio En/Cu.

Table IV

Dissolution of Oxycellulose OL6/B in Cupri-ethylenediamine Solutions at 15° C.

Initial copper concentration (moles/litre)	Molar ratio En/Cu in solution	Ratio of cellulose to solution (g./100 c.c.)	Concentration of dissolved cellulose (g./100 c.c.)	Percentage of cellulose dissolved	Equilibrium copper concentration (moles/litre)	Molar ratio $Cu/C_6H_{11}O_5$ in solid phase	Percentage of cellulose dissolved if ratio En/Cu = 1·780
0·0754	1·780	0·075	0·052	69·3	0·0750	—	69·3
		0·150	0·074	49·3	0·0740	—	49·3
		0·250	0·092	36·8	0·0723	0·32	36·8
		0·400	0·107	26·8	0·0718	0·20	26·8
0·0882	1·783	0·150	0·145	96·7	0·0878	—	99·5
		0·250	0·154	61·6	0·0875	—	62·7
		0·400	0·173	43·3	0·0850	0·23	44·2
		0·600	0·187	31·2	0·0832	0·20	32·0
		0·900	0·195	21·7	0·0810	0·17	22·4
0·1004	1·780	0·250	0·244	97·6	0·1001	—	97·6
		0·400	0·243	60·8	0·0979	0·26	60·8
		0·600	0·255	42·5	0·0955	0·23	42·5
		0·900	0·271	30·1	0·0928	0·20	30·1
		1·200	0·289	24·1	0·0911	0·17	24·1
0·1112	1·783	0·400	0·368	92·0	0·1105	—	94·5
		0·600	0·349	58·2	0·1073	0·25	59·3
		0·800	0·359	44·9	0·1046	0·24	45·8
		1·100	0·374	34·0	0·1021	0·20	34·8
		1·400	0·356	25·4	0·0998	0·18	26·1
0·1294	1·783	0·600	0·544	90·7	0·1276	—	93·3
		0·800	0·489	61·1	0·1245	0·26	62·3
		1·000	0·475	47·5	0·1218	0·23	48·5
		1·300	0·467	35·9	0·1188	0·21	36·7
		1·600	0·465	29·1	0·1163	0·19	29·8
0·1404	1·786	0·800	0·649	81·1	0·1375	0·31	84·8
		1·000	0·656	65·6	0·1352	0·24	68·1
		1·200	0·662	55·2	0·1329	0·23	57·3
		1·400	0·677	48·4	0·1314	0·20	50·4
		1·600	0·630	39·4	0·1288	0·19	41·2
0·1557	1·786	0·800	0·778	97·3	0·1546	—	—
		1·000	0·823	82·3	0·1520	0·34	86·3
		1·200	0·836	69·7	0·1498	0·26	72·3
		1·400	0·838	59·9	0·1469	0·25	62·1

The results of solubility determinations with the oxycellulose OL6/B at 15° and 23° C. are given in Tables IV and V respectively. The curves in Fig. 1 are constructed from these data by interpolation on graphs representing (a) the relation between percentage dissolution (corrected) and ratio of cellulose to solution, and (b) the relation between percentage dissolution (uncorrected) and equilibrium copper concentration.

(*iii*) *Solubility of cellulose in the presence of solid cupric hydroxide*—In experiments in which cupri-ethylenediamine solutions containing dissolved cellulose were shaken with excess of cupric hydroxide it was found that the

Table V

Dissolution of Oxycellulose OL6/B in Cupri-ethylenediamine Solutions at 23° C.

Initial copper concentration (moles/litre)	Molar ratio En/Cu in solution	Ratio of cellulose to solution (g./100 c.c.)	Concentration of dissolved cellulose (g./100 c.c.)	Percentage of cellulose dissolved	Equilibrium copper concentration (moles/litre)	Molar ratio $Cu/C_6H_{11}O_5$ in solid phase	Percentage of cellulose dissolved if ratio En/Cu = 1·780
0·0884	1·780	0·150	0·065	43·3	0·0874	—	43·3
		0·250	0·085	34·0	—	—	34·0
		0·400	0·103	25·8	0·0847	0·20	25·8
		0·600	0·118	19·7	0·0832	0·17	19·7
		0·900	0·135	15·0	0·0813	0·15	15·0
0·1003	1·781	0·150	0·100	66·7	0·0994	—	67·3
		0·250	0·126	50·4	0·0978	0·33	50·9
		0·400	0·150	37·5	0·0962	0·27	38·0
		0·700	0·181	25·9	0·0941	0·19	26·3
		1·100	0·199	18·1	0·0915	0·16	18·3
0·1109	1·789	0·250	0·176	70·4	0·1093	—	74·6
		0·300	0·188	62·7	0·1089	0·29	66·3
		0·400	0·207	51·8	0·1079	0·25	54·9
		0·650	0·240	36·9	0·1053	0·22	39·6
		1·000	0·257	25·7	0·1024	0·19	27·8
0·1117	1·780	0·250	0·205	82·0	0·1104	—	82·0
		0·300	0·216	72·0	0·1099	0·35	72·0
		0·400	0·222	55·5	0·1086	0·28	55·5
		0·650	0·252	38·8	0·1063	0·22	38·8
		1·000	0·284	28·4	0·1038	0·18	28·4
0·1122	1·773	0·400	0·256	64·0	0·1100	0·25	61·6
		0·600	0·277	46·2	0·1073	0·25	44·3
		0·800	0·303	37·9	0·1057	0·21	36·1
		1·100	0·317	28·8	0·1035	0·18	27·2
		1·400	0·311	22·2	0·1015	0·16	20·8
0·1293	1·786	0·400	0·346	86·5	0·1277	—	90·8
		0·700	0·358	51·2	0·1237	0·27	53·2
		1·100	0·408	37·1	0·1206	0·20	38·9
		1·300	0·392	30·2	0·1185	0·19	31·8
		1·600	0·419	26·2	0·1166	0·17	27·6
0·1412	1·780	0·500	0·485	97·0	0·1403	—	97·0
		0·650	0·515	79·2	0·1378	0·41	79·2
		0·800	0·531	66·4	0·1368	0·26	66·4
		1·000	0·572	57·2	1·1352	0·23	57·2
		1·200	0·554	46·2	0·1326	0·22	46·2
0·1411	1·780	0·800	0·505	63·1	0·1358	0·29	63·1
		1·000	0·537	53·7	0·1350	0·21	53·7
		1·200	0·547	45·6	0·1328	0·21	45·6
		1·400	0·565	40·4	0·1312	0·19	40·3
		1·600	0·521	32·6	0·1288	0·18	32·6

concentration of copper in solution increased continuously with the amount of cupric hydroxide present, and showed no sign of reaching a constant value even when the total amount of cupric hydroxide was five times the

amount "secondarily" dissolved. Further, when an arbitrary excess of cupric hydroxide was taken as a standard, and the concentration of the solution was such as to produce incomplete dissolution of the cellulose present, the results obtained were characterised by a marked lack of reproducibility. The attempt to study this system was therefore abandoned.

(e) The Molar Ratio of Ethylenediamine to Copper in the Undissolved Cellulose-Copper Complex

In studying the ratio of ethylenediamine to copper in the undissolved residue after treatment of cellulose with cupri-ethylenediamine solutions the conditions were so chosen as to minimise the dissolution of the cellulose while retaining a considerable preferential absorption of copper and ethylenediamine. Suitable conditions were provided by the use of an unmodified cotton and of solutions with a slightly higher ratio of ethylenediamine to copper than is found in saturated solutions of cupric hydroxide. Table VI gives the results obtained with cupri-ethylenediamine solutions of various compositions, and Table VII shows the effect of the presence of sodium hydroxide at various concentrations in solutions of approximately constant ethylenediamine and copper concentrations.

Table VI

Molar Ratio of Ethylenediamine to Copper in the undissolved Residue after Treatment of an unmodified Cotton (No. 327) with Cupri-ethylenediamine Solutions at 15° C.

Ratio of cellulose to solution (g./100c.c.)	Initial solution			Percentage cellulose dissolved	Equilibrium solution			Molar ratio En/Cu in solid phase
	Ethylenediamine concentration (moles/litre)	Copper concentration (moles/litre)	Molar ratio En/Cu		Ethylenediamine concentration (moles/litre)	Copper concentration (moles/litre)	Molar ratio En/Cu	
1·500	0·3057	0·1663	1·84	12·6	0·2796	0·1398	2·00	0·99
1·500	0·3059	0·1515	2·02	1·4	0·2912	0·1365	2·13	0·98
1·000	0·2418	0·1355	1·78	8·2	0·2205	0·1143	1·93	1·00
1·000	0·2038	0·1105	1·84	2·2	0·1907	0·0976	1·95	1·02
1·000	0·1016	0·0536	1·90	0	0·0976	0·0496	1·97	1·00

Table VII

Molar Ratio of Ethylenediamine to Copper in the undissolved Residue after Treatment of an unmodified Cotton (No. 327) with Cupri-ethylenediamine Solutions containing Sodium Hydroxide (1 g. Cellulose extracted with 100 c.c. Solution at 15° C.)

Initial solution				Percentage of cellulose dissolved	Equilibrium solution		Molar ratio En/Cu in solid phase
Sodium hydroxide concentration (moles/litre)	Ethylenediamine concentration (moles/litre)	Copper concentration (moles/litre)	Molar ratio En/Cu		Ethylenediamine concentration (moles/litre)	Copper concentration (moles/litre)	
0	0·2038	0·1105	1·84	2·2	0·1907	0·0976	1·02
0·20	0·2035	0·1074	1·89	7·4	0·1836	0·0875	1·00
0·48	0·2036	0·1043	1·95	11·9	0·1826	0·0791	0·83
0·93	0·2030	0·1039	1·95	1·0	0·1860	0·0731	0·55
1·93	0·2037	0·1043	1·95	0	0·1949	0·0727	0·28
2·65	0·2035	0·1042	1·95	0	0·1957	0·0726	0·25

(f) The Systems Cellulose-Sodium (or Lithium) Hydroxide-Cupric Hydroxide-Water

The examination of these systems was qualitative and consisted of the following experiments.

(*a*) Half a gram of the modified cotton OL10/B was dissolved in 50 c.c. of 2·5 *N* sodium hydroxide at −5° C., and the solution allowed to revert to room temperature. Cupric hydroxide (0·30 g.) was added to the solution, and the mixture shaken. After 16 hours the cellulose was found to be completely precipitated as a deep-blue gel, which did not dissolve when the system was progressively diluted with water. Under the microscope the precipitated cellulose was seen to consist of a blue gel surrounding individual particles of solid cupric hydroxide in shape somewhat resembling swollen starch grains, and the growth of these grains could be observed.

(*b*) A solution of 2·75 *N* lithium hydroxide saturated with cupric hydroxide was added to a 1 per cent. solution of the modified cotton in 2·75 *N* aqueous lithium hydroxide prepared as described for sodium hydroxide. The addition of even 0·1 c.c. of the copper solution to 5 c.c. of the cellulose solution produced a precipitate of cellulose, and this precipitate increased in amount as the volume of copper solution added was increased to about 5 c.c. Lithium hydroxide was used for this experiment because it was found that the solubility of cupric hydroxide in solutions of this alkali is considerably greater than in sodium hydroxide solutions.

(*c*) Half a gram of the modified cotton was shaken for 16 hours with 0·3 g. of cupric hydroxide and 50 c.c. of solutions of sodium and lithium hydroxide varying in concentration from 0·05 to 1 *N*. In every case the modified cotton was coloured blue by absorption of copper, but the solutions contained no dissolved cellulose.

These observations show that cellulose forms a complex with cupric hydroxide in the presence of sodium or lithium hydroxide, and that this complex is insoluble in dilute solutions of these alkalis.

SUMMARY

1—The solubility of cupric hydroxide has been measured in solutions of ethylenediamine of concentrations varying from 0·01 *M* to 3·5 *M* at temperatures varying from 0° C. to 35° C. The molar ratio of ethylenediamine to copper in the saturated solutions varies from 1·89 to 1·78, and the solutions therefore contain more copper than corresponds to the formula $CuEn_2(OH)_2$. The addition of sodium hydroxide to the system further reduces the ratio of diamine to copper.

2—When cotton is treated with a saturated, or nearly saturated, cupri-ethylenediamine solution under conditions that result in partial solubility of the cellulose, ethylenediamine and copper are preferentially absorbed by the undissolved portion in equimolar proportion, and preferential absorption by the solid thus increases the ratio of diamine to copper in the solution.

3—The solubility of cotton cellulose in cupri-ethylenediamine is extremely sensitive to the ratio of diamine to copper in the solution. At a constant copper concentration, it falls rapidly as the concentration of ethylenediamine increases above that existing in a solvent saturated with cupric hydroxide. This effect is the opposite of that produced in the corresponding cuprammonium system by variations of the ammonia concentration.

4—The fractional solubility of cotton cellulose in a cupri-ethylenediamine solvent of constant composition falls as the ratio of cellulose to solvent

increases. The relation between fractional solubility, ratio of cellulose to solvent, and equilibrium concentration of copper in the solution, has been studied for a number of solvents varying in copper concentration, but with a constant ratio of ethylenediamine to copper. Unlike the case in the corresponding cuprammonium system, the equilibrium concentration of copper is not linearly related to the concentration of dissolved cellulose at constant fractional solubility.

5—These observations are interpreted in the following way—A solid complex that contains ethylenediamine and copper in equimolar proportion is formed by the undissolved fraction of the cellulose. It is presumed that the dissolved fraction is present in the solution as a complex containing the diamine and copper in the same proportion. The non-linear relation between the equilibrium concentrations of dissolved cellulose and copper at constant fractional solubility is shown to follow from these assumptions, and from the established effect of the ratio of diamine to copper on the fractional solubility of cellulose.

6—The solvent activities of different cupric ammine solvents can be compared by means of the limiting copper concentration (obtained by extrapolation) necessary to produce a given fractional dissolution of a given modified cotton as the ratio of cellulose to solvent approaches zero. On this basis of comparison a cuprammonium solution containing 200 grams of ammonia per litre is a better solvent for cellulose than a saturated cupri-ethylenediamine solution of the same copper concentration, and the solvent activity of the latter decreases with rising temperature.

7—The addition of solid cupric hydroxide to a solution of a modified cotton in sodium hydroxide causes complete precipitation of the cellulose in the form of a copper complex. A copper complex is also precipitated when solutions of cupric hydroxide and a modified cotton in lithium hydroxide are mixed. These complexes are thus insoluble in dilute solutions of the alkalis.

8—The nature of the reaction between cellulose and cupri-ethylenediamine is discussed in the light of the experimental results.

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Correspondence

"RESEARCHES ON WOOL FELTING"

To the Editor of the "Journal of the Textile Institute"

SIR

In the November issue of the *Journal* methods of determining the degree of felting of wool are discussed and some reference is made to certain experiments made by the writer. These experiments were carried out with the object of ascertaining the relative degree of felting of a specially selected fabric under varying conditions of treatment. The Barker method of measuring the change in area was adopted and proved useful in selecting the best conditions for milling of the selected fabric. Optimum shrinkage during felting was observed between 40° C. and 50° C. If the experiments had been carried out with loose wool fibres this method of determining the degree of felting would, of course, have been useless. In such cases, a measurement of the change in the bulk of a mass of wool fibres would have had to be used although it is by no means certain that the change in volume would give a measure of the degree of felting. The length of the fibres in the loose wool would have a considerable influence on the results. In the case of loose wool there are no forces to oppose the movement of the fibres during milling and because of this any optimum felting might easily be missed, especially if the change in porosity or volume were taken as a measure of felting. In the case of fabrics the wool fibres are arranged approximately in one plane, so that the shrinkage which normally accompanies felting would show itself in a change of area and not in a change in volume, and so long as the fabric is constructed so that warp and weft are as nearly as possible identical in structure and arrangement and in freedom from strains tending to cause shrinkage, the change in area would give a fairly accurate estimate of the degree of felting. In the writer's experiments the fabric was specially woven for the work and the degree of felting, as decided by a few practical men who were good enough to give their judgment, was certainly the greatest in the samples exhibiting the maximum shrinkage. With fabrics constructed in other ways such as with warps of cotton or of highly twisted worsted, the measurement of the degree of felting would not be accurately proportional to the change in area or volume, so that neither the Barker method nor the Schofield method would be applicable. Whilst pure shrinkage arising from the corrugations in the yarns is certainly not due to felting, there is no certainty that shrinkage not due to such corrugations in the yarn is due entirely to internal felting and not to sliding of fibres or to corrugations of fibres. Neither the Barker method nor the Schofield method could be called scientific nor do I think the originators regarded the methods as scientific. Up to date no scientific definition of felting has been put forward. Felting is usually accompanied by shrinkage, but as the latter can be produced without felting one cannot define felting as a change in the area of fabrics or of the volume of loose wool. In the Barker method it is assumed that the degree of shrinkage in area of a wool fabric is proportional to the degree of felting, whereas in the Schofield method the degree of shrinkage in volume is assumed to be proportional to the degree of felting. No proof of either of these assumptions has so far been produced. There is, in fact, no scientific method of determining the degree of felting, so the practical man has to rely upon his knowledge and experience to decide when a fabric

is sufficiently felted for the required purpose. Felting is defined as the art or process of making felt. Felt is defined as a cloth or stuff of wool wrought into a compact mass by rolling and pressure. With such definitions it is conceivable that a wool cloth could be felted without change in area but not, in this case, without change in thickness and consequently volume.

If all the recent scientific work on felting is carefully examined one arrives at the conclusion that the actual felting together of wool fibres cannot be measured in terms of shrinkage in area or volume. Some scientific definition of felting is needed before a scientific method of measuring it can be devised. The interesting and valuable information brought forward by Speakman and Schofield in the recent discussions on felting all support this opinion.

KILMACOLM (*Signed*) W. HARRISON

3rd January 1939

"RESEARCHES ON WOOL FELTING"

To the Editor of the "Journal of the Textile Institute"

SIR

In his reply to my second criticism, Schofield disputes the fact that the papers published from this laboratory are "concerned throughout with milling shrinkage". At the outset of the first of these papers, however, it is clearly stated (*J. Text. Inst.* 1931, T339) that—"The present paper records the first of a series of investigations undertaken to give quantitative expression to the *shrinkage of wool fabrics in a milling machine.*" Further, in the second paper, the headings under which the subject of milling is discussed are—

(1) "Shrinkage as a Function of the *p*H of the Milling Agent."
(2) "The Relation between Fibre Swelling and Milling Properties."
(3) "The Elastic Properties of Wool and their Relation to Milling Shrinkage."

Because felting of the fibres is the basis of milling shrinkage, Schofield has assumed, without justification, that our papers were intended to develop a theory of felting. Actually, the word 'felting' is used only four times in each of the papers, and in the second, all the uses relate to Arnold's theory of felting, which was under discussion in connection with the *different* view we were compelled to take regarding the nature of milling shrinkage. That our papers were concerned simply with milling shrinkage is still further emphasised by their conclusion (*J. Text. Inst.* 1933, T291)—"From the preceding discussion it is evident that *for milling shrinkage to be possible* a fibre must (1) possess a surface scale structure, (2) be easily stretched and deformed, (3) possess the power of recovery from extension." Hence at the opening of the first paper and at the conclusion of the second, as well as throughout the text, very definite statements are made to show that the purpose of the papers is to develop a theory of milling shrinkage and nothing else.

Despite such precise definition, Schofield proceeded (*J. Text. Inst.* 1938, T239), to criticise "the extensive employment by various workers of the facile and incomplete criterion of area shrinkage as a test of felting action." In the papers published from this laboratory, however, the criterion of area shrinkage was *not* used as a test of felting action: it was used simply as a measure of milling shrinkage, as has been indicated above. Against this simple use there can be no possible criticism. Further, measurements of the

rate of shrinkage of wool fabrics in a milling machine under different conditions of temperature and *p*H are certainly capable of defining the conditions of temperature and *p*H necessary to give the maximum rate of shrinkage, and, as such, the experiments are again above criticism. Finally, two (unpublished) series of experiments have been carried out in conjunction with S. Aral, and these show that there *is* an optimum temperature for acid milling as well as soap milling, so that Schofield's criticism of Harrison's results (the only ones relating to acid milling) is without the slightest foundation.

As regards cotton warp fabrics, these have been utilised in this laboratory to determine the influence of fibre length on milling properties. For obvious reasons, the yarns composed of fibres of different lengths were woven as weft on a cotton warp, and the fabrics were milled with soap in a milling machine. In one case, the shrinkages were expressed (for the sake of consistency) as area shrinkages, but precisely similar conclusions are capable of being drawn from the weft shrinkage data, to which attention was restricted in the third paper (*J. Text. Inst.*, 1936, T171). For some obscure reason, Schofield appears to regard as specially significant the case (*J. Text. Inst.*, 1938, T283), where a cotton warp fabric increased considerably in length during milling: he has in fact called twice for a calculation, not realising that an answer is impossible because insufficient data are provided. Given the necessary data, however, there need be no difficulty in calculating the shrinkage. The value is negative, indicating that the area of the cloth increased, as it certainly did! Had yarns composed of fibres of different lengths been woven as weft in such a cloth, the method of area shrinkage would still have revealed the relative merits of different lengths of fibre in promoting milling shrinkage, which is the sole purpose for which cotton warp fabrics were utilised. There is, however, no objection to the consideration of weft shrinkage data alone, as in the case quoted above (*J. Text. Inst*, 1936, T171).

The only interest of the second "technical case" quoted by Schofield (*J. Text. Inst.*, 1938, T308), is its indication that he has now realised what has already been emphasised on our papers on milling, viz. the complicated nature of milling shrinkage, although the heading given to the diagram—"Shrinkage v. Felting"—and the subsequent discussion, once more betray that failure to recognise the purpose of our experiments which is the cause of his confusion.

There is now no necessity to consider the remaining errors in Schofield's paper, but in reply to his latest letter (*J. Text. Inst.*, 1938, T307), it should be stated that the data of Column 7, Table IV and Column 7, Table V are certainly percentages, but Schofield defines them as simple ratios, and the values are, therefore, as already stated, 100 times too big.

TEXTILE CHEMISTRY LABORATORY (*Signed*) J. B. SPEAKMAN
LEEDS UNIVERSITY 11*th January* 1939

"RESEARCHES ON FELTING"

To the Editor of the "Journal of the Textile Institute"

SIR

It is beginning to appear that the textile industry is to benefit by a revival of interest in the subject of felting; as there has been all too little attention in the past and felting is one of the most complicated of textile phenomena, interest, new experiment and scientific discussion are wholly welcome. I remember, twenty years ago, Mr. Harrison lecturing for the Wool Research Association on this subject of milling and noted that the lecturer was not obsessed by hoary yet current notions about serrations, but stated unhesitatingly that milling was essentially interlacing, a view to which very many people have not advanced even to-day. It was unfortunate for Mr. Harrison that his work on milling was never completed at the Wool Research Association, that it was disclosed by other individuals, and that no full publication ever took place. But, of course, the absence of this publication leaves the conclusion of an optimum temperature in the air—neither accepted nor denied on that basis—merely suspended, awaiting further work.

His temperate and reasoned letter is further welcome for its additional details, e.g. that the method of area shrinkage was used as the criterion of the milling.

In 1926, a paper on "The Shrinkage of Woollen and Worsted Fabrics" was published by A. F. Barker and K. C. Barker, (*Jour. Textile Science, Leeds University*, 1926, **1**, 79; **2**, 23) in which many cloths were stock-milled. Observations of time and area shrinkage were made and graphs plotted. No laws were deduced. The authors remarked—"(1) The limits of shrinkage have never been clearly defined. (2) The shrinkages observed under any stated conditions have never satisfactorily been apportioned to material, thread structure, cloth structure, and finish." Further, the desirability of finding a mathematical interpretation of the graphs was noted.

This rather sterile and barren result was the first occasion on which area shrinkage was applied to the milling operation. I have always regarded it as a somewhat unfortunate legacy to the Leeds workers, but it is so attractively easy that others have also adopted it. In particular the Wool Industries Research Association, in a research on milling issued to their members only—a typical instance of secret working in matters of science—adopted this method and arrived at their conclusion that "Increased milling is therefore due to an increased imbibition of water."

But Dr. Speakman (*J. Text Inst.*, 1933, T286), in experiments he now states to be concerned only with milling shrinkage and not with general felting theory, arrived at the following—"The preceding experiments thus afford a complete proof of the fact that swelling itself plays no direct part in determining the milling properties of a wool under any set of conditions." And in arriving at this absolute denial of the W.I.R.A. position he also used the same method—and that alone—of area shrinkage, and entitled his papers "Contributions to the Theory of Milling."

Mr. Harrison's attention must be drawn to the fact that while, "in the case of fabrics the wool fibres are arranged approximately in one plane", dimensional changes are taking place in all three—and in one, the thickness, positively instead of negatively. Even then, these warp and weft yarns get quite different mechanical treatment in the roller milling machine. One may admit that in certain cases, e.g. wool staple, area shrinkage appears to

have given the correct conclusion: in others it has led to error. No experimenter would, for example, have deduced an optimum temperature from my experiments on felting wool masses, and the technical felt manufacturers do not seem to be aware of it in their work. Last week, in a felt works, two thermometers I read on a plate hardener showed 60° C. and I was informed that it was their regular temperature. Mr. Harrison will pardon me if I regard the paragraph re "A few practical men who were good enough to give their judgment" as perhaps a trifle naïve. Felting will require a great deal of very full and accurate scientific experiment, as quantitative as it can be made. Again, I must reiterate that the volume changes in themselves are not regarded by me as complete criteria of felting, nor even when weight is taken into account, and a porosity or bulk density calculated. All the criteria—of which we have now five—must be used and correlated.

The further letter by Dr. Speakman, a copy of which he has courteously sent me in advance to facilitate reply, is partially concerned, at any rate, with repetition. But this particular question of the real objects of a past research is not now of first importance. The actual facts and deductions therefrom are the primary matter and as experiments are still continuing, it is certain that there is going to be much enlightenment. There is, for example, the method of distinguishing weft shrinkage from weft felting given in my last letter. This delightful and significant device, due to Mr. T. Hindle, managing director of Scapa Dryers, of Blackburn, is bound to be of immense value in future milling experiments on cloth. The tremendous scale of manufacture in the making of paper felts—which may be of any width up to forty feet—renders these factors supremely important.

I recommend this yarn dissection and measurement to the area shrinkage investigators as an invaluable supplement to their research weapons, and also to Mr. Johnson, whose paper on comparative shrinkages of typical weaves was an excellent breaking of new ground, but needs alternative verifications. I must mischievously point out that my two present critics do not seem completely united on certain points: for example, Dr. Speakman's special notice might be directed to Mr. Harrison's very relevant remarks re cotton warps.

Finally, it is very likely that the next twelve months will see some real advance in this difficult section of wool technics. As there is in the hands of the Editor a further paper on felting, and as this correspondence is rather overlapping the general subject, I suggest that it is suspended for the present.

HUDDERSFIELD
14th January 1939

(*Signed*) J. SCHOFIELD

THE JOURNAL OF THE
TEXTILE INSTITUTE

ABSTRACTS

LIST OF ABSTRACTORS

The Abstracts in this Section of the "Journal" are supplied by the following Organisations, and the sources indicated by the initials hereunder shown.

British Cotton Industry Research Association	C.
British Launderers Research Association	La.
Bureau of Hygiene and Tropical Diseases	T.
Cuthill, Dr. R.	S.
Imperial Bureau of Animal Genetics	W.
Imperial Bureau of Plant Genetics	C. or L.
Linen Industry Research Association	L.
Water Pollution Research Board	W.
Whitelegg, C. J.	C.J.W.
Wool Industries Research Association	W.

1—FIBRES AND THEIR PRODUCTION

(B)—ANIMAL

Silk: Production. *M/cr. Gdn. Comml.*, 1938, **37**, 472.

A brief popular account is given of silkworm rearing, with statistics of silk production and exports for 1930 and 1937, by countries, and some notes are added on grading and futures contracts on the principal silk markets. C.

Silk: Culture in Large Establishments. K. Ereky. *Textilberichte*, 1938, **19**, 775-777.

The decline in silk culture in Europe and the decreasing profitableness of this industry are discussed, and it is pointed out that the methods used are generally still the same as those employed in ancient times. The possibility of rationalising the industry is examined and it is suggested that, by large-scale establishments and the use of technical devices, it should be possible to reduce the 12 hours work now required for the production of one kilogram of cocoons to 3 or even fewer working hours. A large establishment in which, without any technical improvements, the working hours for 1 kg. of cocoons have been reduced to 3 hours is briefly described. The costs of production are such that the work could be carried on without a loss at the present market price of raw silk. With technical improvements it will be possible to reduce the labour costs which form about 45 per cent. of the total. The cost of mulberry leaves represents about 15 per cent. of the total. It is pointed out that costs of mulberry tree cultivation can be reduced by using shoots and branches as sources of bast fibres and cellulose. Further, mulberry leaves contain protein from which it has been found possible to spin an artificial fibre. C.

Mongolian Sheep Wool. III—Physical Properties. IV—Coarse Wool. V—Behaviour towards Reagents. M. Saito and M. Tinzei. *Rep. Inst. Sci. Res., Manchoukuo*, 1938, **2**, 171-185, 186-200, 201-219 (through *Brit. Chem. Abs. B.*, 1938, 57, 1275). (See also *J. Text. Inst.*, 1937, A237 and 1938 A718). W.

Merino Development. (1) I. C. Ross, (2) A. B. Wildman. (3) V. Bosman. *Farmers' Weekly*, 1938, 21st Sept., p. 2093.

Replies to articles by E. N. Roberts (see *J. Text. Inst.*, 1938, A386 and 573). (1) Experimental evidence supports the contention that, in stud animals within a single flock, plain sheep may produce as great a clean-scoured weight of wool as animals of a more developed type; this indicates that there need be no sacrifice

of true (not apparent) density and weight of fleece by substituting plainness for development. (2) Further emphasis is given to the points mentioned in (1), and the importance of the number of sebaceous glands in relation to fleece condition is pointed out. It is possible to alter the physical characteristics of fleece wool by altering the environment of sheep, but such change can proceed only as far as the limits set by the animals' genetic constitution. (3) A very brief reference to future research programmes at Onderstepoort, and the Potchefstroom and Grootfontein Schools of Agriculture. W.

External Parasites of Sheep. I—Fly Pests. R. du Toit. *Farming in South Africa*, 1938, **13**, 401-404 and 407.

A description of the life cycle and habits of blowflies and of the sheep nasal fly, with details of symptoms of attack and of treatment. Illustrations are given of the adult sheep nasal fly, three types of blowfly, and a blowfly trap. W.

Sheep Blowfly Investigations. VII—Development of Eggs and Oviposition in the Sheep Blowfly, *Lucilia Sericata* Mg. R. P. Hobson. *Ann. Applied Biol.*, 1938, **25**, 573-582 (through *Chem. Abs.*, 1938, **32**, 8599). See *J. Text. Inst.* 1938, A646).

Two meat meals are essential for development of mature eggs in the ovaries, and for the further production of eggs after oviposition. Neither plant materials nor animal excreta can replace meat in the diet if eggs are to develop. Products of putrefaction (indole, skatole, ammonia, trimethylamine, ammonium carbonate, ethyl alcohol, suint) stimulated gravid females to oviposit but did not attract them from a distance. The stimuli for attraction at a distance are not known. W.

Experiments on the Testing of Procedures for Liming Hides. W. Grassman and H. Schelz. *Spinner u. Weber*, 1938, **56**, No. 29, pp. 2-3 (through *Chem. Abs.*, 1938, **32**, 7761).

Reports of tests on various procedures of liming hides by means of calcium hydroxide and arsenious sulphide, enzymic and bacteriological aids, combinations of chemical and biological methods, etc. W.

(C)—VEGETABLE

Cotton: Cultivation in Nyasaland. *Annl. Rpt., Dep. Agric. Nyassaland Protectorate*, 1937, 68 pp. [Issued 1938.]

The following references to cotton are noted. (P. 10.) Details of crown-land and private-estate yields of seed cotton; the totals are 4,485 tons in the Southern Province and 2,106 tons in the Northern Province. (P. 20-21) Experiences with insect pests, especially the Red bollworm, indicate the need for growing cotton as an annual crop and enforcing a dead season. Progress reports from the Agricultural Officers are given in appendices, viz., Blantyre (p. 40-41), Dowa (p. 47-48) and the Cotton Experiment Station, Domira Bay (p. 60-61). C.

Cotton: Production in Peru. *Wirtschaftsdienst*, 1938, **23**, 1386.

The acreage, yield, export and home consumption of Peruvian cotton since 1916 are shown in a table. An exceptional setback to the industry has occurred this season, after a long period of steady expansion. About 88 per cent. of the crop is of Tanguis type, 8 per cent. of Pima type and 1·3 per cent. of the Semi-Aspero (half-rough) type. The yield per acre nearly approaches that of Egypt. C.

Cotton: Cultivation in Turkey. S. Keskinoglu. *Cotton Trade J., Internat. Edn.*, 1938, 47.

The recent development of cotton growing in Turkey is reviewed. Three main zones are recognised and the chief types of cotton are described. Production in 1937-38 reached 251,000 bales (200 kilo.), including 20,000 of Acala and 64,000 of Cleveland cotton. It is expected that in a few seasons Turkey will provide nearly half-a-million bales of long-staple cotton. C.

Cotton: Cultivation in U.S.S.R. R. Skliar. *Cotton Trade J., Internat. Edn.*, 1938, 138-9.

Asiatic cottons are no longer grown in the Soviet Union. American Upland types predominate but in 1937 about 600,000 acres, out of a total of about 5 millions, were under Egyptian types. About 94 per cent. of the 1,500,000 small farms in the old cotton belt of Central Asia have been combined into some 19,000 collective holdings, extensively mechanised and supplied with fertilisers. C.

Egyptian Cotton: Cultivation. Fouad Abaza Pasha. *Cotton (M/cr.)*, 1938, 44, No. 2134, p. 14.

A brief review is given of the work of the Royal Agricultural Society of Egypt on the improvement of the cotton crop, including references to the early strain "Short Maarad" ("Maarad 10-12"), the early, heavy-yielding strain "Maarad 368" that is gradually replacing the original Maarad, the new "Maarad 33A" that is highly resistant to wilt and gives a stronger and finer lint than other Maarad strains, and the white "Bahtim Abiad". C.

Sind Cotton: Production. M. P. Ghandi. *Cotton Trade J., Internat. Edn.*, 1938, 68.

The activities of the Sakrand Agricultural Research Station and the Agricultural Department to foster the cotton growing industry in Sind are described. More than one million acres are under cotton and the aim is to cultivate three million acres. Sind Deshi W.N. 27 has now become a standard crop in the *deshi* field; it has a ginning percentage of 38-39. Sind American 289 F is now popularly known as Sind Sudhar. A new strain 289 F1 has staple length 1 $\frac{1}{16}$ in. and ginning percentage 30, and spins to 40's. Sind American 4F 98 has staple length $\frac{7}{8}$–$\frac{15}{16}$ in. and ginning percentage 33-34, and spins to 30's. A cross between Sind Deshi WN27 and Meade cotton has reached the sixth generation and is breeding true; it has the *deshi* quality but twice the staple length of the *deshi* parent. Another cross between Sind American and Sea Island cotton has reached the ninth generation. C.

Mummified Cotton Bolls: Occurrence. A. Biraghi. *Boll. Staz. Pat. Veg. Roma*, 1937, **17**, 475-496 (*through Rev. Appl. Mycol.*, 1938, **17**, 674).

Cotton bolls with withered carpels and black, mummified fibre were collected near Rome. The causative fungi are described. One found in the bolls is referred to *Alternaria macrospora* and another, occurring on the carpels, to *A. gossypina*. The classification of *Alternaria* species is discussed. C.

"False-packed" Cotton Bales: Control. F. Taylor (U.S. Bureau of Agricultural Economics). *Textile Weekly*, 1938, **22**, 561-2.

A report of a lecture about complaints of bad deliveries of American cotton in bale, such as "two-sided" and "sandwich" bales, oil-stained, mouldy and damp cotton, and efforts being made by the U.S. Department of Agriculture to improve matters. C.

American Cotton: Economics of Production. W. E. Morgan. *Cotton Trade J., Internat. Edn.*, 1938, 32, 151.

The poor prospects for the American cotton grower are discussed and the question of alternative farming is raised. A series of diagrams is given to show that on the basis of prices in 1923-32 cotton growing still gives a very much greater net return per hour for labour than other crops (15·9 cents per hour as against 5·4 cents for corn, the next best) and requires the smallest acreage for a given return (2·8 acres for 100 dollars worth of produce as against 3·8 for poultry farming). C.

American Cotton Crop, 1937-38. H. Plauche. *Cotton (M/cr)*, 1938, 44, No. 2134, 9-12.

The actual cotton growth for the season 1937-38 was 18,412,000 bales plus 1,461,000 bales of linters. The carry-over is 12,955,000 bales plus 848,000 bales of linters. The world consumption of American cotton for the year ending July 31st, 1938, was 11,177,000 bales plus 985,000 bales of linters. Particulars of production by States, exports from various ports and to various markets, and other statistics are tabulated. C.

Brazilian Cotton: Production. (1) J. G. Dantas. (2) W. F. Pendleton. *Cotton Trade J., Internat. Edn.*, 1938, 127-9, 131.

(1) Governmental activities in Sao Paulo for the improvement and control of grade and staple are reviewed. Exports of cotton to various countries and from the various ports are tabulated. Out of a total of 236,181 metric tons in 1937, Germany took 84,746, Japan 50,918, Great Britain 47,330 and France 12,709. (2) A table shows the distribution of lengths, in ranges of 2 mm., of the American standard cottons (nominal staple lengths $\frac{3}{4}$, $\frac{7}{8}$, $\frac{15}{16}$, 1, and 1 $\frac{1}{32}$ in.) and the S. Paulo crop of the 1934-35 and 1936-37 seasons, as determined by the Zweigle sorter. The modal length of the 1936-37 Brazilian cotton was slightly above 28

mm. (slightly more than that of American 1 $\frac{1}{32}$ in. cotton). The prospects for cotton growing in Brazil are discussed. Cotton is now being grown in pairs of rows between rows of coffee trees on many plantations. C.

Cotton: Cultivation in N. China. (1) K. Sato. (2) T. T. Sih. *Cotton Trade J., Internat. Edn.*, 1938, 60, 62-3.

(1) The prospects of N. China as a source of raw cotton for Japan are reviewed. The yield has fluctuated enormously, due to climatic extremes, but in 1936 reached 4,365,000 bales (500 lb.). (2) Failure to develop cotton growing in Manchuria is claimed as a reason for Japanese interest in N. China. Plans for the improvement of the crop in Shensi are discussed and a Cotton Improvement Institute, an Experiment Farm, and various Co-operative Societies are mentioned. C.

Egyptian Cotton Crop, 1937-38. Davis, Benachi & Co. *Cotton (M/cr.)*., 1938, 44, No. 2134, p. 13.

The total crop was 10,713,374 cantars of which 8,686,978 (=1,183,512 bales) were exported; Lancashire took 381,781 bales and the Continent 624,708. Particulars are given of the exports to individual countries. C.

Empire Cotton: Production. Sir W. H. Himbury. *Cotton (M/cr)*, 1938, 44, No. 2134, p. 21.

A brief review of the output of cotton from various Empire fields in 1937-38. Statistics are summarised in a table that shows a total production of 829,600 bales (400 lb.) in Africa, Australia and the West Indies, and 5,407,000 bales in India. C.

Peruvian Cotton: Production. M. M. Bernales. *Cotton Trade J., Internat. Edn.*, 1938, 132-3.

The prospects for cotton growing in Peru are discussed. The industry is the largest employer of labour and bears the heaviest burden of taxation. Exports in 1937 were 80,676 metric tons (Tanguis 71,730, Pima 4,813 and Acala 2,181), of which Great Britain took 42,799 tons and Germany 23,305. C.

East India Cotton Association: Activities. A. R. Menezes. *Cotton Trade J., Internat. Edn.*, 1938, 67, 70, 186.

The organisation of the East India Cotton Association is described and the types of futures contracts are explained. C.

German Raw Cotton Markets: Activities. (1) E. Schier. (2) G. W. Hirschfeld. *Cotton Trade J., Internat. Edn.*, 1938, 83-5, 88-94.

(1) The development of the Bremen Cotton Exchange from 1860 onwards is reviewed. (2) Imports of raw cotton *via* Bremen and Hamburg from various sources are tabulated for the years 1933-37. Imports from the United States have fallen from 1,758,337 bales to 822,253 but Brazilian cotton has risen from 962 to 487,505 bales and Egyptian from 70,606 to 114,597. The total from all sources has fallen from 2,208,834 to 1,969,867. C.

Instituto Cotoniero Italiano: Activities. *Cotton Trade J., Internat. Edn.*, 1938, 106 (from "*Mostra del Tessile*").

Several examples are cited of the financial assistance given by the Instituto Cotoniero Italiano to cotton growing in the southern provinces of Italy and Sicily. Acala cotton seed has been distributed and ginneries equipped. The area cultivated is expected to reach in a few years 50,000 hectares, providing about one-tenth of the raw cotton requirements of Italy. C.

Cottonised Flax: Production. *Klepzig's Textil-Z.*, 1938, 41, 544-547, 555-556, 565-566.

Attempts to shorten and improve processes for the treatment of flax, to eliminate the retting process, and to develop machines in order to reduce the manual work required are reviewed. The structure of flax is described, the separation of the elementary fibres by cottonising treatments is discussed, and results of measurements of the length, width and weight of fibres obtained from different parts of the stalks are given. It is pointed out that a large proportion of these fibres are very short and that in order to obtain a product of good spinning capacity the cottonising process must not be carried too far. Bratkowski's cottonising process is critically discussed and other patent processes are reviewed. C.

Cotton: Cultivation in Brazil. F. G. Cobb. *Cotton (U.S.)*, 1938, **102**, No. 8, 47-9, 55; No. 9, 58-61; No. 11, 51-2.

The writer records his impressions of a recent visit to Brazil, giving many facts about the production of cotton in Sao Paulo and the conditions of the mills visited. C.

Cotton: Cultivation in Central Africa. A. de Bauw. *Rept. 18th Int. Cotton Congress*, 1938, 288-292.

The expansion of cotton growing in Central Africa is shown by figures of lint production from 1924 to 1937 for the various countries. The systems of "free markets" and "zoning" are described. The "free market" system applied to cotton buying in Central Africa has proved inadequate and has had to undergo everywhere important changes. Good results have been especially noticeable in those areas where the zoning system has been enforced and where private enterprise has been able to work hand in hand with Government officials in training natives in agricultural methods. C.

Cotton: Cultivation in South America, Asia, and Africa. D. de Prat. *L'Industrie Textile*, 1938, 55, 471-473.

A review of recent developments in cotton cultivation in Brazil, Argentina, Peru, Mexico, China, Korea, Turkey, Uganda, the Sudan, and various minor countries such as Iran, Syria and Iraq. It is pointed out that the combined productions of the first nine countries named now amounts to more than a quarter of the total world production of cotton, to more than the combined productions of India and Egypt, and to 65 per cent. of the cotton production of the United States. C.

Cotton: Production in Yugoslavia. D. B. P. Kraljevine. *Rept. 18th Int. Cotton Congress*, 1938, 341-351.

An account is given of cotton production in Yugoslavia under the headings—(1) History, (2) yield, (3) ginning, (4) trade and prices, (5) distribution, (6) premium for home cotton, (7) administration of cotton importation, (8) interest in national cotton and (9) work of the Advisory Commission for cotton. A table gives the imports of raw cotton, yarns and fabrics, from 1925 to 1936. C.

Bahtim Abiad Cotton: Development. H. E. Fuad Abaza Pasha. *Rept. 18th Int. Cotton Congress*, 1938, 245-247; Discussion 81-83.

The Royal Agricultural Society of Egypt is developing the cultivation of a white cotton "Bahtim Abiad", this year's crop being over 1,200 kantars (1 kantar = 100 lb.). In the field the new cotton has maintained its earliness and high productivity and in staple characteristics and price is equal to Giza 7. It is agriculturally suitable for Egypt, especially the southern provinces of Lower Egypt where other long- and medium-staple varieties have been driven out by Uppers. The Ministry of Agriculture formerly tried white cottons and concluded that since they did not show quite as good a return to the grower as the existing varieties when judged on their spinning value, without allowing for whiteness value, there was no justification for their introduction. The Department also considered a very high standard of whiteness necessary to justify Egypt in developing such a cotton. The author, on the other hand, is impressed by the importance of the demand for whiteness. The new cotton is said to be less white than Tanguis. C.

Egyptian Cotton: Causes of Increased Yield per Acre. M. A. Fikry. *Rept. 18th Int. Cotton Congress*, 1938, 247-253: Discussion 83-86.

The increase in the total production of cotton in Egypt is due to a considerable increase in the yield per acre (about 35 per cent. over 1925) and a slight increase in the area under cotton. This increase has been caused by the introduction of new varieties, which are briefly described, and by modifications in agricultural practices. A table shows average yields from 1920-1937. C.

Egyptian Cotton: Prospects of New Varieties. C. H. Brown. *Rept. 18th Int. Cotton Congress*, 1938, 178-180; Discussion, 50-56.

The gradual replacement of Sakel cotton by Giza 7 has culminated in the addition of a Giza 7 contract on the Alexandria market, and the substitution of Giza 7 for Sakel as a basis for the Liverpool long-staple contract. This variety combines to some extent quality and cheapness and has spread to half-a-million acres. The *Maarad* crop is stable at an area of 70,000 to 80,000 acres, mostly in

the eastern province of Sharkia. *Sakha* 4 has been greatly improved so that it is now equal to Sakel in staple and strength but lighter in colour and of very good lustre. The crop is relatively stable at 40,000 acres. Although this variety has wilt-resistance and a higher ginning out-turn to recommend it and the last three seasons' tests make it equal to Sakel in the higher grades and superior in the lower, it has not a market value equal to Sakel. *Giza* 26 is now coming on to the market and is the best quality variety yet grown in Egypt. It is expensive as it gives a low yield, which is, however, slightly better than Sakel and its yarn strength is 10 per cent. superior. *Giza* 29, the newest variety, is the highest-yielding long-staple cotton, with a quality equal to Sakel and the same yield as Giza 7. It will no longer be a question of Giza 7 replacing Sakel; Giza 29 and Maarad could replace them both. Giza 29 is not equal to Giza 26 in quality, so that the latter may still exist, the deciding factor being the premium commanded by Giza 26 over Giza 29. As soon as Giza 29 gets well established Sakha 4 can be allowed to die. *Giza* 12, the best medium-staple variety at present grown, has a yield higher than Giza 7 and Giza 29, works well in the card, is free from nep, is an easy-spinning cotton and is well suited to replace Zagora. The staple is as long as Giza 7, but coarser and it makes a regular yarn with a strength between that of Ashmouni and Giza 7. Since the price is well below that of Giza 7, the cotton should find a ready outlet. Increasing quantities of Giza 12 are therefore predicted for the next few years, particularly as it has also proved suitable to Southern Upper Egypt, the staple being finer and stronger from this region than from the Delta. New high-yielding strains from Giza 12, the highest yielding Delta cotton, are now being tested and will give a variety setting entirely new standards in yield per acre. Some of these are notable for their exceptionally high ginning out-turn and the worst staple of these strains is better than Ashmouni. Other possible substitutes for Ashmouni, are *Giza* 31, a light-coloured fine cotton making good strength but rather neppy, and *Giza* 33, which is long but coarse and makes only slightly stronger yarn than the present Ashmouni (Giza 19). Quantities of each variety being grown are as follows—Giza 26 produced 1,000 bales last year and 5,000 are expected in the coming year; Giza 12 gave 10,000 bales last year and 20,000 to 30,000 are estimated for next year; Sakha 4 gave 20,000 bales last year and all the cotton now being grown at the State Domains is the new Sakha 4 strain. C.

Egyptian Cotton Plant: Effect of Soil Conditions. D. S. Gracie. *Rept. 18th Int. Cotton Congress*, 1938, 191-194; Discussion p. 59.

Soils have two main independent sets of properties, the physical characteristics that govern aeration and water supply, and the chemical and biochemical characteristics. The yield of cotton normally tends to be determined by the physical properties as the plant is deep rooted and nitrogen supply occupies a secondary place. Soils in Egypt are usually well enough supplied naturally with nitrogen to satisfy the main needs of the plant. Nitrogenous fertilisers act on the whole by increasing the number of late bolls and tend to be more effective where the level of yield due to favourable physical conditions is already high. Further illustration of this is afforded by differences in response to phosphatic manuring. When the four cotton varieties are arranged in ascending order of average yield—Sakel, Giza 7, Giza 12 and Ashmouni—they are also arranged in descending order for depth of root system. Sakel, therefore, reacts much more to adverse physical conditions in the sub-soil than the others and its average yield is low because it is grown mainly in the north of the Delta where the proportion of poor soils is high. Conditions in poor soils are better in surface layers and so Giza 7 and Giza 12 succeed better in these circumstances, because they develop lateral root systems in the surface layers. Nitrogenous manuring is more important with Ashmouni than Sakel, with the other varieties intermediate, and phosphatic manuring tends to be more important with Sakel and Giza 7. A graph summarises cotton experiments of the past seven years and shows that yield is determined by the physical properties of the soil. C.

Egyptian Cotton Plant: Weather Effects. W. L. Balls. *Rept. 18th Int. Cotton Congress*, 1938, 226-233; Discussion, p. 70.

An account is given of the weather in Egypt and its effects on the cotton crop. The invariable and predictable crop is in large measure due to the

constancy of the weather and the mechanical superiority of the hair to the pronounced development of the growth ring structure, due to intense sunshine and water shortage in the middle of the day. Planting should not be done until the soil has warmed sufficiently. The temperature could be taken at a large number of observation points, or taken as that of the Nile water in its turbulent flow through the Delta Barrage, or as the temperature of tap water that has passed through long distances underground at depths similar to those occupied by the roots. The difference in soil temperature from point to point has an accumulative effect on the plant, the final result being that a 3° C. temperature difference causes the warmer plant to obtain twice as much water and mineral food from the soil in a very few days after planting. The effects of soil weather also react on the insect pests both directly and through the plants. Humidity variations have direct effects on the growing plant, and morning fog prevents cotton-picking. The drift of humidity within the Delta when attack by the leaf-eating cotton-worm is severe, causes losses in grade and strength to be greater in Sakel and Giza 7 than in the other varieties. Even the variations of barometric pressure have some direct effect on cotton growing, the rise and fall of the barometer causing the underground water level to move through a centimetre or two, thus affecting the supply of water to the roots in the soil above the water-table. C.

Egyptian Cotton Varieties: Production and Control. J. Templeton. *Rept. 18th Int. Cotton Congress*, 1938, 175-177; Discussion, p. 50.

The development of new varieties of Egyptian cotton from promising single plants and by deliberate crossing is described. Giza 7 is an example of a variety produced by the first method and Giza 12 (Sakel × Ashmouni) and Giza 26 (Sakel × Sakha 10) examples of the second method. The purity of a variety is controlled by the Botanical Section at Giza by the following procedure. The purest (nucleolus) seed is grown in a wire cage, the meshes of which are sufficiently small to prevent the access of pollinating insects. The resulting seed is sown on an area of about 10 feddans (acres) on a Government farm or on the State Domains, in the centre of a field which is already growing the variety in a slightly impure state. The seed from the ten feddan area is then given to large cultivators under a contract which binds them to return the resulting seed to the Ministry of Agriculture, who distribute it to smaller cultivators. The whole of this seed-renewal operation is gone through every year with each variety of Government origin in commercial cultivation, making up 96 per cent. of the Egyptian crop. The purity of the variety is preserved, within limits, by the Seed Control Law of 1926, in which it is decreed that samples of all seed to be sold for sowing must first be submitted to the Ministry of Agriculture and only seed that passes the standard of purity set by the Botanical Section may be used for sowing. No control is exercised by the Ministry of Agriculture or the Government on the price or the area of any cotton grown in Egypt. C.

Egyptian Irrigation Works: Development. H. E. Hussein Sirry Pasha. *Rept. 18th Int. Cotton Congress*, 1938, 197-200; Discussion, p. 62.

A historical review is given of the development of irrigation works in Egypt and the consequent increase in land available for cotton growing. The steady increase in area under perennial irrigation and the concurrent decline in area under the basin system in Upper Egypt is discussed. C.

Egyptian State Domains Administration: Activity. Osman Abaza Bey. *Rept. 18th Int. Cotton Congress*, 1938, 203-7; Discussion, pp. 63-5.

The organisation of the State Domains farms is reviewed under the headings—(1) Objects, (2) Improvement of grade of cotton, (3) Ginning, (4) Varieties grown, (5) Quantities of seed produced, (6) Land reclamation, and (7) Improvement of picking. C.

Sakel Cotton: Deterioration and Substitution. H. E. Fouad Abaza Pasha. *Rept. 18th Int. Cotton Congress*, 1938, 242-244; Discussion, 74-81.

The production of Sakel has declined because it has been replaced by cheaper and poorer varieties such as Giza 7 and Ashmouni. The present so-called substitutes of Sakel, namely, Sakha 4, Maarad and Giza 26 have not been able to save the situation of the long staples in Egypt on account of the yield and price factors, although they are equal or superior in staple to the original Sakel and account for only 5 per cent. of Egypt's 1937 crop. A true Sakel substitute therefore

should not only possess Sakel staple but also have a yield high enough to compensate the grower at the present level of prices, and the immediate problem of the Ministry of Agriculture and Agricultural Institutions is the finding of a new cotton, possessing the chief characteristics of Sakel without its deficiencies. There is the possibility that in a year or two a breakdown in the supply of long-staple cottons may occur. The author is of the opinion that Egypt should never let long-staple cotton disappear from her list of varieties. Two diagrams show (1) the percentage of cotton production in Egypt according to staple length and (2) the effect of the price on the decline of long staple production. C.

Wilt-resistant Egyptian Cottons: Development. Tewfik Fahmy. *Rept. 18th Int. Cotton Congress*, 1938, 190-1; Discussion, p. 58.

The first important cotton in Egypt was a short-staple wilt-immune Ashmouni. The superior strain Mit Afifi appeared in 1887, followed by Sakel in 1911. The decline of the latter from about 1,300,000 acres in 1922 to 161,000 in 1937 was due to wilt, the drop in cotton prices during the slump, and the introduction of Giza 7, a wilt-immune strain of excellent yield but intermediate quality. Sakha 4 is a wilt-immune strain obtained from Sakel and of the same high quality but of too low a yield. Giza 29 is a good example of the combination of quality, capacity and immunity and in three years it is expected to have this immune strain isolated. Other immune strains are Giza 27 and Giza 32C, which are being experimented upon by the Botanical and Mycological Sections of the Ministry of Agriculture. C.

Cotton Insect Pests: Control in Egypt. Ibrahim Bishara Effendi. *Rept. 18th Int. Cotton Congress*, 1938, 215-220; Discussion, 66-68.

The major cotton insect pests in Egypt are the cotton worm, and spiny and pink boll worms. The former is controlled chiefly by hand picking, the authorities helping by (1) loaning money to farmers for picking, (2) transportation of labourers at greatly reduced rates, (3) organisation of work on a co-operative system on small holdings, (4) propaganda, and (5) strict laws for dealing with negligence. The boll-worms are most effectively controlled by destruction during the non-cotton season by (1) early removal of cotton sticks to stop breeding and increase the close season of unavailable food, (2) hot-air treatment of seeds to kill larvæ, (3) destruction of refuse bolls on cotton sticks. Other indirect methods, aiming at partial control are (4) early sowing, by the sand-and-dibble method, and close spacing, (5) development of quick-maturing and partially resistant varieties, (6) use of contact insecticides, and (7) utilisation of natural enemies. C.

Cotton Insect Pests: Control in Egypt by Natural Enemies. M. Kamal. *Rept. 18th Int. Cotton Congress*, 1938, 220-225; Discussion, p. 69.

Biological control of the major cotton insect pests is effected by (1) climate, (2) insectivorous animals, parasites and predators and (3) insect diseases, including fungi, bacteria and protozoa. The cotton-worm in Egypt has few natural enemies and therefore various parasites have been transported for field trials by air from South Africa, the East Indies and the Hawaiian Islands. Bacterial control is also under investigation. C.

Cotton Leaf-worm: Control. M. S. El Zoheiry. *Rept. 18th Int. Cotton Congress*, 1938, 234-241; Discussion, 70-71.

An account is given of the effects of dusting and spraying the cotton plant with ten groups of insecticides, mostly arsenical, for combating the leaf-worm, *Prodenia litura*. This treatment induced attacks by aphids due, apparently, to the increased intensity of light reflected from the treated surfaces. To eliminate the danger of heavy and bad dusting and spraying, motor sprayers and dusters were imported. Workmen were trained to dusting and spraying with geared hand-dusters and sprayers fitted with automatic agitators. The fact that arsenical lime-sulphur dust and spray were effective and did not cause aphis infestation gives reason to believe that the problem will be successfully solved with chemicals. This is also the cheapest insecticide tested and in bad cotton-worm years not more than three applications are required. The total cost is about half of that for hand picking. C.

Egyptian Cotton: Ginning and Baling. A. Fikry Abaza Bey. *Rept. 18th Int. Cotton Congress*, 1938, 303-306; Discussion, 102-105.

A brief historical account is given of cotton ginning in Egypt. The number of gins working in the country from 1932 to 1937 and the average results on the

different Egyptian cottons are tabulated. A list of the laws enforced on the ginneries gives an idea of the control practised in the factories. The Government controls mixing of varieties and fumigation of seeds to combat the pink boll-worm. Suggestions are made that dirty masses of cotton should be sorted out before ginning, that the girls working in the ginneries should wear white cotton clothing, and that the string used for tying cotton bales should be made of cotton instead of sisal. C.

Egyptian Cotton Ginnery: Description. *Rept. 18th Int. Cotton Congress*, 1938, 161-164.

An account is given of the machinery and procedure at the modern ginnery at Minieh, Upper Egypt. The freshly ginned cotton contains about 5-6¾ per cent. of moisture and is sprayed before baling. The bales are pressed hydraulically to a net weight of 920 lb. and a density of 13 lb. per cub. ft. The moisture content is about 8·2-9·1 per cent. C.

Cotton Futures Market: Control of Speculation. Youssef Nahas Bey. *Rept. 18th Int. Cotton Congress*, 1938, 309-313; Discussion, 95-100.

Reasons are given and discussed for excluding outside speculators from the Futures Exchange. It is objected that the proposed restrictions would tend to make the market narrower, a result which leads to bigger price fluctuations. What is required is the prevention of the use of the futures market for purely gambling purposes and it is for each country to pass laws which suits its purposes with that end in view. C.

Egyptian Cotton: New Uses. A. S. Pearse. *Rept. 18th Int. Cotton Congress*, 1938, 266-274; Discussion, 87-91.

Indications are given of the possibility of increasing the consumption of cotton, and especially Egyptian cotton, by its use in the construction of (1) motor tyres, (2) roads, (3) canal linings, (4) roofs, (5) cart tyres, (6) cotton bagging for cotton bales and fruit, (7) cotton clothing for pickers to prevent admixture of foreign matter, for hotel staffs and vendors of food as a hygienic measure, and for minor purposes. The appointment of a director of cotton propaganda by the Egyptian Government is suggested. C.

Egyptian Cotton: Production, 1911-36. S. Pinto. *Rept. 18th Int. Cotton Congress*, 1938, 352-360.

A general review is given of the Egyptian cotton trade in the last 25 years, divided into the periods 1912-14, 1914-18, 1918-22 and 1922-37. A list is given of the acreage under cotton in Egypt, harvest, yield per acre and prices of principal varieties (Sakel and Ashmouni) from 1911 to 1936. C.

Egyptian Cotton: Propaganda for Increased Sale. J. I. Craig. *Rept. 18th Int. Cotton Congress*, 1938, 261-265; Discussion, 186-187.

To benefit cotton growers in Egypt it is suggested that the demand be increased through propaganda or the use of a registered trade mark to be attached to goods containing a certain minimum of Egyptian cotton. A campaign is favoured including (1) advertising in the press, (2) regular displays of Egyptian cotton goods, including mannequin parades and museum exhibits and (3) an "Egyptain cotton week". C.

Flax Cultivation in Uruguay: Influence of Research and Breeding. A. Boerger. *Faserforchung*, 1938, **13**, 185-213.

The possibility is discussed of establishing a linen industry based on the large quantities of flax straw derived from oil flax, which are available in the La Plata district. An experimental factory in Argentine for manufacture of coarse yarns and fabrics, in which the straw is not retted, but chemically treated, is described. Research work has been carried on over a long period on agricultural and botanical questions, and useful results have been obtained regarding the time and density of sowing and the use of fertilisers. Work on plant breeding has included comparative tests of different varieties over long periods, cross-breeding to produce varieties intermediate between oil-flax and fibre-flax, and the development of flax types which can be repeatedly grown on the same ground at short intervals, thus dispensing with the customary period of 6-7 years rest between repetitions of the same crop. The practical result of this work is a substantial increase in the quantities of flax grown for seed in Uruguay, and this has been further promoted by State asistance in several directions, so that linseed is now an important export from the country. L.

South American Flax Journey. *Irish Text. J.*, 1938, 4, No. 12, 5.

The impressions of a Belgian textile expert during a journey in Argentina. Aware of the threatened flax shortage due to the drastic curtailment of Soviet fibre experts he investigated the possibility of the production of fibre flax. Each year two million tons of flax straw are wasted in Argentina, where the plant is sown solely for linseed. Many attempts have been made to render flax fibre production a paying proposition without much success, but it is now thought to be possible with the advent of mechanical pullers and mechanical scutching machinery. Flax grown in this country is said to resemble Dutch flax. In Uruguay, over 1,000 flax seed trials have been carried out and provided the seed is sown thickly flax of good quality can be produced. Some bales of South American straw have been sent to Courtrai for experimental decortication. L.

Facing Flax Facts. *Irish Text. J.*, 1938, 4, No. 12, 1.

Refers to competition in the linen industry and in particular to totalitarian trading, when prices well above world parity are being paid for raw material on a barter basis. Mention is made of the distribution of flax in Europe in 1937, and the need for a determined effort to build up flax production within the Empire. Pioneer work has already been done by the Irish Flax Development Committee and the Linen Industry Research Association in this respect. L.

Modern Methods of Flax Production. T. J. Crouch. *Irish Text. J.*, 1938, 4, No. 11, 4-5.

Refers to the tremendous headway which has been made in Belgium this year in modernising flax production. The following points are discussed—

(1) Methods of sowing flax seed for yield and quality of fibre.
(2) The Soenens patent flax puller for economical handling of the straw.
(3) The merits of the tank system of retting.
(4) The Vansteenkiste mechanical scutcher. L.

Pulping and Papermaking Properties of Seed Flax Straw. E. R. Schafer and C. E. Curran. *U.S. Forest Products Lab. Mimeographed Rept. R* 1159, 28 pp. 1938, (through *Chem. Abs.*, 1938, **32**, 9491).

A summary of experiments on the pulping of seed flax straw covering the past 15 years, most of which have been previously published (cf. Rue, Wells and Schafer, *Chemical Abstracts* **17**, 3099; **18**, 3715; Rue and Monsson, *Chemical Abstracts* **19**, 3591; Wells and Schafer, *Chemical Abstracts* **19**, 1947; Bray and Peterson, *Chemical Abstracts*, **21**, 1351; **22**, 1681; Schafer and Peterson, *Chemical Abstracts* **22**, 1681, 4808). Mechanical methods for separating bast and shive fibres, methods of pulping and the conversion of the flax pulps into various grades of papers are reported. Also reported are the possibilities of by-products, as flax wax, and the economics of waste flax straw utilisation for pulp, which appears questionable. L.

(D)—Artificial

Cotton Linters: Production. H. B. Boger. *Cotton Trade J., Internat. Edn.*, 1938, 160-3.

A general account is given of the cutting, classification and grading, and consumption of linters in various countries. American production in 1936-37 reached 1,131,295 bales, of which 270,400 were exported. Germany took 86,271 bales, France 52,186, Great Britain 46,644, the Netherlands 36,643, Japan 22,311, and Italy 13,250. C.

Cotton Linters: U.S. Production, Consumption, Exports and Imports. *Rayon Organon*, 1938, 9, 150.

Statistics are given for the seasons 1933-34 to 1937-38. The 1937-38 season produced a new record total of 1,471,920 running bales which compares with a previous high record of 1,300,163 in 1916. For the three seasons included between 1933 and 1936, domestic consumption plus exports exceeded domestic production plus imports. The deficits were balanced by withdrawals from stock. Domestic production and imports exceeded consumption for the 1936-37 and 1937-38 seasons. A carry-over of 502,700 bales is recorded for the 1937-38 season, this being equivalent to 70 per cent. of the total domestic consumption for the 1937-38 season. This large carry-over will tend to keep the price of linters at low levels for some time, unless the demand in the current season substantially exceeds that in 1937-38. The consumption of cotton linters in the United States

during the 1937-38 season was the smallest quantity used during any of the past five seasons. Exports of cotton linters continued to increase and in 1937-38 were slightly larger than in 1936-37. Germany, the United Kingdom, France and Italy were the chief importers of cotton linters from the United States, although considerable quantities of linters were also shipped to Japan, the Netherlands and Canada during the 1937-38 season. C.

Hardwood Pulps: Preparation and Use for Viscose. C. Carpenter and F. McCall. *Rayon Textile Monthly*, 1938, **19**, 538-539, 618-620.

The principal pulping hardwoods of the South-eastern States (black gum, red gum, cottonwood, etc.) were cooked by the sulphite process to yields of 40 to 43 per cent. The pulps were bleached in two and three stages with 1 to 2 per cent. total chlorine. The bleached pulps were characterised by alpha-cellulose contents of 88 to 91 per cent., cuprammonium viscosities 20 to 40, copper numbers 2·3 to 3·0, and brightness values 82 to 87. Each bleached pulp was converted into viscose and spun. Tables showing the characteristics of the woods, pulps, viscoses and yarns are given. For comparison, commercial pulps were processed under similar conditions. The hardwoods possessed the advantages of easy shredding and rapid ageing. Certain disadvantages were, however, noted in the behaviour of the hardwood soda-celluloses during shredding, in the clarity of the viscose solutions and in the colour of certain yarns. Yarns from cottonwood pulps had an unusual metallic sheen. The yarn strengths of the hardwood pulp products were equivalent to those of yarns obtained from the commercial pulps processed at the same time. C

"Fibro" Staple Fibre: Developments. H. Ashton. *Textile Weekly*, 1938, **22**, 624.

A report of a lecture, giving brief notes on the following new types of "Fibro". (1) A strong staple, filament denier 1·25, capable of being spun from 80's to 120's. (2) Acetate, $1\frac{1}{16}$ in. staple, 2·0 denier, spinning up to 24's; difficulties due to static electricity have been overcome. (3) Casein, in 4·0 to 5·0 denier and 2·5 denier. (4) Coloured "Fibro"; three colours for woollen and worsted spinning, 4·5 denier; five colours for cotton spinning, $1\frac{7}{16}$ in. staple, 1·5 denier. Wool-dyeing and water-repellent "Fibro" are in the later stages of experimental development. C.

"Fibre 66" and "Vinyon" Filaments: Properties. *Textile World*, 1938, 88, No. 11, 55-56.

The development of two new synthetic fibres, Fibre 66 and Vinyon, and the possibility of the displacement of silk from the hosiery industry by these fibres, owing to their high elasticity and strength, are discussed. Due mainly to the replacement of silk by rayon in the manufacture of woven fabrics, consumption of raw silk in the United States dropped from 80 million pounds in 1929 to 54 million pounds in 1937, but the production of silk hosiery increased. The hosiery industry as a whole consumed 65 per cent. of all the raw silk used in the United States in 1937, whilst in 1929 the knit goods industry as a whole consumed less than 15 per cent. of the total. The resistance of silk to the competition of rayon in the hosiery industry is due principally to its greater elasticity and strength. Fibre 66 is one of a series of polyamide fibres which are characterised by high tenacity, high orientation, lack of sensitivity toward changing humidity, good elastic recovery, resistance to solvents and chemical agents, and good ageing characteristics in air. It is claimed that most of the fibres have strengths ranging from 3 to 7 grams per denier, and that it is possible to tie hard knots in polyamide fibres without decreasing their strength. In general, wet strength is at least 85 per cent. of dry strength. It is possible to obtain exceedingly fine polyamide filaments (0·2 denier or less). The fibres are said to have a strong affinity for dyes and to be capable of being dyed rapidly, permanently and directly with the dyes ordinarily used for silk and wool. When a fabric knitted from a 123-denier, 24-filament polyamide yarn of 4 twists per inch was compared with a similar fabric knitted from 95-denier, 7-thread, 10-turn silk, the polyamide fabric was found to have far better elastic recovery than the silk fabric, particularly under conditions of high stretch, high humidity and long periods of time. Though no official information on Vinyon has been released, it appears to be a vinyl product. High elasticity and elongation at break, high tensile

strength as compared with rayon, resistance to water, acids and alkalis, and good dielectric characteristics are claimed for this fibre. Vinyon is thermoplastic, fusing at elevated temperatures. The fibre can be produced in either high-lustre or low lustre types, and it can be dyed with selected dyes and by special processes. Samples of Vinyon obtained some time ago showed a tendency to develop static electricity and to hold the charge, making it necessary to wet the material or to maintain a high relative humidity in order to run it on the usual types of textile machinery. Vinyon is said to have particularly good knitting qualities. C.

"Vistra" Staple Fibre: Production and Qualities. H. Van Beek. *Rept. 18th Int. Cotton Congress*, 1938, 254-260; Discussion, p. 91.

A history of the production of Vistra staple fibre is given, the modern process is briefly described, and the properties and utilisation of the newer varieties are reviewed. The thesis is maintained that staple fibre is a "friend to cotton". C.

Fibre-like Merino Wool made from Casein. S. P. Gould and E. O. Whittier. *Milk Plant Monthly*, 1938, **27**, No. 9, pp. 46-47 (through *Chem. Abs.*, 1938, **32**, 8787).

To make the fibre, casein is softened in water and dissolved in alkali. It then becomes a thick sticky mass which is worked into the proper consistency by ageing, addition of modifying agents and dilution. The mass is then forced through multiple spinnerets of the kind used in making rayon. The fibres are finally separated and hardened in an acid bath containing formaldehyde and modifiers. The fibre has a chemical composition almost identical with that of wool except for a lower sulphur content. It is faintly yellow in colour and resembles the best grade of thoroughly washed and carded Merino wool. The casein fibre has the characteristic fine kink of natural wool. Because the fibres are smooth, rather than scaly like natural wool, they cannot be felted. For the same reason the synthetic fibre does not shrink as much as wool. By varying the acid bath in manufacture, the fibre can be made either soft or harsh to the touch. The soft fibres are not as strong as the harsh fibres but can be made into fabric that will not irritate sensitive skins that cannot tolerate knitted wool. W.

Patents

Wool-like Staple Fibre Yarns: Production. J. F. Hans (Kammgarnspinnerei Stöhr & Co. A.-G.). B.P. 490,460 of 11/1/1937.

A rayon staple fibre yarn simulating a wool yarn is made from fibres of different lengths obtained by cutting across a band of continuous filaments with oblique cuts, or with curved cuts, in alternately opposite directions. The filaments may be of different denier and of different varieties of rayon to which natural fibres may be added. The cuts in the band may be arranged so as to obtain a mixture of fibres corresponding to the staple diagram of the woollen yarn it is desired to simulate. C.

Cuprammonium Rayon: Spinning. W. W. Triggs (for J.P. Bemberg A.-G.). B.P. 491,038 of 31/3/1937.

In the manufacture of rayon threads from cuprammonium cellulose solutions by the funnel stretch-spinning method, several separately-spun thread bundles, each having a fine total titre are before acidification but after leaving the spinning funnel, and while still tacky, guided together to form a composite thread. Suitable apparatus for carrying out the process comprises a large number of small funnels each producing threads of 10-25 denier and arranged in two rows offset with respect to one another. The arrangement permits higher spinning speeds and greater uniformity in the product. The guiding together of the small filament bundles may be achieved with the aid of narrow thread guides which may be V-shaped and which exert a certain degree of pressure on the threads. The composite threads then pass through the acidifiers, over thread guides and on to a reel. They have a multi-lobular cross-section. C.

Polyamide Filaments: Cold-drawing. E. I. Du Pont de Nemours & Co. B.P. 491,111 of 20/7/1937 (Conv. 20/7/1936).

Artificial filaments, films and like materials made of polymeric amides of the kind described in B.P. 461,237 are treated with water, isobutanol or other non-solvent containing hydroxyl groups, and are then subjected to cold-drawing

while still wet. The water or other non-solvent may be in liquid or vapour form. The preferred polymeric amides are those obtained by condensation of diamines of the formula $NH_2(CH_2)_xNH_2$ with dicarboxylic acids of the formula $HOOC(CH_2)_yCOOH$ where x is at least 4 and y at least 3. Polyamides obtained from hexamethylene diamine and adipic acid or from decamethylene diamine and adipic acid may be employed. Filaments or films may be obtained directly from a molten mass of the polymeric amides or by extrusion of a solution of them in a solvent into a coagulating bath or heated chamber. Cold-drawing is effected at ordinary temperature or at a raised temperature provided that the material is below its melting point and in the solid state. The filaments may be spun and cold-drawn in a moist atmosphere or they may be sprinkled with water before being cold-drawn. Thick filaments such as those used as bristles, horsehair or mohair substitutes are preferably soaked in hot water prior to the drawing operation. Water or other hydroxyl non-solvent may be added to the spinning solution which may contain phenol as the solvent. If the coagulation bath contains water, isobutanol, or like non-solvent, the cold-drawing may be carried out in this bath but it is preferably effected outside the bath. In spinning polyamides from a phenol or acid solution, aqueous alkaline coagulation baths such as dilute solutions of caustic soda or sodium sulphide may be used. C.

Cellulose Derivatives: Treatment to Reduce Corrosive Properties. British Celanese Ltd. B.P. 491,119 of 22/9/1937 (Conv. 30/9/1936).

The corrosive properties of organic derivatives of cellulose are reduced by treating the finely divided solid derivatives with organic compounds of basic reaction which are free from hydroxy groups, in the case of cellulose esters, under conditions such that no substantial saponification of the esters is effected. Suitable basic compounds are aliphatic amines, diamines and cyclic amines. The process may be applied to organic esters of cellulose in the finely divided condition in which they are precipitated from the ripening solution or in which they are obtained after having been formed by a process in which solution does not occur, or in the condition in which they are obtained after stabilisation. The basic compound may be used in solution of 0·1 to 0·5 per cent. strength, and in amount equal to 0·03 to 1 per cent. of the weight of the cellulose derivative. Temperatures of 50 to 100° C. may be employed. The cellulose derivatives may be treated with chlorine bleaching agents prior to or subsequent to the treatment with the organic base. C.

Cellulose Acetate Solutions: Preparation. Dr. A. Wacker Ges. für Elektrochemische Industrie Ges. B.P. 491,123 of 12/10/1937 (Conv. 27/10/1936).

Concentrated solutions of stable, partially saponified cellulose acetates of high viscosity are prepared by commencing acetylation of cellulose by means of acetic anhydride at low temperature in the presence of a small quantity of acetic acid or other solvent and concentrated sulphuric acid, continuing at a similar temperature in the presence of an acid sulphate, completing at a raised temperature after addition of an acid such as nitric, phosphoric, or hydrochloric acid, or acetyl chloride and subjecting the triacetate at a raised temperature to the usual partial saponification by means of water, there being added for stabilising the product a salt which reacts with sulphuric acid to form a sulphate which is insoluble in concentrated acetic acid but soluble in water or dilute acetic acid. C.

Cellulose Derivative Spinning and Waterproofing Compositions. Standard Oil Development Co. B.P. 491,199 of 11/2/1938 (Conv. 15/5/1937).

Cellulose compositions comprise a cellulose ether or organic ester, and not more than 50 per cent., usually 0·1-20 per cent., of a substantially saturated linear aliphatic iso-olefine polymer having a molecular weight above 800, usually 40,000-200,000. Polymers of diolefines and isodiolefines and their hydrogenated products are specifically excluded. Polymers specified are polyisobutylene and polyisopentene. Cellulose compounds specified are the acetate, nitrate, oleate, stearate, naphthenate, acetobutyrate, propionate and laurate, and benzyl and ethyl cellulose. The cellulose compound and the polymer may be dissolved in a mutual solvent such as carbon tetrachloride, tetrachlorethane, etc., and the solution may be spun or used for example in the production of films, lacquers, moulded articles, or laminated glass, or for waterproofing textiles, cellulose foil, etc. Dyes, resins, etc., may be added to the solution. C.

Variable-denier Flat Filaments: Production. W. I. Taylor and L. B. Gibbins. B.P. 491,259 of 19/3/1937.

Artificial filaments, yarns and similar materials are produced and treated so as to have in addition to a flat cross-section, a denier which varies along their length. They may also be subjected to a crinkling treatment. The variation in denier may be obtained by stretching the materials to a varying extent in a regular or irregular manner during the course of their production or in an after-treatment operation. The production of filaments of flat cross-section may be effected by use of a spinning solution containing a lower proportion of cellulose derivative than that required for filaments of bulbous cross-section, e.g. less than 24 per cent. of cellulose acetate in acetone. By incorporating plasticisers such as paradichlorobenzene in a cellulose organic derivative solution, filaments of flat cross-section may be obtained. Crinkling may be effected by treating the filaments with hot aqueous media such as hot water, wet steam, or hot solutions of soap, sulphonated oils, sulphonated higher fatty acids or alcohols, or aliphatic sulphonic acids. The lustre of the materials may be altered during the crinkling treatment. Sugars or salts may be added to the aqueous liquor to preserve the lustre during the crinkling operation. The treatment with hot aqueous media may be combined with other crinkling treatments, e.g. yarns may be twisted, the twist set while the yarn is travelling, and the yarns then untwisted. The process may be applied to continuous or short length filaments. Filaments may be cut between an operation for crinkling by setting twist and removing it, and a crinkling treatment with hot aqueous media. Two or more yarns of low twist may be twisted together to a high degree, the high twist set, and the doubled yarn untwisted and left with a small degree of reverse doubling twist. The flat filaments may be of cellulose acetate or other cellulose ester or ether. Yarns may contain also other fibres or filaments of silk, wool, cotton or regenerated cellulose. Staple fibre yarn may be doubled with a continuous filament yarn. C.

Alkali-soluble Cellulose Ethers: Improvement by Heating. L. Lilienfeld. B.P. 491,488 of 2/12/1936.

Cellulose ethers which are soluble in caustic soda solution but insoluble or scarcely soluble in water, are improved as regards their solubility and their filtering and spinning capacities, by exposing the isolated and dried ethers to a temperature exceeding 40° C., e.g. to a temperature between 40 and 250° C. The treatment of cellulose ethers which are soluble in caustic soda solution only on refrigerating the mixture is included. Suitable cellulose ethers are those containing not more than one ether group per one or even ten or more cellulose units. The action of the heating on the cellulose ether may be accelerated or intensified by the addition of a thorium salt, a cerium salt, an alcohol, or an inorganic or organic nitrogen base. The products may be further improved by treating them with an acid or acid salt, e.g. hydrochloric or sulphuric acid of 0·5 to 3 per cent. strength at room temperature. The cellulose ethers may be worked up into products such as filaments, films, finishes, coatings, etc., or may be converted to xanthates. C.

Cellulose: Pre-treatment for Esterification. Gevaert Photo-producten N.V. B.P. 491,583 of 30/1/1936 (Conv. 3/12/1935).

Cellulose is treated prior to esterification with a liquid which is capable of swelling cellulose and of combining chemically with the water in the cellulose. The liquid may consist of a single component or a mixture of components, of which at least one will swell the cellulose and at least one will combine chemically with the water. In a modification, the cellulose is treated first with a swelling agent miscible with water, freed as completely as possible from the swelling agent, and then treated with the agent for combining with the water. In examples, cellulose is treated with (1) acetic anhydride, (2) acetic acid and acetic anhydride, (3) benzene, acetic anhydride and butyric anhydride, (4) phosphoric acid anhydride, acetic acid and benzene, and (5) acetic acid, followed by treatment with benzene and acetic anhydride. C.

Wet-spinning Apparatus. Thuringische Zellwolle A.-G. B.P. 491,774 of 29/3/1938 (Conv. 20/4/1937).

Spinning apparatus for spinning viscose, cuprammonium, or any other cellulosic solution, comprising a spinning cylinder and a separate spinning jet head which is adapted to close one end of the cylinder, is characterised by the provision of means whereby, during the spinning operation, the pressure of the solution

being extruded is utilised to press the spinning head tightly against the cylinder. For this purpose there is disposed within the jet head a plate containing one or more perforations and the resistance this offers to the flow of the spinning solution causes the jet head to be forced downwards till it seals the upper end of the cylinder by means of a flange and rubber gasket. C.

Viscose Rayon: Spinning. American Viscose Corporation. B.P. 492,418 of 8/9/1937.

Viscose rayon of improved tensile strength is made by spinning a viscose solution into a spinning bath containing 6·5-12 per cent. sulphuric acid, 4-10 per cent. zinc sulphate, and 0·1-1 per cent. nickel or cobalt sulphate, and preferably containing 14-26 per cent. sodium sulphate with or without a small quantity of glucose. The freshly spun filaments may be stretched 40-100 per cent. while subjecting them to the action of steam or water heated to 60-100° C. Viscose prepared from cotton pulp or wood pulp purified to a high α-cellulose content is preferably employed. C.

Cellulose Derivative Materials: Lubricating. British Celanese Ltd. B.P. 492,472 of 23/6/1937 (Conv. 30/6/1936).

Textile materials of organic derivatives of cellulose are treated with a lubricating composition comprising a lubricating oil and a sulphonated naphthene and/or a salt thereof. The lubricating oil may be a mineral, vegetable, sulphonated or oxidised vegetable oil or a mixture thereof, e.g. mineral oil blended with olive, castor, teaseed, cottonseed, oxidised olive, oxidised castor, or sulphonated castor oil. The composition may contain a fugitive dye to identify the material to which it is applied. A small amount of an amine soap such as triethanolamine oleate may be added to the composition as an emulsifying agent. The organic derivatives of cellulose may be cellulose acetate, formate, propionate or butyrate, or methyl, ethyl or benzyl cellulose, and may be in the form of yarns, filaments or fibres. The compositions may be applied to the materials in the course of their production, or may be applied before, during or after an operation in which the materials are treated, e.g. by means of a wick, roller or disc, and may be incorporated in solutions from which the materials are spun by dry or wet spinning processes. The lubricated materials may be treated with a conditioning dressing containing an oil, such as olive, castor, teaseed or cottonseed oil, oxidised vegetable oils or mixtures thereof, and a solvent or latent solvent for the cellulose derivative, e.g. a formal diacetone alcohol, benzyl alcohol or ethyl-α-oxy-*iso*butyrate. C.

Rayon Fibres: Curling. Chemische Fabrik J. A. Benckiser Ges., and A. Volz. B.P. 492,570 of 24/11/1937 (Conv. 24/11/1936).

Rayon fibres of cellulose or esterified cellulose are curled by treating with phosphoric acids containing less water of constitution than orthophosphoric acid, e.g. meta-, pyro- or poly-phosphoric acids or their alkali salts. Other material may be added to the bath, including cleansing, wetting, softening and matting agents. In an example, viscose or esterified cellulose fibres are treated in a bath containing $Na_5P_3O_{10}$, $(NaPO_3)_6$ and $Na_4P_2O_7$ at about 90° C., rinsed, treated with soap or an emulsified oil if desired, and finally dried. C.

Cellulose Derivative Filaments: Treatment with Compressed Fluids. R. W. Moncrieff and J. Gooddy. B.P. 492,613 of 25/3/1937.

Filaments, foils and similar materials, particularly those made of cellulose acetate and other organic derivatives of cellulose, are treated with fluids under superatmospheric pressure, while travelling through a substantially closed apparatus, the filaments, etc., entering the treatment zone through a body of inert liquid under superatmospheric pressure contained inside the apparatus. One form of the apparatus consists of a single chamber, the floor of which is covered with inert liquid, the filaments, etc., passing upwards through the inert liquid into the treatment zone. The filaments may be subjected to mechanical stretching simultaneously with their treatment with compressed fluid. The inert liquid may be water, mercury, or an organic liquid, whilst the treatment fluid may be a stretch-assisting agent, such as steam or hot water. If required, the filaments, etc., may pass through inert liquid after leaving the treatment zone and before emerging into the atmopshere. Alternatively, the filaments may be sprayed with cold water immediately on leaving the treatment zone. C.

Zein Filaments: Production. J. E. Pollak (International Patents Development Co.). B.P. 492,653, and 492,657 of 18/3/1937.

(1) Films and filaments are made from zein solutions containing a reactive aldehyde and an aromatic aldehyde and an aromatic alkylated sulphonamide plasticiser. (2) An ester of an hydroxy carboxylic acid is used as plasticiser in the manufacture of films, sheets or artificial fibres from zein and a reactive aldehyde. Fillers, dyes and the like may be added. C.

Casein Threads: Production. Courtaulds Ltd. (London) and W. H. Farrant. B.P. 494,184 of 8/6/1937: 21/10/1938.

A process for the production of thread comprises extruding a solution of casein into a coagulant, collecting the resulting plastic thread in a loose non-compact mass and treating it in this form with a hardening agent until substantial hardening and shrinking of the thread has been effected and then winding the thread into a compact mass or cutting it into short lengths. According to one embodiment the plastic thread after leaving the coagulating bath, and, if desired, after receiving any intermediate treatment is led over a rotating godet and allowed to fall into a vessel, not at the centre but near to the perimeter thereof, which vessel contains a liquid having a hardening action on casein and is being rotated about a vertical axis at a lower peripheral speed than the godet. The thread is allowed to remain immersed in the hardening liquid for a time sufficient to ensure substantial hardening and shrinking, and is thereafter collected by means of a centrifugal box, a reel, bobbin or other device, or led to a cutting device. The casein may be dissolved in aqueous ammonia or sodium hydroxide and the coagulating bath may contain a mineral acid, e.g. sulphuric acid, or an organic acid, e.g. formic acid, and a salt or salts, e.g. sodium sulphate and/or magnesium sulphate. Suitable hardening agents are aqueous solutions of formaldehyde or aluminium sulphate. C.

Low-viscosity Hydrolysed Cellulose Esters: Production. Kodak Ltd. (London). B.P. 495,056 of 7/5/1937: 7/11/1938.

The acetone viscosity of a partially hydrolysed organic cellulose ester is lowered at least 25 per cent. by removing substantially all of the ash content by washing with at least four changes of pure water, preferably hot water. A yarn may be prepared by dissolving in a volatile organic solvent a partially hydrolysed lower fatty acid ester of cellulose treated in this way, extruding the solution and removing the solvent. C.

Vegetable Protein Rayon Filaments: Treatment with Aliphatic Acid Anhydrides and Ketenes. D. Traill and Imperial Chemical Industries Ltd. (London). B.P. 495,332 of 10/5/1937: 10/11/1938.

Filaments, films and other shaped articles made from protein solutions by coagulation and treatment with a hardening agent especially formaldehyde or one of its near conversion products, are improved in their resistance to hot acids and/or in their water-repellent properties by subjecting them for a period of time to the action of a volatile anhydride or ketene of an aliphatic acid. The treatment may be conducted at reduced, atmospheric or raised temperatures, and the anhydride or ketene may be employed in vapour or liquid form or in solution. The preferred anhydride or ketene is the acetic acid derivative and the invention does not include the use of oxides of carbon. C.

Preparation of Hair Suitable for Felt. A. Andri. Italian P. 345,021 of 7/4/1936 (through *J. Amer. Leather Chem. Assoc.*, 1938, **33**, 450).

Raw hides are first treated with a 21° Be. solution of 30% sodium sulphide on the flesh-side, and the flesh sides are placed together and the goods are stored to a sufficient loosening of the hair. The hair is removed mechanically, washed and treated with mercuric nitrate. This method produces good hair and leaves a hide suitable for further treatment. W.

Liming Animal Skins. Wallerstein Co. Inc. Italian P. 352,173 of 18/6/1937 (through *J. Amer. Leather Chem. Assoc.*, 1938, **33**, 546).

To liming solutions of calcium hydroxide, sodium sulphide, arsenious sulphide and such containing amines are added hydrosulphites, sulphoxylates or their derivatives, in particular sodium hydrogen sulphite or sodium hydrosulphite in amounts of 1-10% calculated on the amount of alkali or 0·1-3% on the weight of the skin. W.

2—CONVERSION OF FIBRES INTO FINISHED YARNS

(A)—Preparatory Processes

Carding Engine Flats: Stripping. *Textile Weekly*, 1938, **22**, 688-690.

Methods for driving a stripping brush from the bristle brush shaft are discussed with diagrams and a brush for cleaning the ends of the flats is advocated. C.

"Static" Card-Stripping Apparatus. Casablancas High Draft Co. Ltd. *Textile Weekly*, 1938, **22**, 553-4; *Textile Manufacturer*, 1938, **64**, 485.

An illustration is given of an apparatus that is claimed to strip a card cylinder automatically by electrostatic attraction of the fibre to a surface fixed parallel to the cylinder and at a small distance from its lowest point. C.

Card Web Nep Counts: Application. E. H. Helliwell. *Textile World*, 1938, 88, No. 11, 52-54.

A quick and simple method of checking the quality of work done by the cotton card consists in comparing the nep contents of the scutcher lap and the card web. In preparing a specimen for nep counting, a piece of representative cotton weighing 4 or 5 grains should first be selected and thoroughly torn apart into a loose fluffy mass, free from large matted bunches. A 1-grain specimen weighed from this sample is then spread evenly on a dark napped surface (4 × 4 in.), or on a piece of glass, and a piece of ruled glass is placed over the mounted specimen. The number of neps in each successive division is counted with the aid of a magnifying glass. In another method, a napped mat or a piece of glass of suitable size is placed under the web as it leaves the doffer comber and then (with the doffer stopped) a piece of ruled glass is placed directly on the web held on the mat. When the inclosed web is lifted out, it is ready for counting. This method, which makes use of the unit area instead of the unit weight, is more rapid and, where the sliver weight per yard remains constant, the weight per given area varies only slightly. Problems related to carding that could be solved by the application of these methods are indicated and a chart showing the results of nep counts on scutcher laps and card webs produced from them, before and after re-setting the flats and before and after stripping, is given. C.

Sliver Condensing System. F. Pless. *Textilberichte*, 1938, **19**, 781-783.

The lower calender roller of a card sliver coiling mechanism is provided with a groove into which fits a projecting ring round the upper roller, and the sliver passing through the groove is compressed into a smooth, regular, thin form free from projecting fibres likely to cause entangling of neighbouring layers in the can. It is claimed that such a sliver draws better on the drawing frame and that it occupies less room in the sliver can. A similar condensing arrangement may be used on the drawing frame. Diagrams showing improvements in regularity obtainable in this way are given. It is claimed that the regularity after the second passage is better than that after the third passage without the condensing systems. After a third passage it is possible to pass directly to the roving frame, thus eliminating the slubbing and intermediate frames, reducing work and costs, and at the same time producing a yarn of greater regularity and strength. C.

Drawing Short Fine Wools. "Spyndle". *Textile Recorder*, 1938, **56**, No. 666, p.27.

Practical considerations are given regarding Continental drawing machinery. W.

(B)—Spinning and Doubling

Drafting Mechanisms. R. Montigny. *L'Industrie Textile*, 1938, **55**, 430-432.

A device for providing improved control of the fibres in drafting mechanisms having four lines of rollers comprises an additional roller between the second and third lines of rollers and resting on the two middle lower rollers. The roving passes round and below this additional roller and is also made to pass through a condenser before passing between the third pair of rollers and, if desired, through a second condenser between the third and delivery pairs of rollers. In a drafting system in which the first pair of rollers consists of a lower grooved roller and an upper roller carrying rows of needle points conveniently spaced to gear with the grooved roller, the upper roller is enclosed in a cylindrical cage of larger diameter formed by two rings joined by bars which are so spaced that

as the roller and cage turn the bars fit into the spaces between the rows of needle points as the latter come into contact with the lower grooved roller. The roving presses the bars to the base of the needle points and as it leaves the rollers the bars emerge again, pushing out all the fibres and preventing any accumulations in the roller clothing. Alternatively, the bars of the cleaning device may be arranged in the form of a chain. Diagrams of the two drafting mechanisms are given and details of the constructions are discussed. C.

Lancashire Spinning Mills: Organisation. (1) F. Charnley (Shirley Institute). (2) W. Ford (Messrs. Howard & Bullough Ltd.). (3) A. E. Hibbert (Lancashire Cotton Corporation). *Textile Weekly*, 1938, **22**, 657-8, 661.

A report is given of a general discussion on the efficiency of Lancashire mills. Ford stressed the fact that foreign mills have more modern equipment but Charnley argued that while the new and old machines are fundamentally of the same type, the age of the machine (provided it is in good condition) has little effect on yarn quality. C.

Cotton Yarns: Twist. J. Wiernsberger. *L'Industrie Textile*, 1938, 55, 7-9, 111-114 221-222, 273-275, 428-430, 479-481.

The critical coefficient of twist is discussed and tables are given showing the values of this coefficient for yarns of different counts, designed for various purposes, and spun from combed and carded cottons of different qualities with maximum lengths varying from 1 to $1\frac{3}{4}$ inch. C.

Ring Frame Roller Cleaning Device. Société des Brevets Florimont-Delepierre. *Fils et Tissus*, 1938, **26**, 615-617.

A device for cleaning the rollers of ring spinning frames consists of a guide, composed of one or two conical rollers carried by a rod, and a cleaning device formed by a strip of card clothing wrapped round a cylindrical or slightly conical support. The rod of the guide part passes through the centre of the card clothing support. The conical rollers are placed in contact with the rollers of the spinning frame and turned by the latter, and the shapes and lengths of the conical rollers are such that they travel slowly along the spinning rollers and from one pair of rollers to the next across the whole width of the frame, carrying the cleaning strip with them. C.

Spinning Mill: Lay-out. *Textile World*, 1938, 88, No. 11, 64-65.

A detailed description is given of the lay-out adopted by the Ragan Spinning Co., Gastonia, N.C. The mill is equipped with 21,120 spinning spindles manufacturing 24's to 80's combed peeler yarn in any twist or package required for the knitting, thread, lace curtain, weaving and mercerising trades. The machinery is arranged to give a continuous flow of production through the mill from the opener room to the shipping platform. C.

Staggered-spindle Mule. Davis and Furber Machine Co. *Rayon Text. Monthly*, 1938, **19**, 721.

The staggered arrangement permits production of $2\frac{3}{8}$ in. diameter bobbins, where $1\frac{1}{2}$ in. was formerly the limit, an increase of approximately 60% over the largest diameter possible with single-line spindle arrangement on mules of the same gauge. Similarly, a $2\frac{5}{8}$ in. diameter bobbin can be spun on a $2\frac{1}{4}$ in. gauge staggered-spindle mule. A diagram is given. W.

A Patent Device for Jute Roving Machines. *Textile Recorder*, 1938, 56, No. 669, 45-46.

Refers to a new mechanism designed to simplify the constructions of jute roving frames and to dispense with the present differential mechanism for twisting, bobbin filling and yarn layer distributing operations. In the new device the rove is wound into cans, while a special flyer is incorporated, the main feature of which is a rotatable carrier within which rollers are fitted to grip and feed the material while the carrier revolves simultaneously, thereby imparting twist to the rove sliver. L.

Device for Indicating Yarn Tension in Spinning Frames and for Controlling the Speed of the Machines. *Textilber.*, E. 1938, **19**, 114.

A beam of light runs parallel to the length of the frame, and casts a shadow picture of the path of the threads bent in dependence of the thread tension, on a photocell which in turn controls the speed of the motor driving the frame. L.

Flax Spinning. Technical Developments in the Linen Industry. S. A. G. Caldwell. *Textile Manufacturer*, 1938, 64, 513, 515.

Refers to the trend of improvements in details of methods and machinery in the wet spinning of flax. The following points are specially considered.

(1) The use of a softening agent in the spinning frame trough to speed up the process of macerating the pectic binding substances holding the individual fibres together in the strand, permits of an extension of the leas and qualities to which low grade fibre could be spun, a higher spindle speed is also possible and the yarns spun have an improved appearance and increased strength.

(2) The use of cheap and efficient substitutes for Persian and Abasian boxwood induced many spinners to experiment with gutta percha, and with bakelite composition rollers as alternatives, but another source of supply has now been found within the Empire, the new wood being known as "East London" boxwood, from the name of the port in South Africa from which it is shipped.

(3) The introduction of the Gibson saddle for wet spinning frames has overcome the defect of reach alterations which took place on the older type of Gordon saddle when very large or very small pressing rollers were used. L.

Tape Drive, Band Drive, Power Consumption. *See* Section 8D.

Patents

Spinning Machine Speed and Drag Control. Siemens-Schuckertwerke A.-G. B.P. 490,448 of 10/11/1936.

The tension of the yarn in electrically-driven spinning, twisting, and like machines, in which the yarn is wound in cop form, is controlled by a template regulator effecting a variation in accordance with the effective diameter of the cop and constituting a coarse regulation and by a regulator controlled by the tension of the yarn and constituting a fine regulation. The invention is particularly applicable to ring spinning machines but may be applied to machines wherein the twisting and winding is effected by the relative rotation of a flyer and the cop, the control being applied to the driving motor or to the drag means. The template regulator may effect a variation in the basic speed. The fine regulation is effected by electric control means operating continuously or between limits. C.

Heilmann Combing Machine. Sachsische Textilmaschinenfabrik vorm. R. Hartmann A.-G. B.P. 490,482 of 9/8/1937 (Conv. 3/10/1936).

In a Heilmann combing machine the nip of the drawing-off device is brought close to the top comb by the provision of one or more small rollers in association with the usual drawing-off devices comprising a pair of rollers or a stationary block and a driven roller. The small roller or rollers are located in longitudinal grooves in the block, one of the rollers being located between the vertical axial plane of the driven roller and the top comb. Various modifications are also described. C.

Balanced Cord: Production. B. F. Goodrich. B.P. 490,640 of 16/11/1937.

A balanced cord for use in articles of rubber and cord adapted to withstand cyclic stresses, e.g. tyres and belts, is made by producing a twisted unbalanced cord and then elongating it an amount sufficient to produce in the subsequently relaxed cord a substantially balanced condition. C.

Clearer Roller Support. J. Schilhanek. B.P. 490,895 of 7/1/1938 (Conv. 15/1/1937).

The supporting spring of the under-clearer roller of spinning machines is adjustably mounted in a vertical position in a support so that it may be moved into a rear position in which it is retained whereby removal for cleaning is facilitated. The support may comprise a resilient limb engaging a non-circular supporting bar or a circular bar with snap pins, or may engage shaped bearing eyes in a support in order that it may be retained in the two positions. C.

Spinning and Twisting Machine Drag Arrangements. M. Nickel. B.P. 490,923 and 491,003 of 18/11/1936 (Conv. 19/11/1935—12/10/1936).

(1) Electric drag arrangements for spinning and twisting machines wherein the yarn is twisted and wound by the relative rotation of co-operating parts, such as a flyer and a spindle, bobbin or cop, are controlled so that the variation in the drag as the yarn is wound from the larger to the smaller diameter of

the cop differs from the variation as the yarn is wound in the reverse direction. The control is combined with control in accordance with the tension of the yarn and with the speed of the flyer. (2) Electric drags as above are supplied with current the voltage of which is adjusted in accordance with the speed of the driven part, the diameter of winding, and the tension of the yarn. C.

Sliver Coiling and Packing Arrangements. C. Theumer. B.P. 491,214 of 26/2/1937 (Conv. 22/10/1936).

Slivers are laid in a stationary sliver can by an intermittently rotated guide device which also serves as a packer. The packer is intermittently rotated in opposite directions and is attached to the lower end of a vertical rod. It is provided with inclined guide surfaces for the sliver. C.

Wrapped Thread: Production. F. Longdon & Co. Ltd. and G. H. Russon. B.P. 491,542 of 9/3/1937.

A wrapped thread is made from a continuous length of core, preferably of rubber and coated, preferably with latex adhesive, with an inelastic wrapping thread wound on after the adhesive has been applied and before the core touches any other object. The covering process may be repeated. C.

Glass or Resin Slivers. N. V. Maatschappij tot Beheer en Exploitatie van Octrooien. B.P. 491,584 of 30/11/1936 (Conv. 29/11/1935). Void.

Slivers are made from fibres of glass, silicates and slags, thermoplastic materials such as cellulose acetate, sugar, resin or "vinylite", or of rubber, and consist of a strand, preferably though not necessarily untwisted, of substantially parallel but partially matted or felted fibres, with the individual fibres of such a length to permit winding on spools and other textile operations. The fibres have an average diameter of not more than 10 microns and a length of not less than several inches. C.

Tyre Cords: Production. W. W. Groves (I. G. Farbenindustrie A.-G.). B.P. 491,795 of 6/3/1937.

Cords for insertion in rubber tyres, conveyor bands, and other rubber fabrics or for making fabrics for insertion therein are composed of cellulose hydrate threads which are stretched while in swollen condition and prevented from shrinking both before and after the manufacture of the cords up to the embedding thereof in the rubber mass. The cord may be formed by twisting several cellulose hydrate threads into a twine with a right- or left-handed twist and twisting several times with a twist in the opposite direction and the ratio of the twists of the thread and twine may be 1:2 and of the twine to the cord 2:1. The cords or the threads used for making them may be treated with a rubber solution or latex emulsion before they are embedded in the rubber mass. C.

Yarn Thickness Varying Device. E. R. Goshawk and the Fine Cotton Spinners' and Doublers' Association Ltd. (Manchester). B.P. 493,974 of 20/9/1937: 18/10/1938.

A device for producing variations of thickness at random intervals in yarn in spinning, roving and like machines by actuating a thickness-controlling member co-operating with the drawing rollers in such a way as to change the amount of draft, comprises a ball-carrier affording a succession of ball-pockets spaced apart around a closed path along which relative movement takes place between the pockets and the thickness-controlling member to cause the member and each of the ball-pockets in turn to pass one another, one or more balls for insertion in the pockets to afford one or more projections extending from the pockets for engaging and actuating the thickness-controlling member, by reason of the passage of the thickness-controlling member and the pockets past one another, means for releasing each ball from its pocket after the latter and the thickness-controlling member have passed one another, a run-way arranged to receive a ball released from a pocket, and means for causing or permitting a released ball to move in a random manner over the surface of the run-way and to enter another pocket selected by random movement of the ball. C.

Silk Ring Frame Cop Building Mechanism. E. R. and T. W. Scragg (Macclesfield) and A. Davenport. B.P. 494,244 of 23/4/1937: 24/10/1938.

In a traverse or building mechanism for ring spinning, doubling and winding frames for silk and the like, the lowering and lifting of the ring rail is effected by the rotation of a positively rotated cam progressively lifted and lowered by engagement with a cam below also positively rotated by the same means,

whereby the beginning and ending points of the traverse are varied, the yarn thus being formed into a cop having the same speed of traverse both up and down, and having its maximum thickness at the middle part of the tube. C.

Cord: Production. Dunlop Rubber Co. Ltd. and Dunlop Cotton Mills (London), J. Anderson and M. Langstreth. B.P. 494,509 of 25/3/1937: 25/10/1938.

In an improved method of making cord for articles such as belting and tyre covers the last three twisting operations proceed in the same direction, the ante-penultimate operation being preferably the spinning operation, and a setting treatment is applied. The setting treatment may be applied during or subsequently to the production of the cord or it may arise out of treatment for other purposes. It may comprise the employment of an agent having adhesive properties, such as rubber or gum arabic. Alternatively, the setting treatment may be applied by steaming, under sub-atmospheric pressure or otherwise. If desired, the cord may also be submitted to a stretching treatment before, during or after setting. C.

Ring Spindle Lubricating Apparatus. Platt Bros & Co. Ltd. (Oldham) and J. Hughes. B.P. 494,512 of 24/4/1937: 24/10/1938.

Apparatus for effecting simultaneous lubrication of the spindles of a ring spinning, doubling or like machine includes oil reservoirs arranged below the spindle rails into which the lower ends of the spindle bolsters extend, the reservoirs communicating with a tank for holding a supply of oil, a pump for circulating oil under pressure from the supply tank through the oil reservoirs to maintain an approximately constant level therein and filter means intercalated in the supply system. The oil reservoirs form part of a closed circuit, through which oil is circulated under pressure. C.

Ring Spindles: Mounting. Platt Bros. & Co. Ltd. (Oldham) and J. Hughes. B.P. 494,569 of 24/4/1937: 24/10/1938.

In a ring spinning, doubling or like machine, the bolster carriers of the spindles are mounted in recesses in the spindle rail so that, when the spindles are in position, the lower flange of each spindle wharve or pulley is approximately on a level with, or slightly below, the face of the spindle rail. Each wharve attached to a spindle blade is restrained against endwise displacement by a latch plate positioned at the rear of the spindle, so that the front of the spindle rail is left free from obstruction. C.

Cabled Yarns: Production. Comptoir de Materiel Textile (Paris). B.P. 494,753 of 28/1/1937: 28/10/1938.

A method of making an assembly of doubled and twisted yarns from a set of n assemblies of elementary yarns or threads in each of which the elementary yarns or threads are substantially identical with each other consists in separately presenting each of the assemblies of elementary threads or yarns in the form of a bobbin arranged in a twisting and doubling spindle, simultaneously twisting the assemblies in the n doubling and twisting spindles, the rotary speeds of all the spindles being at any time substantially equal with each other and the linear delivery speed of all the assemblies of elementary yarns or threads to their spindles being at any time substantially equal with each other and proportional to the common rotary speed of the spindles, simultaneously drawing or taking off outside the spindles, at linear speeds equal to each other and proportional to the linear delivery speed of all the assemblies of elementary yarns or threads to their spindles, the n twisted yarns or threads thus obtained being immediately grouped side by side in an assembly of n doubled and twisted yarns in each part of which the doubled and twisted yarns are always substantially identical with each other from the point of view of their twists and the point of view of their tensions. In a method of making a bobbin of an assembly of n doubled and twisted yarns from a set of n twisted yarns or threads manufactured and grouped side by side according to the method described above, the n twisted yarns or threads arranged side by side as soon as drawn or taken off outside the spindles is immediately wound up on a bobbin by means of a bobbin winding device while keeping constant the length of the part of this assembly of doubled and twisted yarns situated between the last fixed guiding point of this assembly and the point moving along the bobbin, where the winding takes place. In order to produce cabled yarn the bobbin is arranged inside a spindle to which it is

delivered at a linear speed which is proportional to the rotary speed of the spindle, and the cabled yarn thus obtained is drawn or taken off outside the spindle at a rotary speed which is proportional to the rotary speed of the spindle. The cabled yarn from the cabling spindle is wound up on a bobbin by a bobbin winding device while keeping constant the length of the part of the cabled yarn situated between the last fixed guiding point thereof, and the point movable along the bobbin where the winding takes place. C.

Spinning Frame Drafting Arrangements. Filature du Canal Soc. Anon. (Alost, Belgium). B.P. 494,887 of 4/4/1938: 2/11/1938.

In drafting arrangements for spinning frames of the type having resilient nips for the sliver between the delivery and feed rollers, each nip being formed by an endless belt and a roller and the pressure of the belt on the roller being applied by an eccentrically-mounted rod which bears against the underside of the belt, the pressure-applying rod, which is continuous for the whole length of the frame, is mounted at each head in a cylindrical sleeve provided with an eccentric bore, each sleeve of the frame being rotated simultaneously by a single control preferably arranged at one end of the frame whereby the distance between the continuous rod and the roller or rollers co-acting with the endless belts can be altered simultaneously to vary to the same degree the pressure of each belt on the roller and consequently the resilient nip on the sliver at each head of the frame. C.

Spinning and Twisting Machine Driving Arrangements. Platt Bros. & Co. Ltd. (Oldham) and J. Hughes. B.P. 495,130 of 17/7/1937: 8/11/1938.

In a spinning, twisting or like textile machine, the driving motor and connections to the tin-roller shaft are housed in a closed compartment between the head-stock and the frame structure, and the gear elements driven from a gear wheel on the tin-roller shaft are mounted on the front side of the head-stock, the doors of the compartment having locking means interlocked with the motor-actuating switch so as to effect automatic locking of the doors when the motor is running and to prevent starting of the motor in case any of the doors should not be properly locked. The head-stock and driving elements are mounted on a base-plate, providing a rigidly constructed self-contained unit adapted to be conveniently adjoined to a spinning or twisting frame. The twist wheel and the twist change wheel are mounted for rotation on fixed studs on the front side of the head-stock. The twist lever is encumbered only by the weight of a small carrier and an idler, so that it may be moved with comparatively little effort, the gearing being so contrived that any desired range of twist can be obtained. An additional change place is provided by change of the gear wheel of the tin-roller shaft. C.

3—CONVERSION OF YARNS INTO FABRICS

(A)—Preparatory Processes

Winding Yarns for Warping. "Flaxman". *Textile Recorder*, 1938, **56**, No. 669, 25-28.

A technical description of the various methods of preparing yarns for the warping machine. The merits of each type of winding machine are discussed, and production speeds to give good results are suggested. L.

(B)—Sizing

Beam-to-beam Rayon Warp Cold Sizing Machine. Messrs. Crepe Sizes Ltd. (Nottingham). *Textile Weekly*, 1938, **22**, 622-4.

A machine for beam-to-beam sizing is briefly described and illustrated that employs a solution of "Gammanappe" size in a volatile solvent such as benzole. No heat is applied, the solvent being evaporated by a current of air and recovered in a separate plant. C.

Rayon Warps: Sizing. W. Schramek. *Leipz. Monats. Text. Ind.*, 1938, **53**, 275-279.

Developments in the sizing of rayon yarns are discussed and it is pointed out that tests based on measurements of warp breaks in weaving have shown that in order to obtain sizing effects with polyvinyl and protein sizes equivalent to those obtained with linseed oil in the hank sizing process it is necessary to

use relatively high concentrations of the polyvinyl and protein sizes, especially of the latter. In the sizing of rayon warp beams, however, it is possible to obtain better results with these sizes than with linseed oil and the concentrations required are lower than those required in hank sizing. Factors that may be of importance in sizing, such as the adhesive power of the size film, the concentration of the sizing solution, the smoothness of the sized yarns, etc., are outlined and the results of adhesive power and smoothness tests on polyvinyl alcohol and protein sizes and various proprietary products (Tylose, Blufajo V.R., etc.) are given. It is shown that in many cases an indication of the value of a sizing preparation can be obtained from a study of the adhesive power of the size film and the smoothness of the sized yarn, a size with a low adhesive power often being effective if it gives high smoothness and vice versa. C.

(C)—Weaving

Shuttleless Looms. "Regiomont". *Revue Textile*, 1938, **36**, 457-460.

Shuttleless looms with flying weft carrier devices and looms with gripper devices carried by bars are critically discussed, the possibility of working with many differently-coloured wefts on them is examined, the unsatisfactory nature of the selvedges produced on such looms is pointed out, and various other disadvantages are dicusssed. Circular looms are also critically discussed. C.

Warp Stop Mechanism. W. Shuttleworth. *Textile Weekly*, 1938, **22**, 454-6.

The action of a new warp-stop mechanism due to James Crook (Nelson) is explained with diagrams. It is attached to the ordinary mechanical dropper motion and actuated by the movable notched bar. When this is arrested, it causes a pull on a cable rope and through this on the lower end of the push lever. This lever then forces the knocking-off bar against the setting-on handle which it forces out of its weaving notch and thus stops the loom. C.

Weft Thread Cutting and Clamping Device. E. Gräbner. *Spinner u. Weber*, 1938, **56**, No. 43, 31-32.

When weaving fabrics with checks or transverse stripes on multiple-box looms considerable amounts of weft are wasted in the lengths stretching along the side of the fabric from one stripe to the next, which are subsequently cut away. Such waste can be voided by the use of the patent device of E. Liebing (D.R.P. 662,209) which comprises a scissors-type of cutting device and a clamping device for holding the end of weft attached to the shuttle until the latter is again brought into operation. The device is mounted on the loom temple and the cutting and clamping devices are operated independently by the sley. A diagram is given and details of the construction and operation are explained. C.

Loom Sley: Setting. *Textile Weekly*, 1938, **22**, 533, 536, 565-7.

The normal setting for the sley and the eccentricity of movement caused by raising or lowering it from the normal position are explained with diagrams. C.

Rayon Fabrics: Weaving. E. Dewhurst. *Textile Weekly*, 1938, **22**, 692, 694, 697, 727.

A report of a lecture, giving practical hints on the selection of healds and reeds, the improvement of Lancashire looms for rayon, shedding, the shuttle traverse, cloth take-up, and various defects to be avoided in the weaving of rayon fabrics. C.

Spanish Silk Weaving Industry: History. A. Wittlin. *Ciba-Rundschau*, 1938, No. 29, 1059-1075.

A survey of the history of silk weaving in Spain from the 8th century, when it was first introduced by the Moors, to the beginning of the 19th century. C.

Weaving Calculations. *Textil Lloyd*, 1938, **12**, No. 14, 19-22, No. 15, 18-21; No. 21, 18-21.

A discussion of the determination of such quantities as the weights of warp and weft required to produce a given length of fabric,the length of warp that can be obtained from a given weight of specified type, the length of fabric that can be obtained from a given weight of weft, the counts of doubled and folded yarns, the counts of single yarns required to produce doubled and folded yarns of specified counts, weights of component yarns required to produce given weights of folded yarns, reed counts and widths, number of warp threads required under

specified conditions, loom efficiencies, weight per metre of woven fabric, and warp and weft densities required to produce a fabric of specified weight. Numerous examples are worked out. C.

Healds: Timing. S. C. Veney. *Textile World*, 1938, **88**, No. 11, 88.

The importance of proper timing of healds in relation to the slay is pointed out and marking of both the crank-shaft and the dobby drive-gear to indicate proper settings is recommended. To do this the slay is moved forward so that the reed is in its extreme front position, touching the goods. Marks are then made on the crank-shaft and gear with a centre punch. The crank-shaft mark should consist of three punches in line, for each position, but the gear mark requires only a single punch. The set-screws holding the gear to the shaft must be loosened so that the harness can be set level when the reed is in front position. After these marks indicating centre and identified by C have been punched, the loom is turned backwards so that the reed is $\frac{1}{2}$ in. away from beat-up. The healds, of course, remain in their original position with all shafts even. At this point another series of punches is made on the crank-shaft, these punches being in line with the new position of a single punch on the gear. These marks receive the letter E, representing early change of shafts or beginning of a new shed before beat-up. Next, the loom is turned forward until the reed passes the beat-up and is half an inch away from the fell of the cloth. With the harnesses again retaining their original level position, a third series of punch marks is made on the crank-shaft, in line with the new position of the single punch on the gear. These marks receive the letter L, indicating late timing of harness; i.e., the new shed opens after the reed has beaten up the last pick. C.

Saurer 100W Loom. A. Saurer. *Filaments*, 1938, No. 15, 269-276.

A detailed description of the Saurer 100W loom is given. Characteristic features include an adaptation of the standard cone under-pick, a fast reed motion of unusual design, a side weft fork motion, a warp stop motion of the sliding serrated bar type, and automatic pirn changing mechanism with various protective devices, a simple automatic let-off motion and a direct type taking-up motion. The driving pulley can be driven by means of a belt from a line-shaft or by means of V belts and an individual motor, and the loom can be fitted with either a dobby or a tappet shedding motion. The width of the loom can be altered and the loom can be easily converted to one with four boxes at one side with a four-colour magazine or to a loom with four boxes at each side, and with pick and pick mechanism. C.

Silk and Rayon Loom. K. Weigel. *Monatsh. Seide u. Kunstseide*, 1938, **43**, 413-417.

The Wolfrum loom, in which the mechanisms for controlling the shafts were placed below the warp, is described and its disadvantages are pointed out. A better method of providing the weaver with an unobstructed view of the warp has been developed in a modern loom for silk and rayon in which the shafts are operated from above but the control devices are situated at the side of the loom and driving rods for the shafts pass under the cloth from the dobby side to the driving side of the loom. The dobby is a Hattersley type, upper- and open-shed double lift dobby. The operation of the loom is described in detail and its advantages are pointed out. Diagrams and photographs are given. C.

Temple Roller. *Revue Textile*, 1938, **36**, 507.

A temple roller comprises a tube of flexible material such as rubber which is drawn over a series of discs and is reinforced by a metal thread of rectangular cross section which is wound into the form of a helix and vulcanised in the rubber tube. The metal parts of this roller are thus protected from contact with liquids and gases. A biconical form is shown. C.

Terry Looms. W. Riesnert. *Leipz. Monats. Text. Ind.*, 1938, **53**, 235-239.

The structure and methods of weaving terry fabrics are briefly discussed and an account is given of devices for preventing certain weft threads from being beaten up close to the fell of the cloth, methods of braking the ground and pile warps, the interlacing of the ground and pile warps, and methods of reeding. C.

Double-faced Double Plush: Weaving. H. Arnold. *Textilberichte*, 1938, **19**, 787-789.

The production of double-faced double plush by the use of extra wefts which are subsequently withdrawn in such a way as to pull ends of pile through the

fabrics to the back is discussed and the fabric structures are shown in diagrams. In order to permit the use of different qualities for the ground and extra wefts and to prevent waste of the latter it is advisable to use a loom provided at each side with 3- or 4-cell drop boxes. The extra weft as it is removed can then be wound on a reel or other suitable device and be used again. Two arrangements for winding the extra weft are briefly described. It is possible to produce pattern effects in this type of plush by the use of a jacquard causing the pile warp to pass round some but not all the extra weft yarns. This method does not always give satisfactory results as it often results in much denser pile on one side than on the other and considerable differences between the clearness of the pattern effects on the two sides. A modified structure is shown by means of which it is possible to draw both ends of each section of pile yarn through to the back of the fabric where desired and to obtain better pattern effects. C.

Double Plush: Weaving History. P. Rodon y Amigo. *Textilberichte*, 1938, 19, 783-787.

A survey of the history of plush weaving from ancient times and the development of double plush weaving. C.

Lace and Openwork Effect Fabrics: Production on Silk Looms. R. Joly. *L'Industrie Textile*, 1938, 55, 487-489.

Various methods of producing fabrics showing lace and openwork effects on silk looms are described. C.

Weaving Shed: Production Planning. O. Bitzenhofer. *Textilberichte*, 1938, 19, 770-772, 837-843.

Delays and inefficiency in weaving mills resulting from lack of co-ordination between the work of different departments are discussed and the advantages of a central department for the planning and control of production are pointed out. The organisation and work of such a department are described. Its activities include the analysis of orders and planning of production, the determination of material requirements (yarn, etc., and its preparation), technical equipment and machine requirements, and the determination of production times. Flow sheets and charts showing the results of work and time studies, standard times for various operations, and cost calculations are given and discussed. C.

Cloth Control and Take-up. W. Wilkinson. *Textile Manufacturer*, 1938, 64, 521-522.

General observations on taking-up of cloth in weaving, and types of take-up motions. L.

(D)—KNITTING

Full-fashioned Hosiery Machines: Development. J. A. Beachell. *Silk J. Rayon World*, 1938, 14, No. 166, 34-5; No. 167, 32-5; No. 168, 33-5; 15, No. 169, 31-3; No. 170, 31-2; No. 171, 27-8; No. 172, 31; No. 173, 37; No. 174, 37-8.

A technical review of English and Continental full-fashioned hosiery machines, under the headings, (1) development of the silk hose industry, (2) an outline of the Cotton frame and the principle of stitch formation, (3) visit to Continental machine works, (4) arrangement of the main operating levers, and important points of design in attaining high speed working of silk, (5) speed of Cotton's machines for maximum production, (6) stitch transfer for narrowing the fabric, (7) and (8) characteristics of fully automatic machines, and (9) the Kalio auto-welt stitch formation. C.

(G)—FABRICS

Staple Fibre: Use in Carpets and Rugs. G. E. Hopkins. *Rayon Textile Monthly*, 1938, 19, 561-563, 630-632.

The use of staple fibre in the pile of carpets and rugs is discussed and curves are given showing the variations in wear resistance and fluffing (shedding) with increasing staple fibre content. Crush resistance and soiling characteristics, the factors influencing these characteristics, and the differences between the different types of rayons are discussed, and it is pointed out that improvements can probably be effected by suitably controlling the denier, resilience, cross-section and surface characteristics of the fibres, the arrangement of the pile yarns in the fabric and of the fibres in the yarn, the yarn twist, and other factors, and by mixing different deniers and mixing staple fibre and wool. The use of rayon

staple fibre involves very little change in present carpet manufacturing processes. Some forms of rayon staple fibre, e.g. cuprammonium, can be used instead of wool at a slight cost advantage compared with normal wool prices and with blends containing up to 30 per cent. it is possible to obtain products showing slightly increased durability, considerably decreased tendency to fluffing, with no general change in appearance and showing only imperceptible decreases in crush and soil resistance. With suitable improvements it should be possible to develop carpets with 100 per cent. staple fibre pile of improved wear resistance, soil resistance and resistance to fluffing compared with that of 100 per cent. wool pile and having definite advantages in stability of price and immunity to moth damage. C.

Denims and Express and Hickory Stripe Fabrics: Constructions and Uses. J. Hoye. *Textile World*, 1938, **88**, No. 11, 93.

Details are given of the constructions and uses of typical furniture and upholstery denims and express and hickory stripe fabrics. C.

Lining Fabric Borders: Design. H. Driesch. *Textilberichte*, 1938, **19**, 717-720, 789-792.

The production of borders on rayon linings such as are used for fur coats is discussed. The two main types are crêpe-satin and crêpe-marocain borders and they are produced by means of dobbies. Various patterns are shown and peg plans, drafts and other details are given. C.

Loop-selvedge Double-face Fabrics: Production. *Fils et Tissus*, 1938, **26**, 619-621.

The production of double-face fabrics in which one or more weft threads are caused to form loops at the selvedges is discussed and diagrams showing the fabric and selvedge structures are given. Connected loops of the different weft threads at the selvedges may be produced by a knitting operation with latch needles or similar devices during the weaving process. Additional threads may be introduced and knitted with the weft threads at the selvedges. C.

Wadded Double Cloths: Design. R. A. C. Scott. *Textile World*, 1938, **88**, No. 7, 58; No. 11, 66.

Wadded double cloths are formed by the introduction of floating weft or warp threads between the face and back fabrics of ordinary double cloths stitched either by floating back ends over face picks or back picks over face ends. In this way it is possible to increase weight and fullness of handle without any alteration of face texture. Heavier and cheaper yarn can be used for the wadding threads as they are not visible on either side of the fabric. Notes are given on the design of weft-wadded and warp-wadded fabrics and typical weaves are shown and discussed. Warp-wadded fabrics are particularly adapted to weaving on automatic looms and, in general, are more economical than weft-wadded fabrics. C.

Press and Filter Cloths: Manufacture. M. Radlegger. *Woollen und Leinen Ind.*, 1938, Sonderheft, pp. 21-25.

A detailed account of the uses and manufacture of press and filter cloths. Illustrations are given. W.

All-wool Blankets. "Bannockburn". *Wool Record*, 1938, **54**, 1139-1141 and 1197-1199.

Developments in the weave, design and colour of all-wool blankets are described, with special reference to the gauze cellular type. W.

Linen as a Re-armament Material. *Irish Text. J.*, 1938, **4**, No. 11, 9.

An article describing the many uses for linen as rearmament material because of its great weaving properties. It stands up to the wind and weather, heat and cold, snow, rain or sunshine, damp or drought, as does no other woven material. L.

Patents

Curtain Tape. D. F. Johnson. B.P. 490,241 of 19/2/1937.

The draw-tape for use in suspending a curtain is thickened by weaving on the ridges of the pleats to provide additional material to aid in forming a rib thereon when the curtain hook is positioned on the ridge. C.

Winding Machine. E. R. and T. W. Scragg and A. Davenport. B.P. 490,363 of 9/2/1937.

A machine for winding yarn on to a cone (*a*) has the winding spiral shaft set at an angle to a hollow shaft carrying a cone (*b*) having a frictional ring

engaging a cone (*c*) on the spiral shaft, and the cone (*b*) is driven and slidable along a bar carrying the shaft so that, at the start of winding, the ring engages the base of the cone (*c*) so as to give a slow start and then automatically moves along the cone (*c*) to give a gradual speeding up of the winding spindle, thereafter being gradually moved back to the base of the cone so as to reduce the speed of the winding spindle as the package wound on the cone increases in diameter and to give a slow finishing speed. C.

Rotary-box Loom. Blackburn Loom and Weaving Machinery Co. Ltd., and E. Watson. B.P. 490,405 of 2/6/1937.

The box is driven positively in both directions through a yielding safety device from a star wheel turned by rollers on a wheel driven by spur-and-bevel gearing from a shaft mounted in a bracket on the swing rail and a bearing in a second bracket. The drive yields in case the shuttle traps and also enables the box to be turned by hand in either direction. The bevel gearing from the swing rail may be replaced by a chain drive, etc. C.

Cone Winding Machine. T. Holt, Ltd. and H. Holt. B.P. 490,677 of 16/2/1937.

In a machine for winding thread or yarn upon a cone, driven by a revolving drum, by a reciprocating thread guide, means are provided for automatically raising the yarn out of the path of the guide on breakage of the thread and at the end of the winding and for ensuring that winding movement is imparted to the yarn in advance of the downward movement of the thread into the path of the traversing thread guide, such means comprising a rod located in proximity to the path of the traverse guide and hingedly connected at one end to a part of the machine frame, a second rod connected to the other end of the first rod and connected at its lower end to a trigger, a lost motion connection between the trigger and a link pivoted to an arm extending from the usual trip mechanism for operating the knock-off mechanism of the machine, and a detent with which the trigger is adapted to engage; the lost motion connection permits a time lag between the initial movement of the trip mechanism and the operation of the trigger. C.

Loom Dobbies. F. Fielden. B.P. 490,917 of 23/3/1938.

The pattern barrels are mounted on shafts each furnished with a single rachet wheel movable either the distance of one or of half a tooth by means of a double pawl on an arm or operated by a reciprocating rod. The pawl has a pushing tooth and also a pulling tooth spaced apart a distance of $1\frac{1}{2}$ ratchet teeth. The pulling tooth is held out of action during the second half of each rearward and first half of each forward movement of the rod by means of a projection resting thereon. Normally the pushing tooth drives the ratchet wheel the distance of one tooth at a time, but may be placed out of action by turning a shield by pattern mechanism so that it engages a projection on the pushing tooth. The pattern barrel thus remains at rest until the shield is restored to its original position. The rod may be reciprocated between limits determined by the engagement of lugs with an adjustable stop by means of a give-way device and a rod adjustably connected to the dobby side lever. C.

Curtain Tapes: Weaving. F. French & Sons, Ltd. and G. F. French. B.P. 491,080 of 25/2/1937.

In making a curtain heading tape embodying suspension hook-tubes, the front and back of each hook-tube may be woven side by side and the warp threads of the front and rear walls respectively of one hook-tube are made to cross over to the rear and front walls of the next tube. In another continuous weaving method, two strips of material are woven side by side to constitute the front and rear walls of the hook-tubes, and at intervals a few weft threads of one strip are interwoven with the warps of the other strip to form the junctions between adjacent hook-tubes. C.

Loom Dobbies. H. Staubli, H. Staubli, jun., and R., H. H., and O. Staubli (trading as Geb. Staubli & Co.). B.P. 491,133 of 28/12/1937.

In a dobby having more than one cylinder for pattern cards of pasteboard, Verdol's paper or similar thin material, the reading needles are mounted in a frame which can be slid or turned about a pivot so that they can read on either cylinder. The needle frame may be moved from one cylinder to the other by a cam and roller. C.

Polymerised Compound Filtering Media. W. W. Groves (I. G. Farbenindustrie A.-G.). B.P. 491,218 of 26/2/1937.

Liquids are filtered through a fabric, felt, fleece, sheet or other permeable layer of artificial fibres made from a chemically indifferent polymerisate or mixed polymerisate of an organic compound or compounds containing at least one vinyl group. Polystyrene, polyisobutylene, polyvinyl ethers, polyvinyl chloride and after-chlorinated polyvinyl chloride are mentioned as suitable materials. C.

Warp Knitted Elastic Band. Narrow Fabric Co. B.P. 491,313 of 30/12/1936.

A warp knitted band for attachment in overlapping relationship to the margin of a garment, e.g. a stocking, comprises rubber threads carried by a finger bar, wrapping weft threads, and interlocking weft threads. The band is provided with an edging strand carried by another finger bar, and arranged to form a series of three loops interlocked at their inner parts with the weft threads. C.

Elastic Band. Narrow Fabric Co. B.P. 491,350 of 30/12/1936 (Conv. 13/3/1936).

An extensible fabric band or strip comprises elastic strands disposed longitudinally of the band, the elastic strands being interconnected by inelastic strands, and the band being provided with a marginal zone which is of less thickness than the remainder of the band, the thinner marginal zone being produced by employing inelastic strands therein which are finer than the inelastic strands in the remainder of the band. The band may be produced by braiding or by warp knitting. C.

Stocking Blanks: Knitting on Flat Frames. G. Dietrich. B.P. 491,409 of 25/10/1937 (Conv. 3/11/1936 and 22/2/1937).

To knit, on a flat frame, stocking blanks having four narrowing lines at the toe by means of two sets of narrowing points, the loops in the inner zones are transferred inwardly at each transfer course and then the points are racked outwardly to enable the loops in the outer zones to be transferred. The transfer of loops in the outer zones may be performed in two or more stages, the formation of additional narrowing lines being, however, avoided. Each set of points is mounted on a bar controlled by a stop when making the outer zones and by a pivoted auxiliary stop when making the inner zones. The auxiliary stop is interposed between the first stop and the end of the bar by a pattern mechanism, the bar being temporarily held away by a cam and lever device acting against a weight. C.

Heald-levelling Devices. W. S. Rotton and J. D. Paterson. B.P. 491,547 of 30/4/1937.

In heald-levelling devices for Leeming and other dobbies, a levelling bar journalled in brackets can be turned by operating a handle lever from a position wherein it acts as a stop on which the lowered bowl levers rest to a position wherein it raises these levers, a second levelling bar connected by lever mechanism to the first being similarly operated. At the same time, a finger on the second bar is moved into the path of projections on a disc on a gear wheel in the train of gears by which and a hand wheel the dobby can be turned over when the power drive is disconnected. The abutments prevent the dobby being thus turned over when the heald-levelling means have been operated. A short arm on the second is connected to a slotted rod receiving a pin on the usual clutch fork on a vertical shaft driving the dobby. This rod prevents movement of the clutch to restart the dobby until the heald-levelling means have been moved into inoperative position. A modification is described wherein only one levelling bar is used. C.

Rotary Needle-cylinder Knitting Machine. A. V. Clarke. B.P. 491,670 of 19/4/1937.

A rotary needle-cylinder machine having means for driving it by power, has a handle whereby it can be turned by hand, and a trap door for withdrawing the knitting instruments in the cylinder, so located that an operator turning the handle can readily see both the trap door and the knitting point. The invention is described in connection with a superposed needle-cylinder machine. C.

Elastic Braid: Production. W. H. Price. B.P. 491,854 of 9/3/1937.

The use of elastic threads in the formation of scalloped edges or other effects in lace, etc., made on braiding machines is described. In an example, elastic and

non-elastic threads are both drawn from traversing bobbins. The non-elastic threads traverse, some in one direction and some in the other direction, to form the substance of scallops. The elastic threads, preferably wrapped with cotton, etc., are traversed under tension from the extreme edge of the material to a suitable distance in the width of the fabric and back again. When the tension is released the scallops are forced out. C.

Knitting Machine Ratchet Gearing. A. V. Clarke. B.P. 491,818 of 24/4/1937.

The pattern drum shaft of a knitting machine is racked by means comprising a ratchet wheel, a pawl, a carrier in which the pawl is slidably mounted, and a cam for sliding the pawl within the carrier. C

Ribbon Package. General Ribbon Mills Inc. B.P. 491,978 of 5/4/1937.

Ribbon is wound into a package comprising a plurality of substantially coaxial groups of convolutions with a common intermediate point of interleaving, and, after the package has been placed in a box, the inner end of the material can be withdrawn substantially free from twist through an aperture facing the point of interleaving. The material is wound on a card which is subsequently withdrawn. C.

Straight-bar Knitting Machine. R. and K. Lieberkneckt (trading as K. Lieberknecht). B.P. 491,995 of 6/7/1937 (Conv. 11/12/1936).

In a straight-bar machine, the fabric draw-off bands at the ends remote from the take-up shaft are provided with welt rod engaging hooks and connected by cords to a weight loaded shaft for restoring the hooks to initial position. The welt rods of a number of sections can be connected simultaneously by attaching the bands to a common take-up shaft. The bands of each section are connected by a rail which slides on the welt bridges during the take-up and each hook has an abutment to prevent the welt rods rolling away. A loaded shaft may be provided for each section. C.

Loom Stop Motion. D. Crabtree & Son, Ltd. and W. Felton. B.P. 492,054 of 5/4/1937.

The selvedge thread inserted through the weft loops by a shuttle carried by an oscillating arm on a shaft is engaged by a wire member or feeler on an oscillating shaft which causes loom stoppage if the selvedge thread is broken. C.

Circular Knitting Machine. Scott and Williams, Inc. B.P. 492,057 of 8/4/1937 (Conv. 8/4/1936).

A circular machine having a dial with instruments for holding and transferring loops in the knitting of a welt has means whereby an elastic yarn is interlaced with the needles, so as to be incorporated in the fabric without being knitted, during the knitting of the welt and the transfer of the welt loops to the needles. The elastic yarn may also be incorporated in the stocking top at spaced courses. The needles are positioned in the path of their operating cams by pattern jacks operated by cams. The rubber yarn is supplied by a slidably mounted guide controlled by connections from a yarn finger which is operated by a push rod from a cam on the main pattern drum. C.

Straight-bar Knitting Machine. R. & K. Lieberknecht (trading as K. Lieberknecht). B.P. 492,067 of 28/5/1937 (Conv. 6/7/1936).

A straight-bar machine having a friction box for driving one or more yarn carrier rods during any traverse has additional friction means on the same friction rod for driving any of the other carrier rods in the same direction during the traverse of the friction rod. C.

Loom Shedding Mechanism. G. Fisher and W. S. Tandler (New York). B.P. 494,618 of 29/9/1937: 28/10/1938.

Loom shedding mechanism having a pattern and a controlling device which by the combination of pattern scanning means electrically operated in accordance with the variations of the pattern and movable electro-mechanical means actuated by the scanning means selects and displaces the heddles of the loom is characterised in that, in order to avoid the mechanisms customary in a Jacquard loom and to impart the electrical impulses of the scanning means to the heddles, oscillating selectors and co-ordinate oscillating control members are provided which are directly connected with the heddles, that one group of the selectors is oscillated by direct impacts of a single electromagnet unit into a locking position for the associated control members and that these are hereby

divided in two groups, namely, one of detented and one of free-to-move members which, in order to form the shed, are displaced in opposite direction. C.

Stationary Weft Supply Loom. C. Clutsom (Ashby-de-la-Zouch). B.P. 494,982 of 26/7/1937: 4/11/1938.

A loom with stationary weft supplies and a weft laying member or members operable in conjunction with a thread engaging element or elements adapted to engage the weft and to operate to form a selvedge or selvedges, is characterised by the provision therein of one or more slidable reciprocatory weft laying members provided or each provided with a thread guiding portion adapted to be deflected in relation to the main portion, and means adapted to effect deflection of the thread guiding portion from the path of reciprocation of the main portion after passage through the shed on the forward stroke of the weft laying member in such a manner as to present the weft carried thereby to the adjacent thread engaging element. C.

Loom Shedding Mechanism. G. Fisher and W. S. Tandler (New York). B.P. 495,139 of 14/9/1937: 8/11/1938.

Loom shedding mechanism having a pattern and a controlling device which by the combination of scanning means electrically operated in accordance with the variations of the pattern and electromechanical means actuated by the scanning means selects and displaces the heddles of a loom is characterised in that rotable control members are directly connected with the needles controlling the hooks connected with the heddles or the control members are directly connected with the heddles, that one group of the selectors is moved by direct impact of a single movable electromagnet into a locking position for the associate control members and the therewith connected needles or heddles, and that the other needles or heddles which are connected with the undetented control members are displaced by a pulling action. C.

4—CHEMICAL AND FINISHING PROCESSES

(A)—Preparatory Processes

Trisodium Phosphate: Use in the Textile Industry. P. Colomb. *Teintex*, 1938, 3, 589-604.

The preparation and properties of phosphates are briefly discussed and a general account is given of the use of trisodium phosphate in the wetting and dyeing of cotton, in the boiling of cotton and linen goods, the scouring of cotton-rayon mixture fabrics, the desizing of fabrics containing cellulose acetate rayon and silk, the scouring and bleaching of jute, the rapid bleaching of cotton fabrics, the bleaching and scouring of wool, the bleaching of silk, the fulling of fabrics containing artificial fibres, in fireproofing, in the dyeing of animal and vegetable fibres with vat dyes, in water purification process, and in the cleaning of machines and equipment. C.

(B)—Boiling, Scouring, Degumming and Washing

Rayon Crêpe Boil-off, Scouring and Washing Baths: Control. C. B. Ordway. *Rayon Textile Monthly*, 1938, **19**, 565-566, 637-638.

Difficulties arising from the sensitivity of developed cellulose acetate dyes are briefly discussed and it is pointed out that great improvements have recently been made in these dyes and that the use of non-actinic glass in dyehouses is advantageous. The processing of rayon crêpes especially mixture crêpes containing cellulose acetate with other types of rayon is discussed and an account is given of investigations of boil-off and washing operations. Tables show boil-off formulæ, scouring and washing formulæ, compositions of reserve solutions and feeding-in schedules for six different runs, and *p*H values of baths at the start and after 300 pieces of crêpe had passed through. Observations of the water supply and of the effects of a change in the treatment of the water are also recorded. The results are discussed and the requirements of properly balanced boil-off and washing and scouring baths are outlined. C.

Some Aspects of Cloth Finishing. J. C. Schofield. *Wool Record*, 1938, **54**, 1194-1195 and 1199.

Lecture at meeting of the Huddersfield Textile Society. Modifications are suggested in woollen and worsted cloth scouring processes and in the machinery

used. Problems connected with increasing the soda strength and the use of solvents, are discussed, also the questions of colour bleeding and listing. W.

Preparing Yarn-dyed Cloths. *Wool Record*, 1938, **54**, 841-843.
Three types of scour are recommended—(1) for light cloths, where the percentage of grease, dirt, etc. is not very great; (2) double scour for heavier cloths; (3) earthing scour for materials in which the smell of the agents used in manufacture cannot be removed by ordinary methods. W.

Patchiness from Crabbing and Scouring. *Wool Record*, 1938, **54**, 1014-1016.
Methods are discussed for avoiding the presence of insoluble fats in piece-dyed fabrics. W.

(D)—Milling

Recent Researches on Wool Felting. J. Schofield. *Wool Record*, 1938, **54**, 1017-1021; Disc. 1021-1023.
Paper read at meeting of the Bradford Textile Society, Oct., 1938. Variable factors in the milling of true felts are discussed. Further experiments are being made to prove or disprove the supposed action of the wool scales in felting. W.

(E)—Drying and Conditioning

Drying Machinery: Efficiency. F. Kershaw. *Ind. Eng. Chem.*, 1938, **30**, 1115-1118.
A general review of the use of drying machinery, with illustrations of various types. Among references to the diversity of drying problems it is said that rayon skeins with oil, wax or gum dressings take 2-4 times as long to dry than skeins without such dressings. C.

Condition and Oil Content of Tops and Yarns. H. T. Rothwell. *Wool Record*, 1938, **54**, 785-793.
A table is given showing the standard English as compared with the international moisture allowances for wool tops, yarns and cloths. Methods of calculating condition and oil and grease content are discussed. W.

The Principles of Drying. *Textile Recorder*, 1938, **56**, No. 669, 40.
Abstracts from two papers on "Principles of Drying and Textile Drying Machinery" read recently before members of the Manchester Section of the Society of Dyers and Colourists, by W. Cowan, M.Sc. and W. W. Spooner, M.A. L.

(G)—Bleaching

Flannelette: Bleaching, Dyeing and Finishing. E. Dutoit. *Teintex*, 1938, **3**, 543-548.
A general account is given of procedures for the treatment of light napped cotton fabrics, such as flannelette, including raising, scouring, bleaching, dyeing, napping and finishing treatments. C.

Hydrogen Peroxide: Application in Bleaching. *Klepzig's Textil-Z.*, 1938, **41**, 557-558, 568-569.
A general discussion of the advantages of hydrogen peroxide bleaching, the selection of suitable apparatus, the purity of the water, goods and bleaching baths, the use of stabilisers, and various necessary precautions, and of the procedures used in bleaching wool, silk, cotton, rayons and staple fibres with hydrogen peroxide and in combined chlorine and hydrogen peroxide bleaching processes. C.

Ramie: Purification. L. Brissaud. *14me. Congrès Chim. Ind.*, 1934, Section 12, 4 pp.
The X-ray diagram of most commercially purified specimens of ramie reveals considerable disintegration of the crystalline structure. Well-defined crystalline patterns are given by ramie bleached by treatment with a mixture of ammonia and sodium sulphite followed by hypochlorite. The fibre is strong and gives a high value on nitration. C.

Sulphite Pulp: Bleaching. J. L. Parsons and D. T. Jackson. *Paper Trade J.*, 1938, **107**, Tappi, 165-168.
The four main reactions in the bleaching of sulphite pulp are (1) removal of lignified and other incrusting material, (2) destruction of colouring matter, (3) reaction between the bleaching agent and dissolved incrusting matter, and

(4) attack on the cellulose. The aim is to promote reactions (1) and (2), and to suppress (3) and (4). Experiments are now described that demonstrate that this is achieved better in a multiple-stage process than in a single hypochlorite bleach, and with economy of materials. The stages are (1) treatment with chlorine, (2) washing with hot caustic soda, and (3) treatment with hypochlorite at *p*H 8-11. C.

Titanium White Pigments: Application in Paper. O. Hansen. *Zellstoff u. Papier*, 1938, **18**, 584-588.

The demand for bleached pulp for rayon manufacture is restricting the supply for the paper industry. Poorer qualities can be used, however, for white papers by the incorporation of titanium white. An account is given of the production of various commercial titanium whites and of their physical properties in comparison with other white pigments. C.

(H)—Mercerising

Cotton: Mercerisation; Influence of Temperature and Alkali Concentration. W. Schramek and H. Thomas. *Leipz. Monats. Text. Ind.*, 1938, **53**, 157-164, 187-194, 219-226, 245-251.

The various methods of determining the degree of mercerisation of cotton are critically reviewed and classed into (1) methods depending on measurements of changes in the outer form of the fibres, (2) methods depending on measurements on changes in the internal fine structure of the fibres, and (3) methods depending on measurements of changes in chemical and physical properties resulting from the changes in structure. The methods of group (1) serve only for determining whether cotton has been mercerised well, badly or not at all and most of the methods of group (3) are only capable of indicating qualitative differences between mercerised and unmercerised material. The only method in group (2) is the X-ray method, and this method and the hydrolysis number method are the only absolute methods for the determination of degree of mercerisation, and these can be used for quantitative determinations. Some of the other methods may be used for relative measurements. A detailed account is given of a study of the shrinkage of cotton yarns in caustic soda solution and the results are shown in shrinkage-concentration curves for various temperatures and periods of immersion and in space models showing shrinkage, alkali concentration and temperature. The optimum conditions for swelling, as measured by shrinkage, are defined for raw yarn with and without addition of wetting agents and for scoured yarn without wetting agents, for different periods of mercerisation. Curves showing the influence of alkali concentration on mercerisation as determined by various methods are also given and are compared with the shrinkage curves. The curves obtained by the X-ray method do not run parallel with the shrinkage curves in all concentration regions, thus showing that the swelling is not solely dependent on the change in internal structure. The results of lustre, fibre strength and dyeing power measurements follow those of X-ray measurements in a satisfactory way but not the shrinkage curves. The effects of scouring the yarn and the effects of preventing shrinkage during mercerisation are briefly discussed. Yarn strength is influenced by conditions apart from mercerisation. The dye adsorption curves follow neither the shrinkage nor the X-ray mercerisation degree curves. It is concluded that the changes in structure shown in X-ray diagrams can be used as a measure of the technical effect of mercerisation, that the changes in structure rather than the shrinkage have the most important influence on lustre, and that strength measurements and dye absorption tests are not suitable bases for the evaluation of technical mercerisation effects. The optimum conditions of mercerisation, considered from the point of view of shrinkage, change in structure, lustre, and fibre strength, are found at 38-40° C. and alkali concentrations of 20-25 per cent. NaOH for a mercerisation period of $2\frac{1}{2}$ min. C.

(I)—Dyeing

Metalliferous Azo Dyes: Preparation and Application. L. Bonnet. *Teintex*, 1938, **3**, 522-526.

A review of the preparation, nature, properties and application of azo dyes containing one or more metals in their molecules. C.

Antique Satins: Cross-Dyeing. L. Pink. *Silk and Rayon*, 1938, **12**, 966, 968, 990.

The pleasing effects obtained in the cross-dyeing of antique satins containing cellulose acetate rayon in combination with cotton and/or viscose rayon, and the costs of this method are briefly discussed. Suitable desizing and bleaching treatments for pale colour combinations and for dark colours are described. The cellulose acetate rayon is dyed first and the cotton and/or viscose rayon may then be dyed with vat dyes, or after dyeing the cellulose acetate rayon the material may be subjected to intermittent clearing with a proprietary bleaching agent and the cotton and/or viscose rayon dyed with substantive dyes in a separate bath. Suitable dyes for the cellulose acetate rayon are mentioned and dyeing procedures are discussed. C.

Cellulose Acetate: Swelling and Dyeing. J. Rolland. *17me. Congrès Chim. Ind.*, 1937, 182-189.

A general discussion is given of the phenomena of swelling in cellulose acetate, due to which the rather hydrophobic material can be delustred and relustred, dyed, printed and weighted. C.

Cellulose Acetate Rayon: Dyeing. *Teintex*, 1938, 3, 527-535.

Methods of dyeing cellulose acetate rayon, including numerous patent processes, are classified into (*a*) methods depending on superficial saponification followed by dyeing with direct and basic dyes, (*b*) procedures based on swelling the fibre and dyeing with the usual cotton and wool dyes, (*c*) methods involving the use of special soluble dyes, such as Ionamines, Duranols, etc., and (*d*) methods depending on the use of dispersed dyes, such as SRA Dispersol and Celatene dyes, and are reviewed. C.

Linseed Oil: Action on Rayon. J. Rolland. *17 me. Congrès Chim. Ind.*, 1937, 113-120.

The cause of streaky dyeing that is sometimes encountered in fabrics containing rayon warps sized with linseed oil is ascribed to the influence of peroxide formation during the drying of the oil. The amount of peroxide formed is determined by reduction with standardised stannous chloride in an atmosphere of carbon dioxide and iodimetric titration of the excess. The presumed formation of oxycellulose on the rayon is tested by staining with Rhodamine B extra and with silver nitrate, after de-sizing. A connection between the "active oxygen" content of an oil and the extent of oxycellulose formation is established in a case of streaky rayon fabric. It was observed that the trouble is increased if the warp is exposed to sunlight and that more oxycellulose is formed if the "drying" of the oil takes place in a moist atmosphere instead of a dry one. Attempts to prepare a boiled oil free from risk were without definite result. No particular success was obtained by adding a reducing substance to the oil, but level dyeings, with acetate warps, were secured by steeping the cloth, before desizing, in a 20-50 per cent. solution of 40 per cent. formalin. C.

Rayon: Direct Dyeing. W. Weltzien and K. Windeck-Schulze. *Angew. Chemie*, 1938, 51, 729-736.

Recent work on the mechanism of direct dyeing is reviewed under the headings (1) Influences of the constitution of the dye; (2) Substantive dyes in solution (particle size, influence of electrolytes, diffusion); (3) The substantive dyeing process ("fixation" of dye and influence of electrolyte concentration, temperature, nature of the fibre, and additions to the bath); and (4) Comparison of the behaviour of the dye in solution with its tinctorial properties. C.

Rayon and Rayon-Cotton Mixture Yarns: Dyeing with Naphtol AS Dyes. *Klepzig's Textile-Z.*, 1938, 41, 549-550, 571-572.

A discussion of precautions to be taken in the dyeing of rayon and rayon-cotton mixture yarns with Naphtol AS dyes, the temperature, concentration and alkali content of the naphthol bath and the use of wetting agents and protective colloids in this bath, the preparation of diazo solutions for the developing treatment, and the final soaping operation. C.

Staple Fibre, Nitrogenous Staple Fibre and Lanital: Dyeing. *Bull. Trim. Lab. Anal. Recherches Ind., Roubaix*, 1938, No. 38, 9-13; No. 39, 9-14.

A general review is given of new artificial fibres under the headings staple fibre, nitrogenous staple fibre (viscose mixed with synthetic resins or proteins) and Lanital, with special reference to their dyeing. C.

Textiles: Dyeing. (1) J. D. Blakeley. (2) H. R. Heap. (3) C. Child. (4) R. Humphries. *J. Soc. Dyers and Col.*, 1938, **54**, 454-462.

A series of papers on miscellaneous difficulties and defects in dyeing. (1) A case is mentioned of rubber stripping from dark stripes in a rubberised bag cloth. The yarn in the stripes did not contain deleterious metals but was dyed in the grey. (2) Many defects are traced to faulty preparation for dyeing. (3) The application of Brenthols is discussed. (4) The recognition and examination of defects is discussed. A general discussion is reported. C.

Photo-electric Dye Absorption Colorimeter. N. Ahmad and D. L. Sen. *J. Indian Chem. Soc., Indust. Ed.*, 1938, **1**, 33 (through *Brit. Chem. Abstr.*, 1938, B. 1029).

A photo-electric colorimeter of the null type is described in which two photo-electric cells are connected to two glass cells containing the dye solution and water respectively, and adjustment is effected by means of a spherometer in conjunction with a shutter placed before the water cell. The instrument has been employed in measurements of the absorption of dyes by Indian cottons. C.

Centrifuges: Calculation of Wall Strength. P. Haidant. *L'Ingénieur Textile*, 1938, No. 349, 374-388.

A list is given of the Belgian regulations, enforced by decree in 1933, for the control of centrifuges. Calculations are made of the strengths of the various parts of a German centrifuge which show that a protecting cover of steel 12 mm. thick affords sufficient protection. C.

Turkey Red: History and Theory. R. Haller. *Textilberichte*, 1938, **19**, 448-452, 504-506, 595-596, 731-734, 796-798.

A review of the history of Turkey red dyeing and of theories of the formation of alizarin red lakes. C.

Linseed Oil Sized Rayon Yarns: Dyeing. G. Taron. *L'Industrie Textile*, 1938, **55**, 496-497.

Viscose and cellulose acetate rayon yarns were sized with linseed oil and stored for periods of four months and two years, and then desized and dyed and compared with similar yarns which had been stored in the unsized condition and subjected to the same desizing and dyeing treatments. The yarns that had been sized gave rather lighter shades than the unsized yarns, the effect being more noticeable with viscose rayon than with cellulose acetate, and more distinct after the longer period of storing. On the whole, provided the period of storing is not too long and is carried out under uniform conditions, linseed oil sizes will not cause shade variations in rayon. Storing of sized rayon produces a loss in strength and elasticity, but the loss is within moderate limits even for a storing period of two years. The loss is less in cellulose acetate yarns than in viscose yarns. The iodine number of linseed oil on rayon falls rapidly immediately after sizing but later falls slowly. The acidity and saponification numbers increase but cease to increase after the first five months and after drying. These observations are in agreement with the view that the first phase consists of oxidation of the linseed oil and the second phase of decompositions resulting in the formation of acids. The action of the size on the fibre appears to take place during the second phase. Injury of the fibre by linseed oil sizes may be prevented by adding reducing agents such as aldehydes to the size or by treating the material after sizing with a solution of an aldehyde, e.g. formaldehyde. C.

Dye Solutions and Dyed Films: Visual Judgment. M. O. Pelton. *J. Text. Inst.*, 1938, **29**, T.227-237. C.

Black Dyeings on Wool. A. Rösler. *Textilber.*, 1938, **19**, No. 4E, pp. 191-194.

A survey of dyestuffs used for black dyeings on wool and the fastness properties attainable. A description is given of the main differences between the large groups of acid black and chrome black brands. Details are also given of the dyeing of mixed fibres. W.

Wool: Dyeing with Indigo. *Dyer*, 1938, 80, 450.

Recipes are given for dark navy blues for government work and for the West of England trade, for a medium lavender and for a salting shade for use when blending Air Force slate. W.

Unlevel Dyeing of Wool with Acid and Chrome Dyes. III. E. Race, F. M. Rowe and J. B. Speakman. *J. Soc. Dyers and Col.*, 1938, **54**, 421-422.

The results are recorded of determinations of the affinity for chromium of non-irradiated cloths and cloths irradiated with and without cooling. The affinity for chromium of cloth irradiated with cooling is very much less than that of cloth irradiated without cooling. W.

Some Aspects of Fur Processing. H. B. Sable. *Dyer*, 1938, **79**, 503-505 and 591-592; **80**, 65-66, 151-152, 247-248, 343-344 and 391-392.

Preliminary operations (cleaning, fleshing and tanning, drying, oiling and trampling) are described. The articles deal mainly with methods of fur dyeing, the colouring matters used and common difficulties liable to arise. It is urged that a definite meaning should be attached to the phrase "owner's risk". W.

Wool Hat Dyeing. K. Rickert. *Deut. Färber-Ztg.*, 1938, **74**, 293-294 (through *Brit. Chem. Abs.* B., 1938, **57**, 1285).

The degreasing, carbonising, and dyeing of wool for hat manufacture is discussed. After-chrome, mordant, or acid dyes are used, the dyes being chosen for good fastness to light. The importance of absence of fatty acids in these processes is emphasised; the rate of boiling and degree of acidification need careful control. Bowler hats are stiffened before dyeing and are dyed with a mixed bath of chrome-black and logwood. W.

Chrome-dyeing of Loose Wool. K. Rickert. *Deut. Färber-Ztg.*, 1938, **74**, 373 (through *Brit. Chem. Abs. B.*, 1938, **57**, 1285).

Machine chrome-dyeing of loose wool is discussed with particular reference to sources of error, e.g. presence of iron and insufficient circulation in the machine. Care must be taken in the selection of suitable dyes for machine-dyeing, and the use of textile assistants, e.g., Igepal W and Igepon T, is advised. Details of typical machine-dyeings are given. W.

(J)—PRINTING

Emulsion Thickening Agents: Use in Printing. H. Gerber. *Textilberichte*, 1938, **19**, 804-807.

A thickening agent for use in printing pastes is prepared by mixing 87·5 parts of water and 10 parts of Skomulgol 70P, heating to 100° C., stirring in 12·5 parts of potato starch, leaving to swell for 5 minutes, cooling, and stirring in 5 parts of sodium chloride dissolved in 20 parts of water. When the thickening agent is to be used in printing with vat dyes the coagulation may be effected with sodium or potassium carbonate instead of with sodium chloride and the amount of alkali added to the printing paste may be reduced accordingly. Thickener and printing paste recipes for various classes of dyes are given. The emulsified starch thickeners of this type give good results in printing and are easily removed by washing. Other thickening agents have been prepared by emulsifying oils, such as Diesel motor oil and machine oil, with Skomulgol 70P and mixing with aqueous solutions of Nekal A.E.M. These did not give entirely satisfactory results in printing and additions of bentonite and montan wax to the printing pastes failed to improve the results appreciably. Very good results in both direct and discharge printing processes can be obtained by the use of thickening agents prepared from tall oil distillate, Skomulgol 70P and Nekal A.E.M. C.

Printing Rollers: Costs and Renewals. H. Perndanner. *Textilberichte*, 1938, **19**, 799-802.

The costs of copper printing rollers and the losses in weight and value caused by engraving, turning and re-engraving are discussed. It is pointed out that a roller can on an average be used for twelve engravings, after which it reaches the minimum usable diameter and its value must be reckoned in terms of scrap copper. The roller requirements of a typical printing mill having six machines and the depreciation of the rollers and costs of renewals are estimated. The advantages of a new process in which a roller is provided with a new surface layer of copper by electrolytic deposition is pointed out. With this method it is possible to maintain the printing rollers at constant diameters and to reduce costs of renewal. The electrolytic copper layer can be applied over a separating surface so that when the engraving with which it is provided is no longer required

the layer can be drawn off. Considerable savings in roller costs can be effected by using steel rollers provided with copper surface layers to receive the engraving. Methods and plant for the production of such rollers are described and costs are compared with those of all-copper printing rollers. C.

Screen Printing Stencils: Preparation. A. Franken. *Textilberichte*, 1938, 19, 802-804.

The photo-mechanical process for the preparation of screen stencils is discussed and copying, illuminating, drying, mounting and reproducing apparatus supplied by Klimsch & Co. is briefly described and shown in photographs. C.

Bemberg Rayon Matt White Reserve Prints under Indigosol Dyeings: Production. F. Nestelberger. *Monatsh. Seide u. Kunstseide*, 1938, **43**, 409-410.

Matt white reserves under Indigosol dyeings on Bemberg rayon fabrics are produced by first printing with a paste containing titanium dioxide, a reserving agent such as Rongalite C, egg albumin, Soromin AF paste, Indanthrene blue RZ, gum, etc., steaming, and then dyeing with Indigosols, preferably by the nitrite padding process without intermediate drying. Recipes, details of the procedures, and samples of fabric are given. C.

Green Rapid Fast, Rapidogen and Indigosol Prints: Production. H. Gürtler. *Textilberichte*, 1938, **19**, 795-796.

The development of Rapid Fast, Rapidogen and Indigosol dyes and their use in printing are discussed with special reference to the problem of producing green shades. Owing to the lack of green in the Rapid Fast series attempts were made to use Rapid Fast dyes in combination with basic and mordant dyes but the results were not satisfactory in regard to fastness and clearness. With the development of Indigosols it became possible to produce certain green shades by the use of Indigosol O and O4B in combination with Rapid Fast yellow, but the fastness of the products was not entirely satisfactory. Later Rapidogen green B was produced but its use is limited to the production of dark bottle green shades. Indigosol green 1B gives bluish greens but can be used in combination with new fast yellow dyes of the Rapidogen and Rapid Fast series for the production of green shades of yellower tone. The use of such combinations, however, presents certain technical difficulties. The development of Indigosol yellow V, the first bright, greenish yellow of the Indigosol series, used with Indigosol green 1B, provided a partial solution of the green problem but the dyeings are not sufficiently fast to light and in sunlight Indigosol yellow V attacks the fibre. The green problem has only recently been solved by the introduction of Indigosol green 13G, which gives bright, yellowish-green shades of good fastness to light. C.

Machine Prints: Production. C. N. Rabold. *Cotton (U.S.)*, 1938, **102**, No. 3, 53-5, 70; No. 4, 78-80; No. 6, 52-4, 101; No. 8, 58-63; No. 11, 46-50.

A general account of machine printing, dealing with (1) Styles of printing, (2) The printing machine and its operation, (3) Engraving the rollers, arranging the colours, and some common troubles, (4) Preparing the colours and pastes, ageing, soaping and drying, and (5) Sewing, singeing and other treatments before bleaching, and calendering. C.

Wool Printing. *Wool Record*, 1938, **54**, 901-902 and 907-909.

A comparison is made of cotton and wool printing. The printing of various types of wool cloths is described, e.g. imitation worsted suitings and overcoatings, scarves, felt, hanks, carpet yarns, pile fabrics and imitation skins. W.

(K)—FINISHING

Colour Theories: Relation to Designing. A. Lambrette. *Revue Textile*, 1938, **36**, 285-289, 439-449; also *Tiba*, 1938, **16**, 477-487.

It is shown how designers may be hampered by wrong ideas of optics resulting from unsatisfactory training. Attempts to explain colour harmonies on the basis of a colour scale analogous to the musical scale, by theories of complementary colours, by methods based on the law of surfaces, or by various other theories are critically discussed and shown to be unsatisfactory. A new explanation of colour harmonies based on a consideration of wave lengths and the different frequencies co-existing in compound colours is proposed and it is shown how such practical conceptions as warm, cold, rich, dull, brilliant and loud colours

can be explained by the new theory. The effects of the juxtaposition of different colours, the differences in appearance on different materials, and the effects of raising, calendering and other finishing treatments on the colour of dyed fabrics are discussed, and the importance of a consideration of diffraction and refraction effects is pointed out. A table is given showing colours giving good, medium and bad effects on various coloured grounds, and also the influence of neighbouring colours on various colours. C.

Diazosulphonates: Application in Printing. R. L. Desai, T. N. Mehta and V. B. Thosar. *J. Soc. Dyers and Col.*, 1938, **54**, 371-381.

The diazosulphonates, obtained by the action of sodium sulphite on diazonium salts, are stable compounds capable under certain conditions of coupling with Naphtols and the like. They exist in a stable *anti*-modification that does not couple until converted into the reactive *syn*-modification, a change that is brought about by light in some cases or by addition of an acid and an oxidising agent. The authors have prepared a number of diazosulphonates from the bases commonly used in Naphtol dyeing and made a systematic study of the conditions under which they can be applied in printing (including photo-printing), of the rate of conversion from the *anti*- to the *syn*- form, and of the effects of substituents and their orientation on this change. The results are summarised in tables and graphs. C.

Plantago Seed Husk Mucilage: Application in Printing and Finishing. S. R. Ramachandran and K. Venkataraman. *J. Soc. Dyers and Col.*, 1938, **54**, 462-464.

The seed husks of *Plantago ovata* form a popular remedy for stomach troubles in India. In the preparation of the clean husk quantities of a darker husk powder accumulate. This forms a mucilage in cold water that can be bleached to a pale cream paste by chlorine. The paste is recommended for printing and finishing, and recipes are given. C.

Textile Printing Research: Development. W. H. Cady. *Amer. Dyes. Rept.* 1938, **27**, 569-571.

The present position of research in the United States on printing pastes and the processes at work in the ager is reviewed and an appeal is made for more support. C.

Artificial Plastics: Production in Germany. K. Mienes. *Angew. Chemie*, 1938, **51**, 673-681.

An illustrated report of a lecture on the production of plastics in Germany and its politico-economic significance. A series of interesting "trees" are given, tracing the production of various materials from (*a*) cellulose, (*b*) phenolic resins, (*c*) urea-formaldehyde resins, and (*d*) acetylene and ethylene. C.

Synthetic Resins: Use in Finishing. J. Wakelin. *Rayon Textile Monthly*, 1938, **19**, 567-568, 635-636.

A review of the use of synthetic resins in finishing processes, including the production of crease-resisting finishes, treatments to reduce the fibre slippage and lustre and to increase the resistance to wear of rayon, the production of permanent mechanical finishes on fabrics and of permanent crimp in staple fibre, treatments to impart affinity for basic and acid dyes to cellulosic fibres and to improve the fastness of dyeings, and treatments to reduce the tendering action of light on cellulosic fibres. C.

Plush: Finishing. N. Alban. *TIBA*, 1938, **16**, 495-503.

A general account is given of the methods of finishing plush for dress materials, trimmings, etc., including plush fabrics with schappe and tussah silk, cotton, rayon and mohair piles. The finishing treatments include carding, smoothing, wetting, pile raising and shearing operations. The production of imitation fur effects on plush fabrics is also described. C.

Ladder-proof Viscose Rayon Fabrics: Finishing. E. Dutoit. *Teintex*, 1938, **3**, 612-616.

An account is given of methods of finishing ladder-proof or warp knitted viscose rayon fabrics, particularly methods of delustring and methods depending on the use of solutions of cellulose ethers. C.

Foam-preventing Agents. F. Ohl. *Monatsh. Seide u. Kunstseide*, 1938, **43**, 411-413.

A general discussion of foam formation, especially in sizing and finishing preparations, the action of foam-preventing agents, the various foam-preventing agents now available and their uses. C.

Comparison of Setting Processes for Wool. G. L. Atkinson. *Dyer*, 1938, **80**, 299-300.

By the use of a 2% solution of borax in the setting liquor, giving a constant *p*H value of about 9·1, the maximum benefits in handle and finish are obtained. W.

Modification of the Colloidal Characteristics of Rubber Latex. C. M. Blow. *Proc. Rubber Technology Conference*, 1938, Paper No. 38, pp. 186-195.

A method and apparatus for determining the electro-kinetic potential of suspended particles by measurements of their cataphoretic velocity is described. Measurements are recorded of the cataphoretic velocity of oil particles suspended in water and of the rubber particles in latex, in the former case in presence of protein, "cationic" soap, and "anionic" soap, and in the latter case in presence of the two types of soap. The influence of *p*H on the cataphoretic velocity is noted also, and an analogy drawn between this effect in the case of oil suspensions and the reversal of the charge on the rubber particles in latex on acidification. An attempt is made to determine the constitution of the adsorbed layer on the particles in latices stabilised by "cationic" and "anionic" soaps. It is concluded that the "cationic" soap is more adsorbed in alkaline solution and the "anionic" soap in acid solution. The technical applications of latex with positively charged particles, produced by adding a "cationic" soap, are illustrated by experiments on the deposition of rubber on wool fibres. W.

Ageing of Rubber in Relation to its Textile Applications (With Particular Reference to Wool). C. M. Blow. *Proc. Rubber Technology Conference*, 1938, Paper No. 101, pp. 697-704.

Rubber desposited on wool from latex by a new process is in the form of a fibre coating, with a large surface area exposed to ageing conditions. Properties of such treated wool are briefly described, and the conditions to which it is likely to be exposed in manufacture and service are outlined. It is emphasised that deterioration of the rubber in these products should be studied in terms of the deterioration of the product, and not simply in terms of rubber oxidation. Loss of tensile strength and increase in acetone extract of the rubber up to 95% does not affect the binding property of the rubber, but affects the handle of the material somewhat. Washing in soap and soda removes a large proportion of the aged rubber from the wool, and also removes the harshness. A washing test has been evolved which has useful application in testing fabrics likely to be laundered in service, and has some advantages over an acetone extract test. For non-laundered fabrics, ageing is followed by means of harshness observations. Various factors, including presence of copper, iron, pigments, and anti-oxidants, which influence washing loss are referred to, and the mechanism of the removal of oxidised rubber by soap is discussed. W.

(L)—Proofing

Aluminium Powder: Application to Preservation of Vulcanised Rubber. T. R. Dawson. *J. Rubber Research*, 1938, **7**, 95-108.

Application of aluminium powder has been suggested as a means of protecting vulcanised rubber against tropical heat and light. It is now shown that it is unsatisfactory to compound the aluminium with the rubber but that dusting or painting serve a useful purpose. Published information on the subject is reviewed and it is pointed out that aluminium paint also affords protection to rubberised fabrics but is surpassed by other pigments, varnishes and dopes. The production and analysis of aluminium powder are briefly outlined. C.

Latex: Impregnation of Textiles. J. Duarry. *17me. Congrès Chim. Ind.*, 1937, 578-584.

It is claimed that thorough impregnation instead of surface coating is obtained by applying a diluted latex, stabilised by the addition of a small quantity of sodium silicate, under high pressure in an autoclave. Evidence of the penetration

is given by cross-sections of a belt, a jute cloth, cotton and hemp yarns, in which the cellulose has been carbonised by sulphuric acid, leaving the rubber white. C.

Recent developments in Electrical Insulating Materials. L. Hartshorn. *Jour. Sci. Insts.*, 1938, 15, 217-222.

The paper describes the large range of materials available for use as insulating materials, and discusses the properties of each. The materials considered are divided into the following groups—(1) those used for general experimental work, e.g. instrument panels; (2) those used for work at high frequencies; and (3) liquids or fusible materials for impregnation or immersion media when various dielectric constants are required. The materials for high frequency work are further subdivided into synthetic resins and ceramics. L.

Patents

Luminescent, Phosphorescent and Fluorescent Fibres and Textile Products. J. Carlier. Belgian P. 424,419 of 31/12/1937 (through *Chem. Abs.*, 1938, **32**, 7744).

Luminescent cadmium sulphide, zinc sulphide, alkaline earth sulphide, etc., are mixed with a solution of a vinyl compound. The resultant mass is used for impregnating fibres or fabrics. W.

Mothproofing Fibrous Material. D. W. Jayne, Jr. (to American Cyanamid Co.). Canadian P. 375,599 of 9/8/1938 (through *Chem. Abs.*, 1938, **32**, 7748).

The material is treated with a phenolic salt of a disubstituted guanadine, e.g., dixylylguanidine. W.

Elastic Fibres. P. J. Gaylor (to Standard Oil Development Co.). Canadian P. 375,669 of 9/8/1938 (through *Chem. Abs.*, 1938, **32**, 7744).

Fibres of high stability and resistance are produced by ejecting through a small opening an emulsion containing a substantially saturated linear hydrocarbon polymer of over 40,000 estimated average molecular weight into a coagulating bath. Threads of textile material are woven around the dried fibre. W.

Increasing the Electrical Resistance of Animal Fibres. A. C. Goodings (to Dominion Silk Mills Ltd.). Canadian P. 375,958 of 23/8/1938 (through *Chem. Abs.*, 1938, **32**, 8158).

Animal fibres, e.g. natural silk or wool yarns, are treated with acid, e.g. acetic acid, to remove at least part of the natural salts, heated, treated with dry steam for about 20 min. and maintained for a short time after removal of the steam at a temperature above the boiling point of water. W.

Waterproofing Wool. Merkel and Kienlin G.m.b.H. D.R.P. 661,673 of 24/6/1938 (through *Chem. Abs.*, 1938, **32**, 8798).

Wool fibres are chlorinated by treatment with commercial calcium hypochlorite and hydrochloric acid, washed, soaked with aluminium acetate, washed in a bath containing soap and paraffin emulsion, pressed and hot-dried. W.

Antiseptic Clothing. E. Lüder. D.R.P. 662,444 of 13/7/1938 (through *Chem. Abs.*, 1938, **32**, 7680).

Articles of clothing are impregnated with a solution of salicylic acid in an organic solvent. W.

Treating Textiles. Böhme Fettchemie-Ges.m.b.H. (H. Bertsch, inventor). D.R.P. 663,153 of 30/7/1938 (through *Chem. Abs.*, 1938, **32**, 7746).

In treating textiles in hard water baths containing soap or Turkey red oil, deleterious effects due to the formation of soaps of calcium, and magnesium are avoided by including in the baths a sulphuric ester of a higher aliphatic alcohol, e.g., $C_{12}H_{25}OH$, with or without a dialkali phosphate. Examples are given. W.

Radioactive Cloth. L. Gitmul. F.P. 826,345 of 29/3/1938 (through *Chem. Abs.*, 1938, **32**, 7346-7).

Radium precipitated in an insoluble state on the cloth in the form of oleate or salt of fatty acid along with metal oleates or other compounds of metals and fatty acids, particularly aluminium oleate. The radium is thus fixed to the cloth. W.

Printers' Blanket. W. C. Calvert, Assr. to Wingfoot Corp. U.S.P. 2,064,780 of 15/12/36 (through *Brit. Chem. Abs., B.* 1938, **57**, 1198).

A printers' blanket (of rubber or felt) is provided with a flexible coating of a (stabilised) rubber hydrohalide (hydrochloride) to render it oil-proof. W.

Treating Furs. J. Jacobs. U.S.P. 2,126,261 of 9/8/1938 (through *Chem. Abs.*, 1938, **32**, 7748).

A comminuted, relatively soft, solid fibrous material such as shredded leather or asbestos impregnated with hide softening, pest-control and glaze-coating agents such as pine oil, PhOH and casein is worked through the fur by a manual combing operation. W.

Mothproofing Wool or Other Textile Fabrics. A. C. Fischer, U.S.P. 2,127,252 of 16/8/1938 (through *Chem. Abs.*, 1938, **32**, 8165).

A process for mothproofing textile fabrics by liquid immersion, consists in agitating the fabrics in a liquid hydrocarbon bath containing a quantity of an aqueous solution of an inorganic moth repellent consisting substantially of a relatively soluble fluoride, the solution being dispersed in the liquid hydrocarbon to an extent to produce a visible opacity, proportioning the quantity of the aqueous solution to the weight of the fabric under treatment, and in agitating the fabric in the liquid mixture until substantial clarification of the liquid, as indicating absorption of the aqueous solution by the fabric. W.

Insect-combating Compositions Suitable for Treating Textile Fabrics, Furs, etc. H. Martin (to J. R. Geigy A.-G.) U.S.P. 2,127,879 of 23/8/1938 (through *Chem. Abs.*, 1938, **32**, 8048).

A composition suitable for use in mothproofing, combating flies, etc., contains as an essential ingredient α-acetobenzotetronic acid, α-carbanilidobenzotetronic acid, the ethyl ester of benzotetronic acid or various compounds of the general formula—

$$\underset{\alpha}{\text{CO·O·X·CO·CHCOR}}$$

X being $-CH_2-$, $>CH\cdot$ lower alkyl, $-CH=CMe-$, $-CH=CPh-$, phenylene or naphthylene, and R being the group $-O\cdot$ lower alkyl, $-O\cdot$ aralkyl, $-NH_2$, $-NH\cdot$lower alkyl, $-NH\cdot$aryl, aryl·N·lower alkyl, $-NH-$ and $-N=$cycloalkyl, lower alkyl, aralkyl or phenyl. Various examples are given. W.

Mothproofing Fabrics. L. E. Mills and W. W. Allen (to Dow Chemical Co.) U.S.P. 2,128,189 of 23/8/1938 (through *Chem. Abs.*, 1938, **32**, 8800).

Woollen fabrics and other materials are treated with phenyldi-(*o*-xenyl)-phosphate. W.

Azo Dyes: Application. E. I. Du Pont de Nemours & Co. B.P. 490,830 of 13/11/1936 (Conv. 13/11/1935). Void.

For dyeing and printing textile and other materials by forming azo dyes in situ, use is made of neutral or alkaline compositions containing (*a*) a diazotised aromatic amine stabilised against reaction with a coupling component in a neutral or alkaline medium, and (*b*) a coupling component containing an azo group. Component (*a*) is stabilised by conversion into a diazoimino compound or a nitrosamine or an azosulphonate. The compositions may be produced in the form of powders, pastes or solutions, and after they have been applied to the material to be dyed, the colour is developed by treatment with an acid. The compositions may be applied to cotton, regenerated cellulose, cellulose esters and ethers, wool, silk and leather. C.

Azo Dyes: Production. W. W. Groves (I. G. Farbenindustrie A.-G. B.P.). 490,941 of 23/2/1937.

Azo dyes, insoluble in water, are made in substance, on a substratum or on the fibre by coupling the diazo compound of an amine of given general formula with an arylide of 2:3-hydroxynaphthoic acid. In examples, bleached cotton piece goods are impregnated with the anilide or *o*-toluidide and printed with a paste containing 2:5-diethoxy- or dimethoxy-5′-methyl-2′:4′-dinitrodiphenylamine-4-diazonium chloride, dried and passed through a hot sodium carbonate solution (blue black). C.

Soluble Cellulose Ester Dyes: Preparation. A. Carpmael (I. G. Farbenindustrie A.-G.). B.P. 490,945 of 24/2/1937.

Water-soluble dyes for dyeing and printing cellulose esters and ethers are made by treating insoluble or difficultly soluble dyes which contain at least once the grouping NR_1R_2, where R_1 is hydrogen or an organic radical, and R_2 is an organic radical, at least one of these radicals containing a reactive halogen atom, with a thiosulphate, whereby a thiosulphuric group $S\cdot SO_3H$ is introduced into the

group R_1 or R_2. In a modification of the process, the thiosulphuric group is introduced in the same manner into an intermediate product and the latter is converted into the dye. C.

Soluble Cellulose Ester Dyes: Preparation. I. G. Farbenindustrie A.-G. and G. W. Johnson. B.P. 490,958 of 16/4/1937.

Dyes are made by coupling diazo compounds of aromatic or heterocyclic amines containing carboxylic groups but being free from sulphonic groups with arylaminocarboxylic acid nitriles of the formula XYN·R·CN which are free from sulphonic and carboxylic groups and in which R is a methylene group or chain of methylene groups, X is a hydrogen atom or an alkyl, hydroxyalkyl, aryl, or aralkyl group and Y is an aryl group. The products are soluble in water and dye cellulose esters and ethers red to yellow shades. C.

Disazo Dyes: Production. Durand and Huguenin A.-G. B.P. 490,965 of 28/5/1937 (Conv. 28/5/1936).

Mordant dyeing disazo dyes are made by coupling J acid first in a weak acid medium and then in an alkaline medium with two molecular proportions of diazotised *o*-aminophenols or *o*-aminonaphthols at least one of them having a hydroxy group and a carboxy group in *o*-position to one another. They may be used for chrome printing and are of particular value in the form of their complex metal compounds, being suitable for dyeing and mordant printing on cotton, silk and regenerated cellulose. C.

Salicylic Acid Derivative Azo Dyes: Production. G. W. Johnson (I. G. Farbenindustrie A.-G.). B.P. 491,019 of 24/2/1937.

Azo dyes are made by treating disazo dyes of the formula A·N:N·B·N:N·C (in which A is the residue of salicylic acid or a derivative thereof, B is the residue of an aromatic middle component, and C is the residue of an aromatic amine coupled in *p*-position to the amino group) with phosgene, or by coupling tetrazotised aromatic amines of the general formula D·NH·CO·NH·D (in which D is the residue of a diazotisable aromatic amine containing the amino group in *p*-position to the urea group) with two molecular proportions of a diazotisable amine, again tetrazotising and coupling with two molecular proportions of salicylic acid or a derivative thereof, and in each case the initial materials being so selected that the final dye contains at least two sulphonic groups. They dye vegetable fibres or regenerated cellulose red to violet-brown shades and may be used in admixture with acid wool dyes for dyeing mixed materials, the dyeings preferably being after-treated with metal salts. C.

Rayon Fabrics: Shrinking to Improve Extensibility. A. Mellor. B.P. 491,021 of 24/2/1937.

Rayon fabrics of improved extensibility are obtained by shrinking fabrics containing superficially saponified yarns of cellulose organic esters with aqueous solutions of organic liquids having a solvent or swelling action on the organic esters. Caustic soda or potash, or sodium carbonate may be used as saponifying agent. In the case of cellulose acetate yarns the superficial saponification may be such that the average acetyl value is reduced to 1·8-2·1 acetyl groups per cellulose unit. Saponification of the yarn may be effected either before or after the formation of the fabric. Acetone, dioxane, or ethylene methylene ether, may be used as shrinking agent. C.

Phthalocyanine Dyes: Production. I. G. Farbenindustrie A.-G. B.P. 491,151 of 26/2/1937.

Phthalocyanine dyes are manufactured by sulphonating phenyl substituted phthalocyanines, such as those obtained by heating 3:4-dicyanodiphenyl and 4-chloro-3′:4′-dicyanodiphenyl with cuprous chloride. The products may be converted into colour lakes, e.g. by means of alkaline-earth metal salts, preferably in the presence of aluminium hydroxide. Some of the dyes have an affinity for cellulosic materials and may be used for dyeing paper light green shades, whilst the lakes may be employed for colouring wall paper and for dyeing rayon in the mass, i.e. by addition to spinning solutions. C.

Cellulose Derivative Crimped and Staple Fibre Yarns: Hot Air Treatment. G. H. Ellis and D. Finlayson. B.P. 491,250 of 26/2/1937.

Crimped or staple-fibre yarns of organic derivatives of cellulose or other thermoplastic substance are treated with hot air after completion of the crimping

or stapling process, until the permanence of their voluminosity and resilience is increased. Hot air of at least 90° C. is preferably employed for 15-30 min. Materials treated include yarns of thermoplastic synthetic resins, e.g. polyvinyl acetate. The materials may be treated as yarn or after being made up into garments. C.

Nitrogenous Fibrous Materials: Treatment to Modify Dyeing Properties. Aceta Ges. B.P. 491,314 of 26/1/1937 (Conv. 6/2/1936).

Animal fibres or other natural or artificial fibrous or film-like materials consisting of or containing protein substances, or containing basic amino or imino groups attached to residues, not removable by rinsing with water, are treated with one or more substances adapted to react under the treatment conditions with amino or imino groups to form a substituted amidine. Such treatment modifies the affinity of the materials for various agents, e.g. acid or basic dyes and their components, mordants, tanning and loading agents or agents for combating pests and may be effected before, during, or after a dyeing operation. Specified materials treated are wool, chromed or chlorinated wool, wool pre-treated with alkali, potassium thiocyanate or hydrogen peroxide, loaded or non-loaded silk, casein or fibroin rayon, feathers, bristles, etc., and cellulose derivatives containing basic ester, ether or amide groups or containing basic resins. The treatment may be applied locally to obtain printing, including reserve printing effects. Specified amidine-forming reagents include cyanogen, cyanogen halides and their polymerides, cyanamide and its dialkyl derivatives and tautomerides, 3-cyanamidobenzoic acid, isourea, etc. C.

Cellulose Ether Coating Compositions. E. I. Du Pont de Nemours & Co., J. K. Hunt and G. H. Latham. B.P. 491,317 of 25/2/1937.

A composition for coating and impregnating paper and other felted or woven fibrous materials contains a mixed ether of cellulose containing an alkyl substituent having less than three carbon atoms per alkyl group and another alkyl substituent containing from 8 to 18 carbon atoms per alkyl group. The mixed ether may contain from 0·5 to 2 higher alkyl groups and from 0·5 to 2 lower alkyl groups for each unit of cellulose. Suitable higher alkyl groups are those corresponding to the mixture of alcohols obtained by catalytic hydrogenation of coconut oil fatty acids, known as "Lorol". C.

Mothproofing; Sulphonic Acid Esters. J. R. Geigy A.-G. B.P. 491,434 of 10/3/38. Addn. to 484,448 (see *J. Text. Inst.*, 1938, A544).

Material such as wool, hair, fur, and feathers is rendered mothproof by treatment with a substituted aryl sulphonic acid ester of the general formula—

$$R_1\text{–}SO_2\text{–}OR_2$$

where R_1 is a halogen substituted benzene radical and R_2 is an aryl radical which may be substituted by halogen or alkyl groups. The compounds may be made from the corresponding acid chlorides, e.g. chlorobenzene and dichlorobenzene-sulphonic acid chlorides and aromatic hydroxy compounds, e.g. cresols, chlorophenols, naphthols, dihydroxy-diaryl-sulphones, dihydroxy-diphenyl-sulphoxides, hydroxy- and dihydroxy-diphenyls. The esters may be applied in solution in organic solvents such as alcohol and acetone. The following esters are particularly specified; the *p*-chlorobenzene sulphonic acid ester of *p*-chlorophenol, *p*-cresol, *o*-chlorophenol, *p*-amyl-phenol, or β-naphthol; the di-(*p*-chlorobenzene sulphonic acid ester) of dihydroxydiphenyl, dihydroxy-diphenyl-sulphone, or diphenol-isatin; 3 : 4-dichlorobenzene sulphonic acid ester of *o*-chlorophenol; 2:5-dichlorobenzene sulphonic acid ester of *p*-chlorophenol. W.

Curling Fibres. Chemische Fabrik J. A. Benckiser Ges., & A. Volz. B.P. 492,570 of 24/11/1937.

Artificial silk fibres of cellulose or esterified cellulose are curled by treating with phosphoric acids containing less water of constitution than orthophosphoric acid, e.g. meta-pyro- or poly-phosphoric acids or their alkali salts. Other material may be added to the bath, including cleansing, wetting, softening and matting agents. An example is given. W.

Azo Dyes: Production. G. W. Johnson (I. G. Farbenindustrie A.-G.). B.P. 491,496 of 1/3/1937.

Azo dyes are made by coupling diazo compounds of amines of the general formula $R{\cdot}NH{\cdot}CO{\cdot}R_1NH_2$ (in which R is the residue of a sulphosalicylic acid in

which the carboxylic group is in *m*-position to the -NH group and R_1=phenyl) with amines capable of coupling (including heterocyclic amines) and treating the resulting dyes with phosgene, or by coupling a diazo compound of an amine of the above formula (2 mols.) with a urea capable of coupling derived from two molecular proportions of an amine (1 mol.). Instead of the amines, there may be used compounds which are capable of being converted into amines, e.g. the diazo compound may be coupled with a nitrophenyl pyrazolone and the nitro-azo dye reduced. The products dye vegetable fibres and regenerated cellulose or mixtures thereof with wool in yellow to red shades; the dyeings may be after-treated with metal salts. C.

Enzyme Desizing Preparations: Stabilising. Rohm and Haas A.-G. B.P. 491,515 of 3/3/1937 (Conv. 5/3/1936).

Starch-degrading enzyme preparations suitable for desizing fabrics are stabilised against the decomposing action of copper salts by adding blood, defibrinated blood, blood powder, a coagulation obtained by boiling blood or salting out blood for instance by ammonium sulphate or by mixing blood with anhydrous sodium sulphate and drying the mixture. Details are given of the loss of activity in presence of copper sulphate of pancreas amylase and malt extract without and with the blood addition, and also with other known additions. C.

Vat Dyes: Production. I. G. Farbenindustrie A.-G. B.P. 491,525 of 4/3/1937 (Conv. 4/3/1936).

Vat dyes are made by ring-closing 4-amino-1-anilidoanthraquinone-3′-halogen-2′-carboxylic acids or the esters or chlorides thereof or the corresponding 3-sulphonic acids, the 4-amino group being aroylated prior to or after ring closure. Ring closure is effected by splitting off water from the acids, treating the acid chlorides with aluminium chloride or vatting the esters. The aroylation is preferably carried out in a solvent such as nitrobenzene, and aroylating agents specified are the chlorides of benzoic acid, halogen or alkoxy benzoic acids, naphthoic acids and diphenyl carboxylic acids. The products dye vegetable fibres blue shades fast to chlorine and boiling. C.

Polyazo Dyes: Production. Society of Chemical Industry in Basle. B.P. 491,551 of 17/6/1937 (Conv. 17/6/1936).

Polyazo dyes are made from azo dyes capable of forming complex metal compounds and characterised by containing the grouping HO·R·N:N- in which R is a phenyl residue having a nitro group in *p*-position to the azo group and having the hydroxy group in *o*-position to the azo group by treating such a dye with an alkaline reducing agent until the corresponding azoxy or azo compound has been produced and if desired treating the dye thus obtained with an agent yielding metal. Starting materials which may be mono-, dis-, or polyazo dyes may be made, e.g. by coupling a diazotised 5-nitro-2-aminophenol which may contain SO_3H, halogens, alkyl or alkoxy groups with coupling components especially aminonaphthol sulphonic acids. Reducing agents which may be used in alkaline medium are glucose, alkali sulphides or stannites. The dyeings on cotton and regenerated cellulose may be after-treated with metal compounds. The dyes may also be treated in substance with agents yielding metals, e.g. chromium, nickel and copper, advantageously in presence of an organic hydroxy compound. C.

Resinous Condensation Products: Production and Application. W. W. Groves (I. G. Farbenindustrie A.-G.). B.P. 491,565 of 3/3/1937.

Insoluble products are prepared by reacting carbon disulphide with ethylene- or 1:3-propylene-imine, a C- or N-substitution product thereof, or their polymers or substitution products, at room or raised temperature in presence or absence of an acid. Equimolecular proportions, or a slight excess of carbon disulphide, may be used, and the reaction may take place in aqueous medium or in an organic liquid, e.g. an alcohol or a hydrocarbon. The products may be produced in or on cellulose or other textile fibres by treating them with solutions or vapours of the parent substances. The products may be incorporated in artificial fibres by passing the unfinished threads through successive baths containing imine and carbon disulphide or by treating xanthate-free cellulose hydrate threads, prepared from viscose or from purified xanthate containing carbon disulphide, with imine. C.

Leather Substitute: Production. A. A. Alegre. B.P. 491,716 of 3/3/1937.

A leather substitute is made by impregnating a mass of fibres of cotton, jute, etc., in the form of a felt with a solution containing rubber latex, coagulating the latex, pressing and vulcanising. The latex may contain titanium oxide, fillers, vulcanising agents, accelerators, a stabiliser, a substance to prevent hardening of the rubber, and substances to assist impregnation. A sheet of the material, after impregnation, is coagulated by means of an acid, chlorine water, steam, hot air, sea-water, etc., and is subjected to pressure, e.g. by rolling, after which it is vulcanised, e.g. by hot air, and dried. C.

Crease-resistant Pile Fabrics: Production. E. I. Du Pont de Nemours & Co. B.P. 491,779 of 4/2/1937 (Conv. 8/2/1936).

A pile fabric comprising a regenerated cellulose pile and a backing substantially non-reactive to formaldehyde, e.g. silk, is treated with formaldehyde or substances yielding formaldehyde, whereby the pile is rendered crush resistant. To the formaldehyde may be added a softening agent, preferably formamide; a stabiliser for the cellulose-formaldehyde reaction product; and a small percentage of an acid catalyst. The crush-resistant effects so produced are not affected by a high relative humidity. A suitable pile fabric may be made by interweaving a pile warp of regenerated cellulose with two ground fabrics, each comprising a warp and a weft of silk, the pile warp threads being then cut between the two fabrics, thus producing the two pile fabrics. Velvet so produced is impregnated with formaldehyde and an acid or acid salt catalyst, dried at 200-250° F. whilst the pile is brushed in alternate directions for 5-10 min., followed if desired by a heating at the same or higher temperatures to complete the reaction. C.

Coating Compositions. W. H. Moss. B.P. 491,792 of 4/3/1937.

A composition for plastics, films, or for impregnating fabrics contains a film-forming polymeric ester or ether, such as a cellulose ester or ether, polyvinyl ester or ether or poly-acrylic acid esters, and a chlorine derivative, obtainable by chlorinating in the phenylol nuclei only, polynuclear phenols of given general formula, chlorination being effected so as to introduce at least one chlorine atom into each of the nuclei. A suitable aeroplane fabric dope contains cellulose acetate, di(4-hydroxy-3:5-dichlorphenyl)dimethylmethane and aluminium powder. The compositions may contain other plasticisers, synthetic resins, pigments or dyes. C.

Azo Dyes: Production. G. W. Johnson (I. G. Farbenindustrie A.-G.). B.P. 491,793 of 4/3/1937.

Azo dyes are manufactured by coupling diazotised aromatic amines free from sulphonic acid groups with N-arylaminocarboxylic acids capable of coupling and having the general formula aryl·N(X)·R·COOH, where X is hydrogen or an alkyl, substituted alkyl, cycloalkyl, aralkyl or aryl radical, or a chain of several methylene groups connected with the aryl nucleus, and R is an alkylene radical containing at least two methylene groups. The products, in the form of their alkali salts, are suitable for dyeing and printing cellulose esters and ethers, and in the form of the free acids for dyeing textile materials prepared from cellulose esters and ethers, especially cellulose acetate rayon, with the aid of dispersing agents. C.

Cotton and Viscose Rayon: Printing. A. Davidson, S. T. McQueen, and Imperial Chemical Industries Ltd. B.P. 491,896 of 12/3/1937.

In printing cotton or viscose materials with N:N′-dihydro-1:2:2′:1′-dianthraquinoneazine or a halogen or hydroxy derivative thereof with the use of an alkali carbonate in the printing paste, the depth and purity of the colouring are improved by incorporating in the paste a trialkyl- or triaralkyl-tri-methylene-triamine. C.

Stiffened Compound Fabrics. British Celanese Ltd. B.P. 491,941 of 4/12/1936 (Conv. 4/12/1935). Void.

Wearing apparel, such as overcoats, robes, dresses, jackets, trousers and waistcoats, and hassocks and pillows are stiffened over at least a part of their area by a reinforcing layer comprising a thermoplastic material at least partly coalesced to the wearing apparel, etc. The thermoplastic material may be cellulose esters or cellulose ethers, may be present as a coating on non-thermoplastic fabric

or as a fabric containing thermoplastic yarn, may contain plasticisers and may be united to the wearing apparel, etc., by sewing or by heat and pressure. The plasticiser may be applied to the non-thermoplastic fabric. During the application of heat and pressure water, or an aqueous solution of alcohol with or without a plasticiser, or wet steam may be applied to the coalescent area. C.

Crease-resistant Cellulose Derivative Materials: Production. H. Dreyfus. B.P. 491,969 of 15/3/1937.

Filaments, ribbons, fabrics, films and like materials having a basis of cellulose acetate or other cellulose ester or ether, containing a plasticiser or other substance soluble in a liquid which is a non-solvent for the cellulose derivative, are rendered more resilient by dissolving out at least a part of the plasticiser or other substance, and simultaneously or immediately thereafter impregnating the materials with a substance or mixture of substances which are capable of reacting to form a resinous condensation product, and heating the materials to effect the condensation. The treated materials have a high resistance to creasing and their affinity for acid dyes and resistance to water are increased. Removal of the plasticiser and impregnation with the resin-forming substances may be effected in a single bath. The solvent for the plasticiser may have a swelling action on the cellulose derivative. The synthetic resin components may be added in the form of an intermediate reaction product such as di-methylol urea. Condensation may be effected by passing the materials through a heated atmosphere or over heated rolls. After the drying step preparatory to the final heating the materials may be subjected to brushing, beating or other treatment to remove resin-forming substances from the outside and to prevent the formation of a coating. Similar treatment may be carried out after the final heating. The materials may be scoured with a dilute alkaline solution. C.

Naphthindenone Derivative Vat Dyes: Production. G. W. Johnson (I. G. Farbenindustrie A.-G.). B.P. 492,043 of 15/3/1937.

Vat dyes are manufactured by treating derivatives of peri-naphthindenones, having in the 7-position or in the 6- and 7-positions either hydrogen or a substituent easily split off, viz. a halogen atom or a nitro group, with alkaline agents, and oxidising any amounts of dye which are in the leuco form. The reaction is preferably effected by heating the initial materials, if desired with the addition of diluents such as aliphatic alcohols, with alkali metal hydroxides. The products dye vegetable and animal fibres. C.

Pyrazolone Azo Dyes: Production. A. Carpmael (I. G. Farbenindustrie A.-G.). B.P. 492,104 of 12/3/1937.

Diazotisable dis- or polyazo dyes are prepared by reacting yellow pyrazolone dyes of the formula A·N:N·B, wherein A is the radical of a diazotisable component containing one or more azo groups, and B is the radical of a 1-aminophenyl-pyrazolone or a substitution product thereof, with acid halides of organic sulphonic or carboxylic acids which contain in an aromatic nucleus a substituent convertible into an amino group, i.e. a nitro or N-acyl group and which may further be substituted by negative substituents, and converting the substituent into the amino group. Alternatively, the 1-aminophenyl-pyrazolone or substitution product thereof may be condensed with the acid halide, then coupled with a diazoazo compound and the convertible group converted or vice versa. The dyes yield yellow shades when diazotised and coupled with β-naphthol on the fibre. C.

Aircraft Fabric Coating Composition. Soc. Nobel Francaise. B.P. 492,133 of 20/3/1937 (Conv. 20/3/1936).

A composition for coating aircraft fabrics comprises a polyvinyl acetal and up to 24 per cent. of a cellulose ester reckoned on the polyvinyl acetal, dissolved in a solvent of which the main ingredient is a glycol formal boiling at 78° C. The acetals may be prepared from formaldehyde, acetaldehyde, butyraldehyde and its isomers, crotonaldehyde, or mixtures thereof; the cellulose ester may be nitrocellulose or cellulose acetate and there may be added plasticisers, fireproofing agents, waterproofing agents, stabilisers, dyes and pigments. Preferably there are applied to the fabric two coats of colourless composition followed by two coats of pigmented composition. C.

Coloured Discharge Prints on Vat Dyed Materials: Production. Society of Chemical Industry in Basle. B.P. 492,166 of 10/3/1937 (Conv. 10/3/1936).

Discharge printing effects on vat dyed material, obtained by the use of an oxidising discharge agent effective in an alkaline medium, are coloured by incorporating in the discharge preparation a water-soluble ester-like derivative of a water-insoluble dye obtainable as described in B.P. 480,358. C.

Phthalocyanine Dyes: Production. G. W. Johnson (I. G. Farbenindustrie A.-G.). B.P. 492,177 of 15/3/1937.

Dyes of the phthalocyanine series are made by heating a halogenated phthalocyanine with aliphatic mercaptans or mercaptans of the benzene or naphthalene series at 250-350° C., for about 15 hours so that the final product contains at least one radical of a mercaptan. Diluents may be used. The colour of the products is displaced towards green. C.

Soluble Dyes: Production. G. W. Johnson (I. G. Farbenindustrie A.-G.). B.P. 492,194 of 19/3/1937.

Water-soluble dyes are made by condensing dinitriles of aromatic *o*-dicarboxylic acids (4 mols.) in the presence of bases of the pyridine or quinoline series (1-6 mols.) and a diluent with halides of polyvalent metals (at least 1 mol.) and separating the water-soluble fraction from the dye mixture obtained by treatment with water. Starting materials specified are phthalodinitrile and its 4-methyl- or 4-chloro-derivatives, 1:2-, or 2:3-dinitrilonaphthalene and compounds capable of conversion into such dinitriles viz. *o*-cyanobenzamide and *o*-cyanobenzaldoxime. Halides of metals of the iron group and those of magnesium, zinc, aluminium and bivalent copper may be used. Compounds of the halides with pyridine and quinoline bases may also be used. The products dye fabrics of all kinds including paper and viscose rayon in blue to blue-green shades. C.

Hollow Rayons: Impregnation with Artificial Resins. H. Dreyfus. B.P. 492,271 of 15/3/1937.

Materials comprising cellulose derivative filaments, ribbons, films or the like, which are of hollow structure or contain closed cavities, or show under the microscope the characteristic pitted or fissured appearance of cellulose derivative materials delustred by hot aqueous media, or which possess a shell of higher density than the interior, are rendered highly resilient by impregnating the materials with a substance or mixture of substances which reacts in the materials under the influence of heat to produce a resinous water-soluble condensation product, and heating to effect such reaction. Instead of cellulose derivative materials, the materials treated may comprise regenerated cellulose filaments, ribbons, films or the like which are of hollow structure or contain enclosed cavities. The materials after treatment are rendered resistant to creasing, and more resistant to water, and their affinity for acid dyes is increased. Effects such as crimping and embossing are more permanent. The resin components may be urea and formaldehyde. Other resin components are also specified. Condensation or polymerisation of the resin components is effected by passing the materials through a heated atmosphere or over heated rolls. The materials may be subjected to brushing, beating or other treatment to remove resin material adhering to the outside of the materials before or after the final heating. C.

Azo Dyes: Production. W. W. Groves (I. G. Farbenindustrie A.-G.). B.P. 492,290 of 17/3/1937.

Water-soluble azo dyes are made on the fibre by coupling on the fibre a diazotised safranine with an acylacetic arylide or a pyrazolone derivative, the salts of which have an affinity for the fibre. Blue and green shades are obtained. Other shades may be produced by mixing the safranines with other diazotisable amines. C.

Anthraquinone Dyes: Production. W. W. Groves (I. G. Farbenindustrie A.-G.). B.P. 492,291 of 17/3/1937.

Unsulphonated dyes of the anthraquinone series are made by (*a*) reacting an anthraquinone-2-carboxylic acid halide containing in 1-position a substituent exchangeable for an amine radical with a primary aliphatic amine or amines or ammonia to form a derivative containing similar or different amine radicals,

halogenating the derivative and causing the 4-halogenanthraquinone derivative thus produced to react further with a primary aliphatic amine or ammonia, care being taken by the use of a hydroxyalkylamine or hydroxyalkylamines that the final substance contains at least two hydroxyalkyl groups one of which is present in the carboxyamide group; (*b*) reacting an anthraquinone-2-carboxylic acid halide containing in 1-position an amino group or the radical of a primary aliphatic amine with a primary hydroxylamine to form a derivative containing similar or different amine radicals, halogenating the product and causing the 4-halogenanthraquinone derivative thus obtained to react further with a primary aliphatic amine or ammonia, a primary hydroxyalkylamine being used for the last-named reaction at least when the 4-halogenanthraquinone derivative does not contain in 1-position the radical of a hydroxyalkylamine; (*c*) reacting an anthraquinone-2-carboxylic acid halide containing in 1- and 4-positions substituents exchangeable for an amine radical or in 1-position an amino group or the radical of a primary aliphatic amine and in 4-position a substituent exchangeable for an amine radical with a primary aliphatic amine or amines or ammonia to form a derivative containing similar or different amine radicals, care being taken, by the use of a hydroxyalkylamine or hydroxyalkylamines, that the final substance contains at least two hydroxyalkyl groups one of which is present in the carboxyamide group; (*d*) using a sulphonamide instead of ammonia in (*a*), (*b*) and (*c*) above, the sulphonamide group in the product being saponified; (*e*) reacting an anthraquinone-2-carboxylic halide of given general formula with a primary hydroxyalkylamine to form a derivative containing similar or different amine radicals and reducing the nitro group or saponifying the acylamino group. The products dye cellulose acetate rayon blue shades. C.

Polymetaphosphoric Acid Ester Wetting Agents: Preparation. Chemische Fabrik J. A. Benckiser Ges. B.P. 492,350 of 19/3/1937 (Conv. 19/3/1936).

Polymetaphosphoric acids or fused mixtures containing them are reacted with organic compounds containing one alcoholic hydroxy group, one or more phenolic hydroxy groups or multiple linkages, e.g. hydroxy or unsaturated fatty acids or their glycerides, such as castor oil or oleic acid, unsaturated hydrocarbons such as octadecylene, higher fatty or naphthenyl alcohols, ethyl, propyl or benzyl alcohol, phenols, and hydro-phenols. The water-soluble esters obtained in this way may be neutralised directly or after taking up in water, with alkalis, alkaline-reacting salts, or organic bases. They react, either before or after neutralising, with compounds of polyvalent metals such as Ca, Mg, Cr, Fe and Cu to form complexes which contain the metal in non-ionised form. They can therefore be used to soften water or bring lime soaps into solution, and for impregnating, preserving and like purposes in the textile, leather and fur industries. C.

Silk Threads: Shrinking. K. Okazaki. B.P. 492,456 of 13/4/1937.

Threads of silk or the silk part of composite threads are shrunk by the action of a heated solution of a neutral salt, e.g. calcium chloride or nitrate. The salt may be applied locally to produce crêpe effects. C.

Vegetable Fibres: Curling. Lanatin Corporation. B.P. 492,467 of 9/6/1937.

Vegetable fibres are treated in loose form with chlorine during mercerisation, whereby they are curled. The chlorine may be introduced from an extraneous source, or may be derived from hypochlorous acid or sodium hypochlorite. In an example, jute fibres are stapled and treated with caustic soda solution, and chlorine is passed in slowly; the fibre is removed, hydro-extracted, neutralised with dilute acid and washed. The fibres may subsequently be treated with ammonium phosphate for fireproofing, and with softening or emulsifying agents and mineral oil, and with bleaching agents. C.

Azo Dyes: Production. A. Carpmael (I. G. Farbenindustrie A.-G.). B.P. 492,528 of 18/3/1937.

Azo dyes are prepared by combining tetrazo compounds prepared from aminobenzoylphenylenediamine-*o*-carboxylic acids of given general formula or their nuclear substitution products firstly with one molecular proportion of an *o*-hydroxycarboxylic acid capable of coupling, and then with one molecular

proportion of an azo component coupling in a position adjacent to a hydroxy group. When the second coupling component contains a free amino group the dye may be diazotised and coupled with an *o*-hydroxyaryl carboxylic acid. Alternatively, the dyes are prepared by coupling an *o*-hydroxycarboxylic acid with a diazotised *o*-hydroxy-azo dye of given general formula, or a nuclear substitution product thereof. The dyes may be after-treated on the fibre with metallising agents. C.

Shrunk Patterned Fabrics: Production. Heberlein & Co. A.-G. B.P. 492,573 of 23/12/1937.

The process described in B.P. 484,094 according to which pattern effects are produced on fabrics of vegetable fibres by subjecting to local parchmentising followed by overlapping local shrinking is modified by treatment of the fabric before the shrinking with a waterproof pigment-containing reserve in the form of a varnish or a solution of rubber or rubber derivative. C.

Monoazo Dyes: Production. A. H. Knight (Imperial Chemical Industries Ltd.). B.P. 492,668 of 23/3/1937.

Water-soluble monoazo dyes are made by treating the dyes obtained by coupling a diazotised *p*-nitroamine of the benzene or naphthalene series which does not contain sulphonic and carboxylic acid groups, with a substituted *Py*-tetrahydro-3-hydroxyquinoline of given general formula with an agent to form their sulphuric esters. Alternatively, the coupling component may be esterified before coupling. Sulphuric and chlorosulphonic acids are specified esterifying agents. In an example, 2:4-dinitraniline→(acid) 1-*n*-butyl-3-hydroxy-7-methyl-*Py*-tetrahydro-quinoline is treated with concentrated sulphuric acid for about 5 hours. The dyes give red, brown, violet and blue shades on cellulose acetate rayon for which they possess a good affinity. C.

Anthraquinone Dyes: Production. Imperial Chemical Industries Ltd. B.P. 492,696/7 of 25/3/1937 (Conv. 25/3/1936).

(1) Diaralkylaminoanthraquinones are obtained by reacting an amino-anthraquinone devoid of sulphonic acid groups with an aralkyl halide or sulphate above 160° C. in presence of an alkali; the products dye cellulose acetate rayon blue shades, and dissolve in organic solvents. (2) Aralkylaminoanthraquinones are obtained by reacting a nitro- or amino-anthraquinone, which may carry additional substituents, with an aralkylalcohol at an elevated temperature. Examples giving blue, orange and red shades on cellulose acetate rayon are described. C.

Quaternary Ammonium Compound Waterproofing Agents: Preparation. Farberei A.-G. vorm. E. Stolte Nachfolger and W. Missy. B.P. 492,699 of 31/3/1937 (Conv. 4/12/1936 and 6/1/1937).

High-molecular water-soluble quaternary ammonium compounds are manufactured by reacting volatile tertiary bases with the products of the action of formaldehyde or its polymers and hydrogen halides or halogens on nitrogen-containing derivatives of saturated fatty acids containing at least ten carbon atoms in the molecule or on methanes of saturated fatty alcohols containing at least ten carbon atoms in the molecule. Suitable fatty acid derivatives are higher fatty acid amides or their methylol compounds, higher hydroxamic acids, higher hydrazides, higher amidines or urea or dimethylolurea derivatives acylated on one side with higher fatty acids. When the initial material is a methylol compound the use of formaldehyde or its polymers may be dispensed with. The products are suitable for rendering textiles permanently water-repellent. C.

Softening and Weighting Compositions. W. W. Triggs (E. I. Du Pont de Nemours & Co.). B.P. 492,742 of 21/1/1937.

Self-emulsifying compositions comprise alkyl cyclohexylamine derivatives of an alcohol sulphate ester, preferably of an alcohol having 10-20 carbon atoms, together with one or more alcohols, aliphatic acids or esters as solubilising agents, and one or more aliphatic hydrocarbon oils, or waxes or halogen derivatives thereof. Oil-in-water or water-in-oil emulsions may be formed. The alcohols are preferred to the acids since they are not precipitated by heavy metal ions,

and they are also more resistant to oxidation. They are also preferred to the esters. A textile finishing oil consists of a diethylcyclohexylamine derivative of dodecyl sulphate, white mineral oil and stearyl alcohol. An emulsion is formed in the presence of 10 per cent. of Epsom salt. This emulsion is also suitable for weighting textiles. C.

Rayon: Improvement of Affinity for Dyes. A. Carpmael (I. G. Farbenindustrie A.-G.). B.P. 492,743 of 21/1/1937.

The affinity for dyes of articles such as threads, yarns, fabrics or films, made from cellulose, cellulose derivatives or polymers, (e.g. polystyrol or polyvinyl chloride) soluble in organic solvents is increased by incorporating in substance therein a reaction product of a sulphonic acid ester of a carbohydrate or carbohydrate derivative with ammonia, an amine or urea, thiourea or a substitution product thereof, which reaction product still contains sulphonic acid ester groups. Such products may be incorporated by admixture into the solutions or plastic masses from which the articles are made or by treatment of the finished articles. In the latter case the product may be applied in a solvent or emulsifying agent having a swelling action on the material treated. Specified sulphonic acid ester components are the benzene, toluene, ethane and other sulphonic acid esters of sugars, mannitol, starch, cellulose and alkyl- and hydroxyalkyl-celluloses. For admixture into solutions or plastic masses of cellulose the reaction products may, in the case of viscose, be dissolved in a solvent such as isobutylamine or benzylamine with or without an emulsifying agent and, in the case of cuprammonium cellulose be emulsified in aqueous ammonia. Specified solvents for use in treatment of the finished articles, especially of cellulose derivatives, are glacial acetic acid, glycol monoacetate, butylamine, benzylamine and pyridine. The fixation of the reaction products on the articles may be improved by an after-treatment with a solution of an electrolyte such as sodium chloride and/or by adding salts of amines, thiocyanates, thiosulphates or mordants to the impregnating and/or the after-treatment baths. C.

Weighted Crease-resistant Materials: Production. Sir Thomas and Arthur Wardle Ltd. (Leek) and C. M. Keyworth. B.P. 493,938 of 16/2/1937: 17/10/1938.

A process for improving textile materials, especially cotton, rayon or silk yarns or fabrics, by means of which it is possible to increase their weight and usually also at the same time to improve their resistance to rumpling, comprises treating the fabric or yarn with a solution of a modified urea-formaldehyde resin in which the modifying substance is added at the initial stage of condensation and consists of an organic aliphatic amino compound having not more than 5 carbon atoms or a salt of such an organic aliphatic amino compound, and in carrying the solution to the final stage of condensation under the action of heat applied to the material, which may be at, or if desired above, normal atmospheric pressure. Suitable organic aliphatic amino compounds are cyanamide, dicyandiamide, guanidine, thiodicyandiamide and amino-guanidine, or their salts. The *p*H value of the solution may vary from 3 to 10. An organic acid such as lactic or acetylsalicylic acid may be added to the solution. C.

Fabric Milling, Felting or Softening Apparatus. A. T. King and J. B. Speakman (Leeds). B.P. 494,033 of 28/5/1937: 19/10/1938.

Means for treating fibrous materials or fabrics to produce milling, fulling, felting or softening effects comprise a pair of travelling bands or conveyor belts between which, after preparation in known manner, the fabric or material to be treated is fed in open width, the opposed surfaces of the aprons or belts moving in the same direction and carrying the material continuously forward. The conveyor surfaces are constituted by endless rubber or equivalent aprons, extended between respective pairs of rollers, and having their opposed surfaces studded, nippled or otherwise provided with a relatively large number of independent or separate appropriately spaced resilient or yielding projections. Means are also provided whereby the conveyor belts or aprons can be oscillated transversely of the direction of their forward movement. The projections on the aprons may for some fabrics or for producing some effects, be provided by facing the aprons with suitable wire card clothing. C.

Crêpe Fabrics: Production. B. J. Flanagan and A. Mellor (Spondon). B.P. 494,259 of 23/4/1937:24/10/1938.

A fabric containing high twist crêpe yarns of an organic ester of cellulose is subjected to treatment with a solution of an agent having a hydrolysing or saponifying action before the crêping bath. The hydrolysing treatment increases the rate of shrinkage of the crêpe yarns and also makes it possible to obtain satisfactory crêpe effects with yarns twisted to a lower degree than that formerly required. The hydrolysing agents may be inorganic or organic acids, caustic alkalis or alkali metal salts of weak acids. Preferably the saponification results in a loss of weight of the cellulose ester materials of 5 per cent. or less. Fabrics composed entirely of cellulose ester crêpe yarns or fabrics containing such yarns in combination with regenerated cellulose, cotton, silk or wool may be treated. C.

Non-Curling Stiffened Fabric: Production. Heberlein & Co. A.-G. (Wattwil, Switzerland). B.P. 494,663 of 16/5/1938: 28/10/1938.

A process for the manufacture of a non-curling fabric stiffened by treatment with a parchmentising agent is characterised by the fact that at least one selvedge is wholly or partly excluded from treatment with the parchmentising agent. For example, the reinforced selvedge may be wholly or partially woven from yarns which resist parchmentising agents. Thus yarns may be used for the edges in the warp which have been rendered non-sensitive by formaldehyde or the yarns may be impregnated with chlorinated rubber and the like. Alternatively, the selvedges may be protected by providing the finished woven edges with a reserve which is insensitive to the parchmentising agent, say by printing a suitable reserve agent in the form of a narrow strip on the selvedge or by impregnating it with a reagent which will produce a resist to parchmentising. Another method of protecting the selvedges consists in attaching a strip of film or rubber or the like to the edge of the fabric to protect it from the parchmentising medium, the strip being removed after treatment. The treatment of the fabric may be carried out in an apparatus which is provided with guiding or protecting devices which prevent the direct access of the liquid to the selvedges. C.

Non-Curling Stiffened Fabrics: Production. Raduner & Co. A.-G. (Horn, Switzerland). B.P. 494,707 of 29/12/1937: 31/10/1938.

In a method of producing smooth, flat, non-curling stiffened fabrics, particularly permanently stiffened transparent fabrics, fabrics having the warp or weft or both consisting of right-hand and left-hand twisted yarns interspersed therein, for instance, alternating individually or in groups, are subjected to the required finishing treatments by means of known processes for producing transparency or other finishing processes having a stiffening effect. C.

Methylimino Ether Quaternary Ammonium Halides: Application to make Textiles Water-repellent. Färberei A.-G. vormals E. Stolte Nachfolger and W. Missy (Krefeld, Germany). B.P. 494,761 of 31/3/1937: 31/10/1938.

A process for rendering textiles water-repellent consists in treating the textiles with the quaternary ammonium compounds of the halogen methyl imino ethers of the general formula $R{\cdot}C{:}(NH){\cdot}O{\cdot}CH_2{\cdot}N{\cdot}Hal.$ of the halogen methyl ethers of the general formula $R{\cdot}CONH{\cdot}CH_2OCH_2{\cdot}N{\cdot}Hal.$ derived from fatty acid amides or methylol amides of the halogen methyl ethers of the general formula $R{\cdot}CHOHC{:}(NH){\cdot}OCH_2N{\cdot}Hal.$ derived from cyanhydrins (where R is an aliphatic residue of at least 10 carbon atoms and Hal. is a halogen), and then submitting the treated textiles to a heat treatment. The treatment can be applied to wool, cellulose and cellulose derivatives in the form of fibres, threads, yarns and woven and knitted goods. When applied to rayon the treatment produces not only a water-repellent effect but also diminution in the swelling power and an increase in wet strength. The effects obtained are resistant to washing with either benzene or soap. A crease-proof treatment can be combined with the water-repellent treatment and carried out in the same bath. C.

Alkoxy Thiocyanates: Application to make Textiles Water-repellent. N. E. Brookes, London (Färberei A.-G. vormals E. Stolte Nachfolger and W. Missy; Krefeld, Germany). B.P. 494,833 of 31/3/1937: 31/10/1938.

Textiles, particularly those of cellulose and cellulose derivatives, are rendered water-repellent by treatment with high molecular thiocyanic methyl ethers of the general formula $R{\cdot}O{\cdot}CH_2{\cdot}S{\cdot}C{:}N$ where R is an alkyl, cycloalkyl or aralkyl

radical which contains a saturated alkyl radical containing at least 10 carbon atoms or also the saturated or unsaturated radical of an alcohol of the sterol series, and then submitting the treated textiles to a heat treatment In a modification, the ethers are added to viscose spinning solutions. Water-soluble quaternary ammonium compounds of the thiocyanic methyl ethers may be used. Crease-proofing agents may be added to the bath. The treatment may be applied to cotton, rayon, jute, linen and wool. C.

Cotton Goods: Improvement of Wetting Properties. N. V. Chemische Fabriek Servo (Delden, The Netherlands) and M. D. Rozenbroek. B.P. 494,905 of 30/4/1937: 31/10/1938.

In order to improve the capacity of fibrous materials for being wetted prior to treatment in a liquid bath, the material is subjected in a non-compact form to an alternate drying and humidifying treatment at a temperature not exceeding 60° C. The wetting properties may further be improved by causing the fibres to absorb substances which do not naturally occur in the fibres and which reduce the rate of swelling. Suitable substances include soaps, sulphonated fatty acids, alcohols, derivatives of fatty acids and alcohols and other wetting agents. The process may be applied to cotton, rayon, jute, linen and wool. Examples describe the treatment of cotton fabrics. C.

Cold Swelling Starches: Preparation and Application. N.V. W.A. Scholten's Chemische Fabrieken. B.P. 494,927 of 14/9/1937: 3/11/1938.

Starch solutions capable of producing water-resistant layers when dried are obtained by the use of cold swelling or cold soluble starches to which an aldehyde, preferably formaldehyde, has been added before or during manufacture. It is advantageous to add to the solution a catalyst which promotes the condensation of the starch with the aldehyde. Further improvements may be effected by adding to the cold swelling starch solution a substance capable of producing condensation products of synthetic resin character with the aldehyde. C.

Alkoxy-quaternary Ammonium Salts: Application to make Cellulosic Materials Water-repellent. J. G. Evans, H. A. Piggott, C. E. Salkeld, R. J. W. Reynolds, E. E. Walker, C. S. Woolvin and Imperial Chemical Industries Ltd. (London). B.P. 495,025 of 2/4/1937: 2/11/1938.

A process for making cellulosic material water-repellent comprises impregnation with an aqueous solution of a quaternary salt of the general formula $R{\cdot}O{\cdot}CH_2{\cdot}NR'R''R'''X$ in which R stands for an aliphatic hydrocarbon radical of at least 12 carbon atoms, NR′R″R‴ stands for a heterocyclic or aliphatic tertiary amine and X stands for a salt-forming acid radical other than halogen, and heating the impregnated material (preferably after previous drying) to a temperature such that the quaternary ammonium salt undergoes decomposition. A typical salt is octadecyloxypyridinium sulphite, which is obtained by the interaction of octadecyl alcohol, formaldehyde and sulphur dioxide in the presence of pyridine. C.

Powdered Water-soluble Cellulose Ethers: Preparation. F. Sichel A.-G. (Hannover-Limmer, Germany). B.P. 495,173 of 13/5/1938: 8/11/1938.

For the production of water-soluble cellulose ethers in powder form, solutions of cellulose ether compounds, which are soluble both in cold and in hot water or alkali lyes, are dried at temperatures above 100° C. in thin layers on heated surfaces and the dry products are ground. Preferably, pasty solutions of cellulose ether compounds or salts are spread on rotating cylinders heated to temperatures above 100° C. and the dried products are detached, preferably in the form of bands, and ground. C.

Fabric Feeding Apparatus. British Thomson-Houston Co. Ltd. (London). B.P. 495,175 of 9/6/1938: 8/11/1938.

In a control system for a fabric feeding apparatus driven by an electric motor in common with a tenter frame in which the speed of the feeding apparatus can be steplessly increased in relation to the actual machine speed, an asynchronous motor used as a timing device is coupled with the driving motor of the tenter machine through a stepless regulating gear and is connected on the stator and rotor side with a similar machine mounted on the shaft of the fabric feeding apparatus and serving as a timing receiver. C.

5—ANALYSIS, TESTING, GRADING AND DEFECTS

(A)—Fibres

Argentine Cotton: Production and Fibre Characters. Messrs. L. Dreyfus et Cie. *Cotton Trade J. Internat. Edn.*, 1938, 130-1.

Cotton acreage in the Chaco reached 1,035,000 in 1937 but the crop was a comparative failure, being only 332,000 bales (480 lb.). The acreage sown in 1938 is still above the million mark. Argentine cotton is a popular substitute for N. American and in the 1936-37 season 268,361 bales were exported, including about 30,000-35,000 bales from Paraguay. Great Britain took 129,011 bales, Germany 37,468, Spain 36,315, France (with Belgium) 19,433 and Japan 17,227. A comparison between a good Argentine cotton (A) and S.M. Texas (T), $\frac{7}{8}$ in., due to the Laboratoire des Travaux de Filature et Tissage, Paris, gave the following figures—Staple, A 29·5, T 27 mm.; weight percentage of short fibre A 5·8, T 11·8; weight per 10 metres of fibre, A 0·00193, T 0·0022 gm.; breaking length, A 29, T 27·15 kilom.; breaking load per sq. mm., A 43·5, T 41·2 kilogm.; maximum counts spinnable, combed, A 62·7, T 49·6, carded for weft A 46·5, T 36·7, carded for warp, A 37·3, T 29·4. C.

Cotton Fibre: "Flat Bundle" Strength Test. H. R. Bellinson. *Textile Research*, 1938, **8**, 421-428.

An alternative to the Chandler bundle test is described. Small tufts of cotton are assembled from many parts of the supply (e.g. bale), made into a sliver and repeatedly drawn and doubled by hand, and separate tufts are then removed, held in a clamp (e.g. that supplied with the Baer sorter) and combed. The combed tuft is cut to a length of half an inch, a steel clamp being used as guide, and two or three tufts are combined to make about 21 milligrams and weighed. The weighed tuft is then spread evenly into a "flat bundle" over a space of $\frac{3}{4}$ in. and strips of adhesive tape are applied to leave a gap of 0·08 in. A simple device for mounting the bundle and strips is described. The prepared bundle is broken on a Scott pendulum-type tester, a special device being employed to ensure that the jaws are just 0·08 in. apart at the start. (The effect of length of specimen on breaking load is discussed). The breaking load, S, is converted into "lb. per gm. of fibre half an inch long," from the equation $S = 1000\ L/W$, where L is the observed breaking load in lb., and W is the weight in milligrams. A more generally useful figure is the "strength in lb. per count", or the strength of a bundle equivalent in weight to one count in the "Typp" system. Half an inch of a "1-count" (1,000 yds. per lb.) bundle would weigh 0·0063 gm., the conversion is therefore obtained by multiplying S by 0·0063. The correlation coefficient of weight per bundle and strength per unit weight for bundles weighing 11·7 to 31·1 mg. was only + 0·004, so that the assumption that breaking load varies directly with the size of the bundle, prepared as described, is justified. C.

Egyptian Cotton 1935-36 Crop: Spinning Tests. H. A. Hancock. *Min. Agric. Egypt, Tech. Sci. Serv., Bot. Sec., Bull.* No. **189**, 58 pp. (1938).

An account is given of the technique employed at the Spinning Test Mill, Giza. The standard error of a spinning test is shown to be about 1 per cent. In comparing the spinning values of old or new varieties, the strength level to which the yarns are spun is found to be of little consequence. Providing the cottons are given identical treatment, they rank in much the same order whether spun from combed or from carded preparation, in fine or in coarse counts, in warp twist or in doubling weft, over the range of Egyptian cottons. A spinning in a medium counts carded yarn gives sufficiently accurate information for most purposes. It is also found that the cash value of a cotton sample may be estimated from the result of its spinning test. The results are summarised of about 100 spinning tests on commercial cottons of the 1934-35 crop, comprising all the chief varieties in high and low grade from several graders. For comparison, spinning tests on some N. and S. American, African, and Australian varieties are given. A report on the yarn strength of mixings shows that the strength of any 50:50 mixing is near to the average strength of the components. In an experiment on the effects of bad ginning it was found that the staple was not damaged or the yarn directly weakened by bad ginning but that yarn strength was improved by about 1 per cent. for every $2\frac{1}{2}$ per cent. of "Mabruma" ("Scarto") removed before ginning. In a test on the spinning value of samples

from the different plots of a chequer it was found that the different plots are much more constant in the ultimate yarn strength than in yield, so that in sampling it is unnecessary to sample the plots proportionately to the yield. Spinnings on samples from commercial variety chequers with Giza 7 and Giza 12 indicated that high yield is not associated with inferior quality nor does low yielding land necessarily produce poor quality cotton. The yarn strength actually remains much the same whatever the yield. The results from various provinces are listed. The effect of jute on spinning value was trivial. With regard to the yarn strength of cottons spun to different counts, under the spinning conditions at Giza, a single spinning in a medium count is found sufficient to assess the merit as twist yarns of any of the cottons. The routine of the mill will therefore continue to be a spinning in 60's. The predominant influence of hair clinging power whatever the twist, is emphasised. The strength at low twist appears to be the basis on which corrections should be made, by factors at present unknown, in order to predict the strength at higher twists. An experiment in varying the feed of cotton to the carding engine showed that fast thin laps produced stronger yarns than slow thick ones. Parallel-haired laps produced, on the other hand, inferior results to normal laps. C.

Cotton Fibre: Behaviour in Cuprammonium Solution. Wanda K. Farr, J. Compton and W. A. Sisson. *Rayon Textile Monthly*, 1938, **19**, 621-626.

The results of work carried out at the Boyce Thompson Institute are outlined and illustrated by a series of photo-micrographs. The authors claim that the cellulose component of the cell membrane of the cotton fibre, which is in the form of diminutive cellulose particles, does not dissolve in standard solutions of cuprammonium hydroxide to produce the viscosities commonly attributed to it. The fibre is transformed by the cuprammonium hydroxide into a swollen, viscous mass of cementing material in which the cellulose particles are dispersed. The separated cellulose particles from which the cementing material has been removed will not produce viscosities in cuprammonium hydroxide. One component of the cementing material, the pectic fraction extracted with ammonium oxalate, will produce viscosities in the same solution to the point of formation of a stiff gel. The successive lowering of the cuprammonium viscosity of native cotton-seed fibres by the action of dilute acids or mild oxidising agents is not accompanied by a change in the optical activity of the resulting dispersions. It then follows that the optical activity of plant fibre dispersions in cuprammonium solutions is dependent upon the formation of a cellulose particle-copper complex. Quantitative examination of variously treated plant fibres dispersed in cuprammonium solutions, using the slit-ultramicroscope, reveals the presence of approximately the theoretical number of cellulose particles. It is suggested that the behaviour of plant fibres when dispersed in cuprammonium solution is attributable to properties of the crystalline microscopic cellulose particles in conjunction with the inter-crystalline fibre phase. Cotton fibres, when treated with electrolytically-prepared cuprammonium hydroxide solutions, swell and are disintegrated into small particles which disperse in the solution. The particles exhibit Brownian movement, and possess a negative charge as indicated by their cataphoretic migration toward the anode. Upon removal of the cuprammonium cations by electrolysis the particles are coagulated to form a flocculent deposit. Microscopic examination shows the deposit to consist of uniform-sized cellulose particles which give a mercerised X-ray diagram. The presence of particles in the deposited fibre material is attributed to a flocculation of colloidally dispersed crystalline particles rather than to the recrystallisation of cellulose from a state of molecular dispersion in the cuprammonium hydroxide solution. It is tentatively suggested that the peptisation and change in crystalline structure of the cellulose particle is associated with the formation of a swelling compound with cuprammonium solution. C.

Cotton Moisture Content: Volumetric Determination. N. C. Mitra and K. Venkataraman. *J. Soc. Chem. Ind.*, 1938, **57**, 306-310.

A method for the determination of moisture in cotton depends on refluxing the material with acetic anhydride in solvent naphtha, treating the excess of acetic anhydride with aniline and determining the total acetic acid formed by titration. The results obtained with raw cotton, yarn, cloth and dyed cloth are compared with those from the oven-drying and azeotropic distillation methods. C.

Cotton: Determination of Reducing Power. R. B. Forster, S. M. Kaji and K. Venkataraman. *J. Soc. Chem. Ind.*, 1938, **57**, 310-315.

A rapid method for the determination of reducing power in cellulose consists in extracting with caustic soda solution in the absence of air, oxidising the acidified extract with excess of ceric sulphate and determining the excess by titration with ferrous ammonium sulphate. The results of the "copper number" obtained by this method when the procedure is precisely followed agree with those of the Braidy method, except that for oxycelluloses of Braidy numbers above 2 the new method gives lower values. C.

Cotton for Nitration: Analytical Testing. L. Brissaud. 14 *me. Congrès Chim. Ind.*, 1934; Section 9, 29 pp.

The author gives particulars of established methods for determining copper, iodine, silver and potash numbers, α-cellulose content, methylene blue absorption, and viscosity in cuprammonium, and gives comparable results for 30-40 samples of "cotton for nitration". The results are plotted in pairs, and equations for the curves are calculated for the pairs—(1) copper and iodine numbers, (2) copper and potash numbers, (3) copper number and α-cellulose content, (4) potash and iodine numbers, (5) silver and potash numbers, and potash number and α-cellulose content. No precise relationship is found between viscosity and the various "numbers". It is recommended that at least two methods should be applied for testing a sample of cotton, preferably widely different in principle, such as copper number and viscosity. C.

Oxycellulose and Hydrocellulose: Distinction. R. B. Forster, S. M. Kaji and K. Venkataraman. *J. Indian Chem. Soc., Indust. Ed.*, 1938, **1**, 36-47, (through *Brit. Chem. Abstr.*, 1938, B. 1024).

Oxycellulose of either the reducing or acidic types can be distinguished from hydrocellulose of the same copper number by successive extractions with 10 per cent. and 1 per cent. caustic soda and addition of Indanthrene-yellow G paste to the final extract. The dye is vatted more readily by the extract from hydrocellulose. C.

Lanital and Wool Mixtures: Analysis. American Society for Testing Materials. *A.S.T.M. Standards on Textile Materials*, 1938, p. 271-272.

A "proposed method for the quantitative analysis of textiles composed of wool and Lanital" is based on flotation in a liquid of specific gravity 1·310, in which wool fibres sink and Lanital floats. C.

Tussah Silk: Determination in Mixtures. American Society for Testing Materials. *A.S.T.M. Standards on Textile Materials*, 1938, p. 270.

A "proposed method for the quantitative determination of tussah silk in mixtures with other fibres" employs acetone to remove cellulose acetate rayon, hot 5 per cent. caustic soda to dissolve wool and silk, and calcium thiocyanate as solvent for silk. C.

Wool: Stapling Test. American Society for Testing Materials. *A.S.T.M. Standards on Textile Materials*, 1938, pp. 174-176.

A "tentative method of test for fibre length of wool" (D.519) employs a stapling apparatus of the Baer type, capable of segregating the longer fibres into half-inch groups and the shorter into quarter inch groups. C.

Ashed Fibres: Microscopy. W. Schmandt. *Leipz. Monats. Text. Ind.*, 1938, **53**, 252-253.

The author describes briefly Czapla's method for the ashing of fibres, discusses the ash skeletons produced by the different types of fibres, and points out the usefulness of this method of identification. C.

Cotton Fibre: Strength Testing. W. L. Balls. *Rept. 18th Int. Cotton Congress*, 1938, 167-172; Discussion, 46-49.

The author claims advantages for his Impact Tester as a rapid means of determining the strength of cotton fibres. He contends that with Egyptian cottons there is an important "residue" of spinning quality not predictable by hair-weight, length and waste and necessitating a direct measurement of strength. Experience at the Shirley Institute is discussed that suggests that, if maturity is allowed for, the "residue" might be supplied without strength tests. C.

Egyptian Cottons: Strength, Grade and Price. H. A. Hancock. *Rept. 18th Int. Cotton Congress*, 1938, 183-189; Discussion, 56-58.

A general review of the work of the Giza Spinning-test Mill. In reply to a question about the previously published correlation between lea strength and price of cotton the author stated that work in the subsequent two years has improved the accuracy of the correlation. C.

Cotton Bales: Moisture Conditions. F. C. Toy. *Rept.* 18th *Int. Cotton Congress*, 1938, 322-323; Discussion, 108-113.

The moisture condition of cotton at the time of baling can be determined from measurements made on delivery by examination of the cotton at the centre of the bale, experiments having shown that the centre remains almost unchanged for a period of a year after baling, irrespective of where the bales are stored or of the weather conditions. The only exceptions are bales exposed to extreme conditions, such as direct contact with liquid water or excessive heat over a long period. C.

Cotton Moisture Content: Testing. International Cotton Federation. *Rept. 18th Int. Cotton Congress*, 1938, 363-388.

A German proposal for the international standardisation of the conditioning process for raw cotton is reproduced and the replies to a questionnaire received from the various European testing houses are given. Agreement appears to be necessary on the following points—(1) Number and position of samples to be taken from each bale, (2) size of the sample, (3) drying temperature, (4) method of obtaining successive equal weighings or allowance of weight tolerance and (5) the possibility of adhering to the 8·5 per cent. regain. A list of official testing houses in Austria, Czechoslovakia, Egypt, England, France, Italy, Germany, Hungary, Poland, Switzerland and Yugoslavia is added. C.

Egyptian Cotton: Regain Testing. D. A. Newby. *Rept. 18th Int. Cotton Congress*, 1938, 113-118.

An account is given of the Alexandria Testing House, including management, control and financial standing. Two methods of regain testing are used, one, of local concern only, for hydraulic bales, and the other for steam-pressed bales. Samples are taken from six or seven layers right through the bale and immediately transferred to canisters in which they are weighed. They are then dried at 120° C. An alternative method of sampling from sacks of loose cotton on their way to the bale press is mentioned. Costs of testing in Alexandria and advantages to spinners, especially of sampling at the press head, are discussed. C.

Egyptian Cotton: Regain Testing. International Cotton Congress. *Rept. 18th Int. Cotton Congress*, 1938, 122-136.

The report is given of a general discussion on the moisture content of Egyptian cotton, with special reference to the resolution adopted at the meeting of the Joint Egyptian Cotton Committee in 1936, that the standard regain of Egyptian cotton should be 8·5 ± 0·4 per cent. This is held by Egyptian authorities to be below the average "natural" regain of cotton at Alexandria but spinners contend that the practice of watering cotton in Egypt—defended because of the difficulty of grading and baling dry cotton—is the cause of the excess regain. The subject was referred for further consideration to the joint Egyptian Cotton Committee. C.

Rayon Staple Fibre and Cottonised Hemp: Properties. C. Levi. *Bollettino Cotoniera*, 1938, 33, 250-259 (Italian); *Rept. 18th Int. Cotton Congress*, 1938, 323-338 (English).

An account is given of work at the Royal Research Institute for Cellulose, Paper and Vegetable and Artificial Textile Fibres, Milan, to promote the use of staple fibre and cottonised hemp. (1) *Staple fibre.* Tensile tests and load/extension diagrams are reported for old and new Italian products (single fibres). Breaking loads at 65 per cent. R.H. and 20° C. are now equal to comparable figures for cotton. Great improvements in wet strength are also recorded. Extensions show rather large differences between the different types. The strain curves exhibit a "knee",the flatter portion corresponding with elastic deformations and the final, steep portion with permanent deformations. Typical curves are reproduced and discussed. Results of spinning tests (counts, twists, tensile data) are also recorded. Strain curves for the yarns are reproduced and differences from curves

for cotton are discussed. (2) *Cottonised hemp.* Staple diagrams of typical products are given. A common staple length is about 20 mm., and products as fine as medium American cotton are available. The breaking length generally exceeds 30 km. and reaches 60 km. The strain curve, similar to that of bast fibres in general displays the characteristic rigidity of this material. Spinning of mixtures of cotton and cottonised hemp, containing up to 50 per cent. of the latter, is normal in 16's-20's counts. The principal difficulties encountered in spinning are enumerated. The short length of the fibre does not react in an excessively unfavourable manner in spinning the mixtures In general, the strength of the yarn diminishes when the proportion of cottonised hemp increases, but it does not reach very low levels in the case of well disintegrated and carefully manufactured material. Tensile tests on mixed yarns in the wet state also show the characteristic increase in strength of the two fibres in comparison with the dry state. The elasticity of the mixed yarns is generally below that for pure cotton but the strain curves resemble those of pure cotton. C.

Silk: Water of Constitution and Hydration. A. Baroni. *Boll. Uffic. R. Staz. Sperim. Seta,* 1938, **8**, 25-27.

Cotton dried at 110° C., and wool and silk dried at 140° C., were brought to various regains at 25° C. by storage over sulphuric acid solutions and the specimens were then placed in water in a Dewar vessel and the temperature rise measured by a Beckmann thermometer. Curves connecting heat of hydration with moisture content are reproduced. The curve for cotton is smooth and lies between that for wool (higher) and silk (lower), these displaying a break at 1·5 per cent. moisture content for silk and at 2 per cent. for wool. The bearing of this on the difference in structure between cellulosic and protein fibres is discussed. C.

Mohair: Fleece Types. *Angora J.*, 1938, **28**, No. 9, pp. 3-9 and No. 10, pp. 7-8.

An account is given of attempts to evolve standards for mohair. The need for a comprehensive grading standard is great, and the superiority of the "ringlet" type in manufacture is pointed out. General suggestions are made for manufacturers' requirements as regards fineness, kemp, length, type, lustre, shrinkage and staining. W.

Grading Wool. J. W. Christie. *U.S. Dept. Agric., Farmers' Bulletin,* No. 1805, 1938, 23 pp.

A short account is given of the wool growing industry in U.S.A. and of the position regarding imports. Wool qualities and grades are described, a diagram relating American and English systems. In America, domestic wools are first broadly classified into four general groups based on areas of production: territory wool, semi-bright wool, bright wool, and southern wool. Grading in relation to the wool producer is discussed. W.

Progress in Methods of Wool Research. V. Bosman. *Farming in South Africa,* 1938, **13**, 397-400.

A brief description of methods used at the Wool Research Laboratories, Onderstepoort, S.A., for measuring fibre fineness, fleece density and yield, tensile strength, resilience, durability and scaliness. W.

Determination of Acid in Wool. *Analyst,* 1938, **63**, 782-797.

An examination of three of the methods in general use for the determination of acid in wool has been carried out in each of four independent laboratories. In initial experiments the sodium terephthalate method was found to give lower acid values than those obtained by either the sodium acetate or the pyridine method. Since it did not appear possible that the pyridine method could return more acid than is actually present, work on the sodium terephthalate method was not pursued. The results obtained by the sodium acetate distillation method were irregular and the method is influenced appreciably by a large blank correction which was found to be erratic. The results obtained by the four investigators by the pyridine method on commercially dyed and laboratory acid prepared cloth agreed well. Work was therefore directed to an examination of possible defects in the method, such as (i) degree of recovery of acid present; (ii) degree of recovery of acid from wool dried at high temperatures; (iii) titration difficulties in coloured liquors. It has now been shown that the recovery of acid from wool, whether dried at low or high temperatures, is almost complete (of the order of 90 to 100 per cent.) under conditions as originally described; i.e. the sample is

thoroughly wetted out in 0·5 per cent. pyridine (100 ml./1 g. of wool), and allowed to stand for one hour at room temperature. The difficulty of determining the end point of the titration in red or violet liquors with phenolphthalein as indicator may be overcome by substituting thymol blue for phenolphthalein. W.

Colour Reaction for Detection of Wool Fibres Treated with Hydrogen Peroxide. J. Pinte. *Rev. Gén. Mat. Col.*, 1938, **42**, 281-282 (through *Brit. Chem. Abs. B.*, 1938, **57**, 1147).

The treated fibres are detected by treatment with aqueous potassium iodide in the presence of starch. Residual oxygen in the fibres may be determined by use of potassium iodide and manganese chloride and titrating the liberated iodine with aqueous sodium thiosulphate. Details of these tests, which are specific for hydrogen peroxide treated wool, are given. W.

(B)—YARNS

Cotton Yarns: Twist and Strength. G. Taron. *L'Industrie Textile*, 1938, **55**, 271-272, 432-433.

The influence of twist on the strength of cotton yarns prepared from carded cotton and from combed cotton, the influence of irregularities in the length and distribution of the fibres in the yarn, and the distribution of the points at which break occurs between places of high, low and medium twist in the yarn are discussed, the observations being based on the results of tests on yarns spun from combed and carded Egyptian Sakel cottons. The extensibilities of the two types of yarns are also discussed and the relative importances of slipping, stretching out, and actual extension of the constituent fibres are studied. It is shown that it is possible to obtain a carded yarn of high twist equal in strength to a combed yarn of medium twist and that cotton of lower quality can be used to produce yarn of the same strength as that obtained from higher quality cotton provided that the staple length is regular and the fibres are distributed as regularly as possible in the yarn. In the selection of cotton for the production of yarn of specified strength it is necessary to consider both the differences in costs between the different qualities of cotton and the cost of the extra doublings, etc. required to produce the necessary regularity in yarns from the poorer qualities.

Moscrop Single-thread Test Records: Analysis. M. E. Campbell and G. W. Field. *Textile Research*, 1938, **8**, 429-435.

An examination of several thousand observations on the charts obtained with a Moscrop tester has shown that they are distributed according to the normal probability curve, that is 68·27 per cent. lie between limits distant from the mean by plus and minus the standard deviation. Hence, if the machine is set to give 80 readings per bobbin, 13 will fall above and 13 below the mean. The 13th punctures from the top and from the bottom of the chart, respectively, are found by inspection. The distance between them gives twice the standard error and the mid-point gives the mean. A device for the optical projection of the record on to a drawing board to facilitate inspection is described with an illustration. C.

Rayon Staple Fibre Yarns and Threads: Testing. American Society for Testing Materials. *A.S.T.M. Standards on Textile Materials*, 1938, p. 140-146.

"Tentative general methods of testing and tolerances for spun rayon yarns and threads" (D.507) are laid down. The strength tests include directions for preparing a lea from bobbins, cones, beams, etc. C.

Wetting Power and Wettability Testing Device: Application. R. B. Forster, I. S. Uppal and K. Venkataraman. *J. Soc. Dyers and Col.*, 1938, **54**, 465-472.

Various methods for conducting sinking tests are briefly reviewed and considered to be unsatisfactory. Details are given of a new apparatus based on that of Herbig, as modified by Evans, with which skeins of grey yarn, 0·5 gm., are automatically immersed in the liquid under test, removed after a prescribed interval and placed in a weighing bottle, the wetting power being calculated as the weight of liquid absorbed by 100 gm. of the yarn. A systematic study is reported on the effect on this "Herbig number" of (*a*) time of immersion, (*b*) concentration of agent, (*c*) temperature (30-97° C.), (*d*) *p*H, and (*e*) purity of the cotton yarn, results for various technical products being tabulated and graphed. Two other experiments are reported in which the apparatus was used to test the wettability of (*a*) grey and (*b*) sized yarns after various scouring treatments.

Distilled water at 30° or 24° C. was used and the apparatus set to give 30 seconds immersion. C.

Woollen and Worsted Yarns: Testing. American Society for Testing Materials. *A.S.T.M. Standards on Textile Materials*, 1938.

Revisions are noted in the following specifications—D.403, Standard methods of testing and tolerances for woollen yarns (p. 177-180). D.404, Do. for worsted yarns (p. 181-184). A new standard, D.508, covers "Tentative methods of testing and tolerances for yarns spun from wool mixed with fibres other than wool." C.

Sized Rayon Warp: Testing. W. L. Bentley. *Textile World*, 1938, **88**, No. 11, 58-59.

The results of further tests on sized viscose and acetate rayon yarns, including observations on the permanent stretch, elasticity and fatigue of the yarns, the effect of temperature on the size and caramelisation of the size, are given and discussed. The results show that correct sizing protects the yarn against permanent stretch due to normal tension in weaving. The effect of sizing on the elasticity of rayon yarn is different at different loads. Sizing increases the resistance of the yarn to fatigue. Gelatin base sizes can be heated to 160° F. without injurious effect, but for every 10° F. increase above 160° F. a 5 per cent. decrease in jelly strength occurs. In mill tests the best results were obtained from warps which absorbed 1 lb. of size to 1 lb. of yarn. C.

The Effect of Tension and Speed in Yarn Testing. R. E. Booth. *Textile Recorder*, 1938, **56**, No. 669, 20-21.

A treatise on the differences in the results of tests carried out at different tensions and different speeds.

Suggestions are given for the care and maintenance of testing instruments. L.

(C)—Fabrics

Gurley Stiffness Tester and Densometer. Gurley Testing Instruments (H. E. Messmer, Ltd.). *Silk and Rayon*, 1938, **12**, 932.

The Gurley stiffness tester for measuring the stiffness, pliability or handle of fabrics consists of a balanced pointer which can be loaded with weights of various values placed in various positions below the centre. A sample of material is cut to a standard size, clamped in a movable arm, and drawn over the top of the pointer until the bending of the sample releases the pointer. The amount the pointer is deflected, read on a scale at the bottom end, is a measure of stiffness. The readings may be converted to milligrams of bending resistance, if desired, by multiplying the average scale reading by a factor. Factors for each combination of size of sample, and value and position of loading weight, are given in a table furnished with the instrument. The Gurley densometer for measuring the porosity of fabrics and other materials is used for testing the wind-proofness, tightness of weave, or completeness of filling, starching, rubberising or other treatments. The results may be interpreted to indicate the manner in which the cloth will absorb various coatings and other data. The test consists of forcing a known volume of air through a standard area of the fabric, under standard pressure, and noting the time required for its passage. Air pressure is supplied by an inverted cylindrical cup, floating freely in an outside cylinder partly filled with oil. The inner cylinder is graduated each 50 c.c. The sample is clamped between orifice plates at the outlet of an air tube extending upward through the sealing liquid. The test is conducted by raising the inner cylinder until supported by a spring catch, clamping the sample, and releasing the cylinder, which floats in the oil. The cylinder will sink as the air escapes through the fabric. The rate of fall, timed on the graduations by means of a stopwatch as they pass the upper edge of the outer cylinder, is the reading secured. Results are usually expressed as the number of seconds per 100 c.c. air flow. Three weights of cylinder and three sizes of orifice plates are available. C.

Dyed Cotton: Identification of Dye. M. Robinet. 15 *me. Congrès Chim. Ind.*, 1935, 640-646.

The methods proposed by Green (1915) and Zänker and Rettberg (1925) for the identification of a dye on cotton, or at least its type, are outlined and various difficulties are mentioned. The author suggests that Zänker and Rettberg's washing test should be carried out at 60-70° C. instead of at the boil. Whether the dye is stripped or not, the material should be tested for sulphur

colours. The sample is reduced with stannous chloride and the vapour tested for sulphuretted hydrogen by lead acetate paper. To distinguish a direct from a basic dyeing, the sample is boiled in a mixture of 6 gm. of caustic soda in 4 c.c. water with 100 c.c. of saturated salt solution, rinsed and then boiled with water in the presence of wool. A direct dye leaves the wool unstained. In a doubtful case, the water is slightly acidified with sulphuric acid. If the wool is now strongly stained and the bath discharged, the dye is a direct with affinity for wool; if the wool had been previously stained and now loses some colour, the dye is a basic one. C.

Dyed Textiles: Fluorescence in Ultra-violet Light. Society of Chemical Industry in Basle. *Ciba-Rundschau*, 1938, No. 29, 1079-1080.

The use of ultra-violet light for the identification of textile materials and of dyes on textile materials is briefly discussed, and the fluorescence effects shown by the various natural and artificial fibres and by materials dyed with direct, Rosanthrene, diazo and Chlorantine light dyes, Ciba and Cibanone dyes, Ciba-naphtol, basic, Pyrogene, Thiophenol, Cibacet and acid wool dyes are described. It is pointed out that Neolan and Chrome fast dyes do not give characteristic fluorescence effects. C.

Permanent Finished Cotton and Rayon Fabrics: Testing. K. H. Barnard. *Amer. Dyes. Rept.*, 1938, **27**, 567-8.

A progress report of the Sub-committee of the American Association of Textile Chemists and Colorists on permanent finishes. A washing test for cotton and a dry-cleaning test for rayon are described in which loss of weight, stiffness, resiliency, lustre and thickness is determined. C.

Rubberised Textiles: Specification and Testing. American Society for Testing Materials. *Suppl. Book of A.S.T.M. Standards*, 1938.

Revisions are noted in the standard specification for cotton rubber-lined fire hose (pp. 198-201) and in the standard methods of chemical analysis of rubberised products (pp. 202-219). C.

Textiles: Accelerated Ageing Test. American Society for Testing Materials. *A.S.T.M. Standards on Textile Materials*, 1938, p. 269.

A "proposed method of test for accelerated ageing of textiles" employs an enclosed carbon-arc lamp as suggested by Appel and Jessup, of the National Bureau of Standards. C.

Textile Fabrics: Specification and Testing. American Society for Testing Materials. *A.S.T.M. Standards on Textile Materials*, 1938; in part also, *Suppl. Book of A.S.T.M. Standards*, 1938.

Revisions are noted in the following standards—D.39, Standard general methods of testing woven textile fabrics (p. 2-9 or Suppl. p. 220-224). D.506, Tentative method of test for fastness of coloured textiles to light (p. 40-41). D.504, Tentative specifications for single-ply bleached cotton broadcloth (p. 96-97). D.503, Tentative specifications for bleached white cotton sheeting (p. 98-99). D.505, Tentative specification for terry (turkish) towelling (p. 100-101). D.179, Standard methods of testing and tolerances for tire cord, woven and on cones (p. 121-125, or Suppl. p. 227-231). D.415, Standard method of test for strength of rayon woven fabric when wet (p. 147-148, or Suppl. p. 225-226). D.461, Tentative methods of testing wool felt (p. 192-196). D.418, Tentative methods of testing pile floor covering (p. 201-205). C.

Wood-boring Beetles: Attack on Cotton-Viscose Cloth. A. N. Gulati. *Indian Textile J.*, 1938, **48**, 435-6.

Damage to cotton-viscose union cloth by wood-boring beetles from the packing case is described, with illustrations. The cotton fibres were nibbled by the beetles but not the rayon. There was evidence of mildew attack and the author believes that the beetles were probably seeking the fungi. Control measures are suggested. C.

Microscope Side-viewing Device. A. Herzog. *Textilberichte*, 1938, **19**, 773-775.

A device which permits objects to be observed from the side under the microscope comprises a brass plate of the size of a microscope stage carrying in the middle a flat circular piece which can be rotated. In the centre of the circular piece is a short cylindrical piece on the top of which is placed the object to be studied. The cylindrical piece is blackened to prevent disturbing reflections. A raised metal plate to one side of the cylindrical piece carries a rectangular reflection prism

with a silvered diagonal surface. When the microscope objective is above the prism a side view of the object is obtained and different sides can be brought into view by turning the circular piece carrying the support for the object. Photomicrographs of a cornflower seed in different positions obtained by this method are given. If the central cylindrical piece is replaced by means for supporting a plate or sheet of paper or fabric, the device can be used for the measurement of the thickness of the plate, paper or fabric. This method is particularly useful for the measurement of the thickness of raised fabrics. The device can also be used for the rapid determination of the form of cross-section of rayon fibres. C.

Frozen Moist Heat Insulating Materials: Thermal Conductivity. Z. Nagaoka, A. Watanabe and Y. Yasiro. *Sci. Papers Inst. Phys. Chem. Res., Tokyo*, 1938, **34**, 1034-1041.

An apparatus and technique are described for the determination by the ordinary plate method of the heat conductivity of frozen moist insulators. The "cold" plate was kept at about −20° C. and the "hot" plate at about −3° C. Conductivity was calculated from the equation $Q = (\lambda/d)\cdot F(t_h - t_c)$, where Q is input to the main heater, λ the conductivity in k. cal. per metre per hour per ° C., d thickness in metres, F area of main heater in sq. metres, at t_h and t_c the temperatures of the hot and cold plates in ° C. Results are expressed in graphs of conductivity against volume -per cent. of frozen moisture in the material. The thermal conductivity increases with volume of frozen moisture especially with the less-absorbent materials, "silicate cotton", glass wool and granulated cork. The effect is less striking with rice hulls, cotton flannels and wool felt. With granulated cork made waterproof by steeping in a solution of paraffin in benzine, the effect of moisture is much reduced, but waterproofing enhances the effect with cotton cloths. C.

Inspection and Testing of Textiles. R. G. Orrell (Aeronautical Inspection Directorate of the Air Ministry). *Hosiery Tr. J.*, 1938, **45**, No. 538, p. 40.

Details are given of conditions of humidity and temperature specified for official Government tests, and of the official methods for testing cloth for tensile strength and for shrinkage. Official tests for washability and fastness of dye are not specified. W.

(D)—Other Materials

Cellulose Triacetate Film and Filament: Properties. K. Werner. *Angew. Chemie*, 1938, **51**, 681-684.

The superiority of cellulose triacetate film and filament over acetone-soluble acetate products is claimed. Load/extension curves are shown of film strips, 0·022-0·038 mm. thick, cast from acetic acid solutions of the triacetate into baths of dilute acetic acid, with and without stretch and with and without softener, in comparison with dry-spun film, and the relevant data are tabulated. Filaments have been spun in the same wet way with breaking load 1·6-1·8 gm. per denier, that is with higher strength, in both dry and wet states, than ordinary acetate filaments. C.

"Glassine" Paper: Transparency. D. B. Wicker. *Paper Trade J.*, 1938, **107**, *TAPPI*, 198-206.

Various factors of reflectance and transmission that are concerned in the judgment of the transparency of sheet cellulose and papers are defined, provision being made for the scattering of reflected and transmitted light. A special optical bench for measuring the various factors is described. It incorporates a whitened sphere for reflectance and a blackened one for transmission measurements and the various intensities are measured by photo-electric cells. Results that indicate the value of the method and apparatus are recorded. C.

Paper and Sheet Cellulose: Penetration by Water Vapour. S. Oguri and M. Takei. *J. Soc. Chem. Ind., Japan*, 1938, **41**, 295-7 B.

The penetration of paper by water vapour is measured in an apparatus in which the paper separates a space containing water or a known solution of sulphuric acid from one that is swept out by a regulated current of dry air, which ultimately passes through weighed drying tubes. Results are recorded, in tables and curves, for various Japanese papers, sheet cellulose and celluloid film. They show that when absorption equilibrium is once established—which

depends on the thickness of the paper and the humidity—the rate of flow of moisture is linear. The permeability at low humidities rises almost linearly with vapour pressure but the rate decreases as saturation is approached. C.

Nitrocellulose and Cellulose Acetate Aircraft Varnishes: Testing. Rusch and P. Lion. *17me. Congrès Chim. Ind.*, 1937, 331-346.

Established methods for testing aircraft varnishes on cloth and in the form of films are reviewed and typical data are given to illustrate the tests. Nitrocellulose and cellulose acetate varnishes do not differ very much as films, except that nitrocellulose is more sensitive to ultra-violet light. On cloth, however, they behave differently. Collodion appears to unite with the fibre, forming a kind of homogeneous, reinforced plastic mass. Stresses are distributed in the varnish as in the cloth so that the film does not tend to strip from the cloth. On the other hand, the tearing strength of the varnished cloth is low. Cellulose acetate appears to be merely "plated" on the cloth, thus preserving its textile qualities (resisting to tear), but as stresses are distributed differently there is a tendency for the varnish to crack. By the use of appropriate plastifying agents, however, acetate varnishes can be produced with the properties of nitrocellulose varnishes, but without their inflammability. C.

Pulp: Alkali-binding Power. M. L. Downs. *Paper Trade J.*, 1938, **107**, *TAPPI*, 184-189.

The abstraction of alkali from 0·005 *N* sodium hydroxide by a number of pulps has been measured by direct titration and the pulps analysed for ash and its constituents, pentosans, copper number, uronic acid and lignin to check the connection between composition and alkali binding power. In some cases, part of the removal of alkali is traced to combination with acidic constituents of the pulp, combined organic acids being found in the alkaline filtrates. The removal is also effected by sorption, this being the sole cause with rag and purified pulp; such sorbed alkali is easily washed out. Analyses of the ash show that no exchange of cations occurs. The amount of alkali removed varies with the lignin content and copper number. C.

Fluorescence Test for the Differentiation of Oil from Pressed Olives and Refined Olive Oil. W. Ciusa. *Olii minerali, grassi e saponi, colori e vernici*, 1938, **18**, 33-35 (through *Chem. Abs.*, 1938, **32**, 8178).

The objections raised against Wood's fluorescence test are not valid; blue fluorescence observed in some oils from pressed olives does not occur normally, but is due to secondary changes in the oil. If treated with 5% activated charcoal, oils from pressed olives lose their yellow colour, and their blue-red fluorescence turns blue; while refined oils do not lose their colour or do so only to an insignificant extent, and their fluorescence remains unchanged. An addition of chlorophyll to refined oils (to veil fluorescence) is easily detected by treatment with activated charcoal; there is poor discoloration and an intense blue fluorescence. A brief characterisation is given of the seven classes of olive oils known in the market. W.

7—LAUNDERING AND DRY CLEANING

(A)—Cleaning

Chlorinated Ethane Solvents: Properties. J. D. Converse. *Chem. and Ind.*, 1938, 1068-1072.

The preparation, properties and uses of the following solvents, obtained by the chlorination of acetylene, action of alkali to open a new double bond, and further chlorination, are described with a table of their constants—*trans*.-dichlorethylene, trichlorethylene, perchlorethylene, pentachlorethane and hexachlorethane. C.

Patents

Washing Machines. A. Ekstrom. B.P. 490,412. Acc. Aug. 15, 1938.

A rotary washing machine is provided with a longitudinal channel in the casing beneath the rotary receptacle having inlets for rinsing water, which after passing through the receptacle is discharged from a higher point of the casing. The channel may be formed by ribs extending longitudinally on both sides of the inlets or may be formed by a depression in the casing wall. Heating pipes may be arranged in the channel. La.

Washing Machines. Siemens-Schuckert-Werke A.G. B.P. 490,974. Acc. Aug. 24, 1938. Conv. (Germany) Oct. 2, 1936.

In a washing machine in which the clothes receptacle is rotated unidirectionally, there is a partition that extends from the periphery to a point beyond the axis, and a portion of the partition is curved concentrically with the axis, so that the clothes slip off in succession from that part of the partition which is at about 30° to the horizontal. La.

Ironing Machines. British Thomson-Houston Co. Ltd., B.P. 491,429. Acc. Sept. 1, 1938. Conv. (U.S.) Feb. 18, 1938.

An ironing machine having a roller coacting with a concave shoe, with power means for rotating the roller and for swinging the shoe into and out for contact with roller, is described. La.

Hand-Irons. E. F. Pohl. B.P. 491,759. Acc. Sept. 8, 1938.

A hand-iron, having a water reservoir for generating steam, which is conducted from a steam dome, by a pipe to apertures in the sole plate, is described. La.

Zinc Stains: Prevention in Laundering. Kohle- und Eisenforschung G.m.b.H. (Düsseldorf, Germany), (1) B.P. 492,589 of 17/2/1937: 19/9/1938. (2) B.P. 495,249 of 4/8/1937: 9/11/1938.

(1) The formation of zinc stains on laundry boiled in vessels coated with zinc is prevented by adding to the washing medium about 3 per cent. of Na thiosulphate, hydrosulphite or sulphide. (2) The corresponding K or NH_4 salts are claimed, the addition being 2-3 per cent. on the weight of the dry washing medium. C.

8—BUILDINGS AND ENGINEERING

(A)—Construction of Buildings

Metals: Wet Corrosion. G. D. Bengough, U. R. Evans, T. P. Hoar and F. Wormwell. *Chem. and Ind.*, 1938, 1043-1047.

The wet corrosion of metals is ascribed to the passage of electric currents between anodic and cathodic regions in the metal. Three types are distinguished, (1) both anodic and cathodic products are freely soluble, and (2) the cathodic and (3) the anodic product is sparingly soluble. The main function of oxygen is that of a depolariser of the cathodic reaction. The distribution of attack in total or partial immersion and factors determining the velocity of corrosion are reviewed, the whole report being an agreed statement of the authors based on their work at the Chemical Research Laboratory, Teddington, and the Metallurgical Laboratories of Cambridge University. C.

Nails: Hold in Wood. *L'Ingenieur Textile*, 1938, No. 348, 343-347.

Factors influencing the hold of nails in wood are discussed and the results of tests on various forms of nails in wood of different moisture contents are given. The longitudinal pressure of the fibres of the wood is shown to be of greater importance than the transverse pressure. Nails with points have a better hold than those with blunt ends and a rough surface is advantageous. The difference in hold of round and grooved nails is small. For the same length, nails of square cross-section have a better hold than those of circular cross-section, but if the comparison is based on hold per unit of surface of the nail, round nails are superior. Driving the nails in obliquely has a certain advantage when the wood is damp and has an opportunity to dry later but in tests where nails were driven in and then pulled out almost immediately afterwards no appreciable advantage in oblique positions was observed. C.

Nickel Alloys: Use in Dyeing and Bleaching Apparatus. R. W. Müller. *Leipz. Monats. Text. Ind.*, 1938, 53, 283-285.

The composition and properties of Monel metal and its behaviour in contact with the baths used in dyeing with the various classes of dyes and in contact with chlorine and hydrogen peroxide bleaching liquors are discussed. The use of this alloy in the construction of dyeing and bleaching apparatus is described and the use of Inconel and nickel is briefly discussed. C.

Wrought R. R. Aluminium Light Alloys: Properties. *Nickel Bulletin*, 1938, 11, 215.

Tables are given to show the chemical composition, physical and mechanical properties and the tensile properties at elevated temperatures of the wrought aluminium light alloys, R.R. 56, 59 and 77 C.

(C)—Steam Raising and Power Supply

Boiler Water: Control. *Rayon Textile Monthly*, 1938, **19**, 643-646.

The efficiency of modern boilers is discussed and a case in which a battery of five old style 150 h.p. units was replaced by a 500-h.p. modern bent-tube type of boiler is reported. It was found that the new boiler required much more frequent blowdown than the old type in order to keep the saline content within reasonable limits but the problem was successfully solved by means of a continuous controlled blowdown. Boiler water impurities and chemical treatment of the water supply are briefly discussed and the advantages of the use of a sludge deconcentrator system are pointed out. In such a system, a predetermined quantity of the water in the active boiler is circulated continuously through a deconcentrator or tank separator, located outside the boiler proper. The impurities carried in suspension are thrown out in this deconcentrator and collect in the settling chamber of the device from which section they are periodically drained in concentrated mass. The return from the deconcentrator back to the boiler consists, consequently, only of clarified water from which all suspended matter has been removed. With certain types of hard water, a predetermined and controlled amount of chemically softened water should be fed to the boiler in order to convert scale-forming impurities into soft sludge and mud. C.

Combustion Control Instruments. *Instruments*, 1938, **11**, 227-254

Illustrated descriptions are given of the following automatic combustion control systems (1) Askania, by H. Ziebolz, p. 228. (2) Bailey Meter, by H. M. Hammond, p. 230. (3) Bristol, by O. J. Leone, p. 232. (4) Brooke, by J. S. Merritt, p. 234. (5) Brown, by H. M. Schmitt, p. 236. (6) Cash, by J. J. Klinker, p. 237. (7) D.F.C. (Denver Fire Clay Co.), by F. Gawan, p. 238. (8) Dexter-Goebel, by E. F. Goebel, p. 240. (9) GE. (General Electric Co.) by H. M. Webber, p. 241. (10) Hagan, by T. A. Peebles, p. 242. (11) Hays, by W. H. Pugsley, p. 244. (12) Metermax, by E. S. Bristol, p. 246. (13) Valveless, by E. L. Kroon, p. 248. (14) R.K. (Ruggles Klingemann Co.), by L. Kimball, p. 249. (15) Shallcross, by C. Schindler, p. 250. (16) Smoot, by C. R. Earle, p. 251. (17) Westinghouse, by C. E. Peck, p. 254. C.

(D)—Power Transmission

Tape Drive, Band Drive, Power Consumption. *Melliand Textilberichte* (English Edition) 1938, **19**, 79-80.

A comparison of the power consumption of tape and band driven spindles is made. The power consumption is found to increase with the band tension and with the spindle speed, and with the quantity of yarn on the bobbin. It is less, however, for tape drives than for band drives. The reason why frames installed a few years ago with tape drives use more power than similar tape driven frames is that when driving four spindles from one tape the angle of contact between tape and wharve is very much less for tapes, and consequently greater tension in the tapes is required. This can be overcome by using roller bearings. L.

(F)—Lighting

Textile Mills: Lighting. A. G. Arnold. *Spinner u. Weber*, 1938, **56**, No. 43, 28-30.

The importance of adequate illumination in mills is pointed out and the life of tungsten filament lamps, the prevention of dazzle by the use of matt bulbs and by indirect illumination, the influence of illumination on the frequency of accidents, the use of mercury vapour lamps, the lighting of stairs, general lighting and separate lights for individual machines or machine parts are briefly discussed. Photographs of work rooms with different methods of lighting are given and discussed. Points to be considered in the control of illumination are outlined, the need for measurement of intensity of illumination and for frequent cleaning of windows, walls, lamps, etc., being emphasised. Intensities of illumination required in different departments and of general and local illumination for different types of work are tabulated. C.

Hosiery Mills: Lighting. H. S. Regar. *Textile World*, 1938, **88**, No. 11, 62-63.

The importance of adequate lighting in hosiery mills is discussed and it is pointed out that the ordinary type of spot lighting is not adaptable to the lighting of circular knitting machines. In one mill a high level of illumination with a mimimum of glare and shadows has been obtained by the use of long-tube

mercury vapour lamps of the Cooper Hewitt type. Suspended directly above each machine at a hanging height of about 9½ ft. from the floor, these lamps furnish an average illumination level of 32 foot candles on the work. It is claimed that this method of illumination has cut down rejects, eliminated eye fatigue, and reduced power consumption. Only a short time is required to become accustomed to the bluish colour of mercury light. In mills where discrimination of closely related tints and shades is of major importance, a daylight effect can be produced by a combination of mercury and incandescent light. C.

Textile Mills: Lighting. W. A. Seelig. *Leipz. Monats. Text. Ind.*, 1938, **53**, 272-274.

The need for good lighting in textile mills and the requirements of a lighting system are discussed, the advantages of general over local lighting and the advantages of mixed mercury vapour and incandescent lighting are pointed out, and examples of modern methods of lighting different departments are shown in photographs and briefly discussed. C.

(G)—Heating, Ventilation, and Humidification

Cotton Mill: Ventilation and Humidification. James Howorth & Co. Ltd (Farnworth). *Textile Weekly*, 1938, **22**, 591-4.

An account is given of new equipment at the Manor Ring Mill, Oldham, including a centralised air-conditioning installation designed to give 60,000 cub. ft. of pure air per minute. Conditions in the card-room are controlled to 75° F. and 5·1 grains per cub. ft. of moisture. C.

Condition of the Air and Comfort. M. Hottinger. *Gesundh. Ing.*, 1938, **61**, (39), 542-553 (through *Building Sci. Abs.*, 1938, **11**, 347).

The influence of temperature, humidity and air movement on comfort and the determination of comfort conditions are discussed with reference to the work of various investigators. Charts showing the relationship between these influences and comfort conditions for persons at rest, or engaged in light muscular activity, and suitable for general use in practice are shown. Attention is drawn to the need for developing other similar charts for special conditions, e.g., of clothing and occupation, and for different latitudes and altitudes. W.

9—PURE SCIENCE

3:4-Benzphenanthrene Derivatives: Synthesis. C. L. Hewett. *J. Chem. Soc.*, 1938, 1286-1291.

An account is given of the synthesis of 3:4-benzphenanthroic acid by the elimination of hydrogen bromide, by means of fused potassium hydroxide, from α-2′-(1′-bromonaphthyl)-cinnamic acid, and of the preparation of 6-, 7-, and 8-methyl-3:4-benzphenanthrenes, 1:2:5:6-dibenzphenanthrene, and 1:2-(1′:2′-naphth)anthracene from their carboxylic acids, prepared in a similar manner. C.

High-polymerides: Elastic Properties and Residual Valencies. W. Kuhn. *Angew. Chemie*, 1938, **51**, 640-7.

The significance of residual valencies for the elastic behaviour of high-polymerides is discussed under the main headings (1) form isomerism of organic compounds, (2) molecular structure of the fibre molecules (*a*) in solution, (*b*) in the free state, (3) the extension of elastic solids, (4) the elastic-thermal behaviour of rubber, (*a*) dependence of tension on temperature at constant extension, (*b*) thermal effects on extension and relaxation of rubber, (*c*) quantitative relationships between elastic modulus and molecular dimensions, (5) the significance of residual valencies for the display or otherwise of elasticity in rubber, and also macro- and micro-Brownian motion; and (6) additional effects, (*a*) crystallisation, and (*b*) elastic after-effect. C.

Magnesium Oleate: Preparation. R. C. Pink. *J. Chem. Soc.*, 1938, 1252-1254.

The preparation and examination of anhydrous and hydrated magnesium oleate are described and it is shown that addition of small amounts of water to solutions of the anhydrous soap in benzene causes its precipitation in an insoluble form containing water. It is pointed out that the benzene-magnesium oleate-water systems examined were not true emulsions, but suspensions of

hydrated magnesium oleate in benzene. The results indicate that in the inversion of oil-in-water emulsions with magnesium chloride the magnesium oleate formed does not dissolve in the oil phase. C.

Methyl Ethyl Ketone: Solvent Properties. S. L. Langedijk. *Chemistry and Industry*, 1938, p. 891-898.

The production and properties of methyl ethyl ketone are reviewed, with a table of physical constants, and various uses of the solvent are recorded. Its use as a solvent for cellulose acetate is discussed and the "areas of solubility" for two samples of the acetate in mixtures of the ketone, isopropyl alcohol, and water are plotted on triangular co-ordinates. C.

Organic Compounds: Magnetic Effects. E. Müller. *Angew. Chemie*, 1938, **51**, 657-663.

A concise review is given of the value of magnetic measurements in the study of the structure of diamagnetic and paramagnetic organic compounds. C.

Polystyrene: Chain-length and Properties. E. Jenckel and K. Ueberreiter. *Z. physikal. Chem.*, 1938, A**182**, 361-383.

A series of polystyrenes of different chain-lengths has been prepared and the effect of temperature on specific volume and viscosity measured. Specimens spun into filaments were also tested for elastic properties (load/extension cycles) and it was found that brittleness disappeared as the chain-length increased. Apart from the brittleness of the low-molecular polystyrenes and the elasticity of the high-molecular members, the phenomena displayed are those of a typical glass. C.

Resistant Esters: Saponification. W. E. Shaefer and J. Piccard. *Ind. Eng. Chem. Anal. Ed.*, 1938, **10**, 515-517.

A reagent for the saponification of resistant esters (e.g. Me abietate) in analysis is prepared by dissolving about 9·3 gm. of sodium in 500 cc. of cyclohexanol to which 250 cc. of methyl alcohol is added in portions. In use, the methyl alcohol is allowed to evaporate and the mixture is heated at 150° C. for 16 hours in a current of moist nitrogen. The method is not suitable for glycol or glycerol derivatives. C.

Thyratron-controlled Thermostat. J. M. Sturtevant. *Rev. Sci. Instr.*, 1938, **9**, 276-279.

A circuit diagram and a detailed description are given of a relatively inexpensive thermoregulator employing a resistance thermometer and phase-shifting thyratron circuit. Continuous control precise to ± 0·003° C. has been obtained with the device in a water bath of average quality of design. C.

Ultra-centrifuge: Application in Particle Size and Weight Determinations. P. von Mutzenbecher. *Angew. Chemie*, 1938, **51**, 633-640.

A concise review is given of the theory of the use of the ultra-centrifuge in the determination of particle size and molecular weight. Section drawings are given of several instruments described in recent years. C.

Electrolyte and Colloid Solutions: Anomalous Conductivity Effects. K. Hoffmann. *Kolloid Z.*, 1938, **84**, 344-357.

A review is given, with bibliography, of the anomalous conductivity (field and frequency effects) in molecularly and colloidally dispersed solutions under the following headings (1) theory, including (*a*) anomalies due to interionic forces, (*b*) dissociation voltage effect, (*c*) the dipole effect, and (*d*) the influence of the inhomogeneity of the medium; (2) experimental investigations on strong and weak electrolytes, under (*a*) field effects and (*b*) frequency effects, and (3) experimental investigations on colloidal systems, under (*a*) field and (*b*) frequency effects. C.

Soap Sols: High-frequency Conductivity. G. Schmid and E. C. Larsen. *Z. Elektrochemie*, 1938, **44**, 651-658.

The great increase in conductivity for high-frequency current (10 or 20 m. wave-length) in comparison with the usual low-frequency conductivity is used as a means to determine whether colloidal electrolytes are strong or weak electrolytes. Measurements are recorded on Na dodecyl sulphate, cetylpyridinium chloride, Na oleate, and K and Ca arabinate that show that at concentrations corresponding with the change from molecularly dispersed to colloidally

dispersed salts there is a sharp increase in the excess conductivity (reckoned as a percentage of the low-frequency conductivity), due to the exertion of strong inter-ionic forces. The electrostatic conception of colloidal electrolytes thus receives support. C.

Electrolyte Solutions: Spreading on Filter Paper. K. Prosad and B. N. Ghosh. *Kolloid Z.*, 1938, 84, 275-283.

The spreading of electrolyte solutions on filter paper, investigated previously by Mokruschin, has been examined by the authors by the technique they employed for the spreading of organic liquids on filter paper. Equations are theoretically derived and the results of experiments with solutions of phosphoric, sulphuric and hydrochloric acids and sodium sulphate are given. The rates of spreading are expressed in curves. C.

Sodium Palmitate-Sodium Chloride-Water System: Phase Study. R. D. Vold and R. H. Ferguson. *J. Amer. Chem. Soc.*, 1938, 60, 2066-2076.

A complete equilibrium diagram of the system sodium palmitate-sodium chloride-water at 90° is presented. For the various equilibria relating to curd phase, and to check phase boundaries in the neat and middle soap fields, an isopiestic vapour pressure method was devised, that has the advantage of being independent of subjective visual observation of the appearance of the system and is unaffected whether the different phases separate nicely or remain in intimate admixture. A dew-point vapour pressure method was also employed in certain instances. As shown by a figure, sixteen different equilibrium conditions are possible at 90°, the particular state of any given system being determined by the relative amounts of soap, salt and water present. Inspection of the phase diagram shows the concentration limits for the existence of these various equilibria. The curd phase is a single phase of continuously variable composition. The formation and appearance of curd fibres are described and photomicrographs of macroscopic curd fibres are given. C.

Porous Diaphragms: Electro-osmotic Behaviour. A. I. Jurshenko. *Ann. Leningrad State Bubnova Univ., Chem. Series*, 1936, **2**, No. 11. 121-161 (Russian) (through *Chem. Zentr.*, 1938, ii, 1379).

The electro-osmotic behaviour of diaphragms of gelatin, a fabric impregnated with regenerated cellulose, Bakelite, glass, etc., has been studied. It is found that the electro-osmotic transference of liquid and the alteration of the ionic transport number in the pores of the diaphragm do not run parallel. Increase of pore radius is accompanied by increase in the electro-osmotic effect and decrease in the influence on the ions passing through. This influence of pore radius is especially marked with the compound diaphragms. In the range 10-80° C., temperature is without influence on both effects. C.

Pulp: "Degree of Gelatinisation" in Beating. E. C. Jahn. *Paper Trade J.*, 1938, **107**, *TAPPI*, 94-96.

When cellulose is comminuted in water, as in a paper mill beater, the fibres gradually disintegrate into a slimy mass. The author describes an attempt to measure the extent of this change (tentatively called "gelatinisation") by studying the retention of water by the beaten pulp when pressed in a mould. It is shown that the physical changes in the pulp mat influence the retention of water in a short-period expression but not if the pressure is prolonged. Thus, an unbeaten pulp and the same after 48½ hours in a rod mill retained 26·9 and 40·4 per cent. of water when placed for 10 minutes under a pressure of 2 tons per sq. inch but 21·9 and 21·7 per cent., respectively, after 4 hours. C.

Cellulose: Heat of Absorption of Water Vapour. S. Oguri and T. Yoshida. *Mem. Fac. Sci. Engng., Waseda Univ.*, 1937, No. 12, 85-87 (through *Chem. Zentr.*, 1938, ii, 1412).

The heat of absorption of water vapour by cellulose at 0° C. is found by direct measurement in an ice-calorimeter to be about 1,000 cal. per gm. of water vapour. C.

Cellulose: Structure and Physical Properties. H. Staudinger. *Papier-Fabrikant*, 1938, **36**, *Techn.*, 373-9, 381-8, 473-480, 481-485.

A comprehensive review, under the headings (1) Importance of the elucidation of the constitution of cellulose, (2) earlier conceptions, (3) the chain conception, (4) the micelle theory of Meyer and Mark, (5) the macromolecular structure,

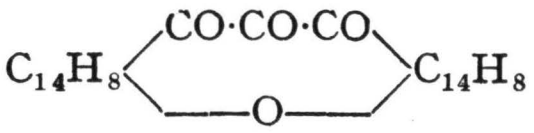
(6) determination of molecular weights by the osmotic method, (7) the viscosity rule, (8) polydispersivity of cellulose and its derivatives, (9) structure of the cellulose molecule, (10) degree of polymerism of native and technical celluloses and cellulose derivatives, (11) chemical behaviour of celluloses and their derivatives, and (12) relations between the degree of polymerisation of celluloses and the viscosity of their solutions. On p. 482, the author gives a table of tensile data for a series of cottons and acid-treated cottons ranging from a degree of polymerisation of 1650 down to 150. On p. 484 there is a table of viscosity data for celluloses from museum specimens of mummy cloths; the degree of polymerisation ranged from 500 down to 160. **C.**

Long-chain Thread Molecules: Anomalous Behaviour in Solution. G. Berger. *Rec. Trav. Chim.*, 1938, **57**, 1029-1049.

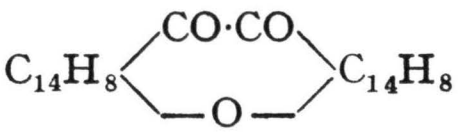
Ebullioscopic determinations are tabulated for the paraffin hydrocarbons with 10, 12, 15, 27, 31 and 32 C atoms, hexadecene-1, and myristone and palmitone in the solvents hexane, cyclohexane and benzene at concentrations of 0·01 to 0·1 *N*. Positive and negative deviations from Raoult's law occur, the law being valid as a rule at infinite dilution. The lower members of the paraffin series show an apparent association, which with increasing molecular weight becomes gradually smaller until in the higher members it passes over into an apparent dissociation. The solvent plays a considerable part, hexadecane showing association in benzene and dissociation in cyclohexane, and behaving normally in hexane. The heat of mixing can be calculated from the observed rise in the boiling point and for binary hydrocarbon mixtures. A theory of the heat of mixing has been formulated, which reproduces the observed deviations from Raoult's law qualitatively correctly. The theory pays particular attention to the influence exerted on the London cohesion energy by the irregularly curved form of the long mobile carbon chains and furnishes a simple explanation for the apparent dissociation of the long-chain compounds. C.

Blue Triketone from Phenanthraquinone: Properties. O. Diels and R. Kassebart. *Liebigs Ann. Chem.*, 1938, **536**, 78-88.

The blue triketone (A), first observed by Schwarwin (1905), is obtained when phenanthraquinone is left in the dark with pyridine and acetic anhydride. It



(A)



(B)

loses carbon monoxide and changes into the pale-yellow diketone (B) when irradiated in pyridine solution. It combines with aniline by addition at the middle CO group and the compound changes into (B) when boiled with nitrobenzene. C.

Polar Molecules: Adsorption at Solution Surface. R. Dubois and E. E. Todd. *J. Amer. Chem. Soc.*, 1938, **60**, 2355-2359.

The adsorption of solutes at the air-solution interface, when measured by dynamic methods has been found to be several times greater than the values calculated from surface tension data by means of the Gibbs adsorption equations. It has been suggested that the excess is due to electrification of the moving surface. This explanation is tested by measuring the effect of forced electrification of bubbles in *p*-toluidine solution on the adsorption. Marked decrease in the apparent adsorption was observed when the gas was subjected to spark discharge and to silent discharge before entering the adsorption apparatus, but the effect is thought to be of chemical origin, because of its persistance after discharge. Ionisation of the bubbling gas by exposure to ionium salt was also found to have no effect on the measured adsorption. C.

Soap and Fatty Acid Films: Mechanical Properties. P. A. Rehbinder and A. A. Trapeznikov. *C. r. Acad. Sci., U.S.S.R.*, 1938, **18**, 423-6, 427-430 (through *Sci. Abstr.*, 1938, **A.41**, 822, 823).

(1) The viscosity of solutions of sodium oleate, *C* 1·05-0·03 per cent., was measured within two days of their preparation and after 50 days by determining the logarithmic decrement (λ) of the oscillation of a ring in the surface of the solutions. Curves of λ against *C* show maxima at $\lambda = 0{\cdot}045$, but the whole curve for the aged solution is below that of the fresh. The stability of the foam given by solutions 30 sec. to 22 hr. old decreased with time, and after 22 hr. showed a

maximum for a concentration of 0·04 per cent. (2) The stabilising action of adsorption layers as functions of their surface concentrations was investigated by determining the life of bubbles at the surface of water (or $N/100$ hydrochloric acid) covered with films of a higher fatty acid, alcohol or ester. A maximum effect is observed for a smaller area per molecule than has been noted hitherto. C.

Biocolloids: Classification of Complex Systems. H. G. Bungenberg de Jong. *Proc. Kon. Ned. Akad. Wet.*, 1938, **41**, 776-787, 788-799.

A survey and classification of complex systems of biocolloids is given, according to (1) the colloidal-chemical and electro-chemical points of view and (2) the specific factors of importance to the intensity of the complex relations and their meaning with regard to the formation of the tri-complex systems. C

Gas Bubbles: Cataphoresis in Salt Solutions. Natalie Bach and A. Gilman. *Acta Physicochimica, U.R.S.S.*, 1938, **9**, 1-26.

The true cataphoretic velocity of gas bubbles of various dimensions, produced by electrolysis, has been measured by the deflection in a horizontal field of a bubble ascending freely through the liquid in a special cell. The deflection was read directly on the eye-piece micrometer scale of a travelling microscope, the vertical rack and pinion movement being used to follow the bubble. The cell constant was determined on the assumption that the velocity distribution during cataphoresis is independent of the nature of the particles, measurements being taken with emulsions of a mixture of carbon tetrachloride and benzene in water, (negative droplets and cell walls), with suspensions of glass powder in solutions of 10^{-5} N potassium chloride (negative particles and cell walls) and 4×10^{-5} thorium chloride (positive charge on the glass). The values of the true cataphoretic mobility, obtained from the observed velocity corrected for the electro-osmotic flow, show that gas bubbles have a negative charge in water and salt solutions. In potassium chloride solutions, the true value of the ζ-potential on the surface of the bubble remains almost constant at about −30 millivolts between 5×10^{-6} N and 10^{-3} N, and the true cataphoretic velocity is about one half of the apparent one. In thorium chloride solutions, the true charge on a bubble also remains negative at all concentrations up to 10^{-3} N, and the true cataphoretic velocity scarcely differs from the values obtained for water and potassium chloride solutions. C.

Gas Bubbles: Cataphoresis in Capillary-active Organic Electrolytes. A. Gilman and Natalie Bach. *Acta Physicochimica, U.R.S.S.*, 1938, **9**, 27-38.

The influence of capillary-active substances on the electrokinetic potential at the liquid-gas interface has been determined by the method described in the preceding paper and the results are compared with the total potential drop at the same interface. Measurements on the ascent of hydrogen bubbles in solutions of tetrabutyl-and tetra-amyl-ammonium chloride or sodium palmitate show that organic compounds with capillary-active ions that are adsorbed on the surface of water materially affect the electrokinetic charge on the bubbles. The bubble has a positive charge in solutions of the ammonium salts at concentrations greater than 10^{-6} mole/litre, and the magnitude of the ζ-potential in these solutions rises with concentration. At concentrations lower than 10^{-4} mole/litre a large part of the total potential drop lies in the diffuse double layer. Sodium palmitate on the other hand imparts to the bubble a negative charge which grows with the concentration and at the same time the ζ-potential at the liquid-glass interface increases greatly. Its magnitude, however, remains constant in the limits of concentrations of from $1{\cdot}2 \times 10^{-6}$ to $1{\cdot}2 \times 10^{-4}$ moles/litre and is approximately 100 mV. C.

Powders: Particle Size Determination. H. Heywood. *Engineering*, 1938, **146**, 492-494.

The determination of particle size by sifting and by elutriation is reviewed. Various standard sieves are discussed and an illustration shows wire and silk sieves of 18 and 200 mesh. Diagrams are given of different types of elutriators. C.

Cuprammonium Cellulose Dispersions: Optical Properties and Viscosity. J. Compton. *J. Amer. Chem. Soc.*, 1938, **60**, 1807-1812.

Experiments have been undertaken (1) to determine if any relation exists between the viscosity and optical rotation of the cuprammonium dispersions; (2) to measure the contribution of the crystalline cellulose particles and the

inter-crystalline phase to the phenomena of viscosity and optical activity of cuprammonium dispersions; (3) to study quantitatively the effect of varying the concentration of differently treated celluloses dispersed in cuprammonium solutions on the microscopic particle count, using the slit ultramicroscope and (4) to study the mechanism of the dispersion of crystalline cellulose particles by cuprammonium solution. The results showed that the successive lowering of the cuprammonium viscosity of native cotton fibres by the action of dilute acids or mild oxidising agents is not accompanied by a change in optical activity of the resulting dispersions. The optical activity is dependent upon the formation of a cellulose particle-copper complex and cellulose-copper compound formation precedes dispersion of cellulose in cuprammonium solutions. The approximate theoretical number of cellulose particles ($1{\cdot}1 \times 1{\cdot}5\mu$) occur in the solutions, and they possess the essential features, with the exception of size and shape, of the hypothetical micelles. C.

Monomolecular Layers: Flow and Viscosity. M. Joly. *J. Physique et Radium*, 1938, [vii], 9, 345-351.

A review is given of the theories for calculating surface flow, the viscosity of films and the friction of the surface in contact. The general equations of flow are given and tests of the theories discussed. Certain of the theories lead to results in fairly good agreement with experimental facts. Concordant values are obtained if the various formulæ are applied in suitable regions. Poiseuille's formula can be used in the case of infinitely narrow channels in which the speed of flow is very low and for which the true viscosity of the layer is the dominant feature. Prandtl's theory can be satisfactorily applied to rapid flow in broad channels in which the interval friction of the film can be neglected with respect to the resistance of the support. The author shows the impossibility of extending the theory of the limited layer to narrow channels. The theory proposed by Bresler and B. and D. Talmud gives a general picture of the phenomenon and could furnish an empirical formula suitable for calculating the coefficient of viscosity from the flow in channels of medium width. By means of these values for μ calculations can be made of a viscosity, defined as for classical fluids, and also a molecular viscosity. C.

Arc Lamp Carbons: Design. C. H. Champion. *Photographic J.*, 1938, 78, 589-597.

The development of alternating current arcs for cinema theatres is reviewed. Experiments with A.C. showed that on loading between 85 and 95 amperes a stable and flickerless illumination was produced and that the two incandescent craters contribute the preponderant share of the total luminous flux. Consequently the A.C. light obtained in comparison with the modern high current density D.C. arc is (1) nearly as steady, (2) as powerful and (3) more economical in energy consumption. The possibilities of the A.C. arc are enumerated as regards its economy, facility of operation, steadiness of projection and high-utilisation efficiency. C.

Mercury Discharge Phosphorescence Lamps: Efficiency. W. Uyterhoeven and G. Zecher. *Philips Tech. Rev.*, 1938, 3, 272-278.

Column discharges in mercury at low pressure, providing the strong ultra-violet resonance line 2537A., are employed for the excitation of the luminescence of zinc silicate and other phosphorescent substances. The process of this conversion of ultra-violet into visible radiation is discussed and also the various factors that determine the efficiency. The use of phosphorescent substances for improving the colour and efficiency, and for rendering A.C. current discharges free from flicker is also considered. C.

Zinc Amalgam Lamp: Application. C. V. Raman and C. S. Venkateswaran. *Nature*, 1938, 142, 791.

A zinc-mercury lamp in Pyrex glass gives the zinc triplet of lines 4680, 4722 and 4811 A., undisturbed by hyperfine structure or continuous spectrum and can be run continuously for days without trouble. It is therefore suitable for the spectroscopic study of the light scattered in solids and liquids with interferometers of high resolving power. Photographs obtained with glycerol and phenol show well-defined Brillouin components on both sides of the incident lines, along with a continuous background. The conclusion is therefore drawn that hydrodynamic viscosity has little influence on the propagation of thermal sound waves of very high frequencies. C.

Photographic Densitometer. M. H. Sweet. *J. Opt. Soc. Amer.*, 1938, **28**, 349-353.

A density comparator is described which allows the measurement of both transmission and reflection densities. Radiation from a tungsten lamp passes through water to absorb infra-red and after two refractions is incident upon a plane mirror. After passing through a fixed polaroid plate the rays encounter a rotatable one which transmits a portion of the flux incident upon it according to its angular position relative to the fixed plate. Thereupon the flux is concentrated by a condenser so as to pass through an aperture disc, the blue component of a Viscor filter, the portion of film under test and finally impresses itself on the Photronic photoelectric cell. In use the plane of polarisation of the rotatable plate is brought parallel to that of the fixed plate and with the film in place the photoelectric response of the Photronic cell is noted from a microammeter. After the film is removed, the rotatable plate is moved by means of an index, until a response results equal to the original. The scale of the index is calibrated directly in terms of density units. It may also be calibrated to read directly, in terms of transmission, relative exposure units or any other functional unit. C.

Acid Amides and Oximes: Association. A. M. Buswell, W. H. Rodebush and M. F. Roy. *J. Amer. Chem. Soc.*, 1938, **60**, 2444-2449.

The results of infra-red absorption studies on a number of acid amides and oximes are recorded in graphs and tables. In the amides evidence points to hydrogen bonding as the mechanism by which association takes place, accompanied in the mono-substituted series by enolisation. As the absorption curve of gelatin shows striking similarities with those of the associated amides it is probable that the same type of hydrogen bonding is present in both cases, presumably at a cross linkage between two polymeric chains or between parts of the same chain. One of the conditions for enolisation is that the shift of the mobile hydrogen usually involves the formation of a hydrogen bond and the authors suggest that the reactions of the acid amides will under comparable conditions confirm this hypothesis. In all the results with oximes there is no direct evidence whether the bonding is to oxygen or nitrogen since either is possible. C.

Hydrogen Bonds: Infra-red Absorption Studies. A. M. Buswell, W. H. Rodebush and M. F. Roy. *J. Amer. Chem. Soc.*, 1938, **60**, 2528-2531.

Venkateswaran's generalisation that the shift of the fundamental absorption band when hydrogen forms a bond is the greater, and the band itself the broader, the more active the hydrogen, has been verified by examination of complex formation between solvents and chloroform or hydrogen chloride, these two compounds having hydrogens at the two extremes of activity. A study of the infra-red absorption of ether containing hydrogen chloride suggests that hydrogen bonding causes a shift of the HCl fundamental to $4{\cdot}14\mu$. As the concentrations are diminished the amount of H-bonding is decreased and the $4{\cdot}14\mu$ band is correspondingly less intense. An absorption band which shifts to shorter wave lengths on bond formation is observed in complexes of chloroform and quinoline. This absorption is ascribed tentatively to the second harmonic perpendicular vibration of the hydrogen. C.

Allene: Infra-red Spectrum: E. H. Eyster. *J. Chem. Phys.*, 1938, **6**, 580-585.

The spectrum of allene between 7000 and 12,000 A has been photographed under high dispersion, the observed bands being assigned as harmonics and combinations of fundamental frequencies of the molecule. Rotational analysis of the parallel band at 11,444 A has given $97{\cdot}0 \times 10^{-40}$ g. cm.^{2} as the large moment of inertia. The perpendicular band of 11,017 A has been found to be unexpectedly complicated, but was too weak for detailed analysis. It is concluded that the dimensions in ethylene and allene are C-H$=1{\cdot}087$ A, C=C$=1{\cdot}330$ A, and H-C-H$=116°$. C.

Benzene: Lower Excited Levels; Calculation. M. Goeppert-Mayer and A. L. Sklar. *J. Chem. Phys.*, 1938, **6**, 645-652.

The energy of the first excited levels of benzene is calculated by the method of antisymmetrised molecular orbitals. The results predict two weak bands, due to forbidden electronic transitions, at $\lambda=2500$ and $\lambda=2100$ and a strong band at $\lambda=1500$. No empirical data except the carbon-carbon distance in benzene are used. C.

Ethylene Compounds: Infra-red Absorption Spectra. E. H. Eyster. *J. Chem. Phys.*, 1938, **6**, 576-579.

The absorption spectra of cyclopropane, ethylene oxide, ethylene sulphide, and ethylene-imine have been investigated in the region between 7000 and 12,000 A and the stronger bands have been assigned as third harmonics of the fundamental C-H stretching frequencies of these molecules. Rotational fine structure was not observed under high dispersion, but the well-defined band envelopes of the three asymmetric rotators provide interesting examples of these little-investigated band types. C.

Hexamethylene Glycol: Raman Frequencies. R. C. Williamson. *J. Chem. Phys.*, 1938, **6**, 653.

Observations were made on a specimen of hexamethylene glycol of melting point 40·9° C. and boiling point range 135·5-136·5° C. at a pressure of 8 mm. Hg, using mercury arcs in pyrex for excitation. In some runs a filter consisting of a saturated solution of sodium nitrite was used to eliminate the Raman lines resulting from the mercury 4047 A group of lines. An iron spark spectrum adjacent to the Raman spectrum was used for the purpose of interpolating the wave numbers of the Raman lines. The values are as follows, with estimated relative intensities and mercury line sources according to the Kohlrausch designations—814 (2-*e*), 852 (2-*e*), 874 (2-*e*), 915 (1-*e*), 1000 (2-*e*), 1052 (3-*e*), 1084 (3-*e*), 1298 (4-*ek*), 1435 (4-*ekc*), 1472 (4-*ekc*), 2855 (8-*ek*), 2905 diffuse (8-*ek*). C.

Inorganic Compounds: Raman Effect. A. Simon. *Angew. Chem.*, 1938, **51**, 783-795, 808-815.

A useful summary is given of recent studies on the Raman effect in inorganic chemistry, under the main headings—(A) General; (1) Quantum mechanics of the effect, (2) mechanical model and types of vibration, (3) polarisability theory and Placzek selection rule, (4) advances in technique and apparatus. (B) Application to problems in inorganic chemistry; (1) Introduction to the qualitative and quantitative evaluation of Raman spectra, (2) elements, (3) simple compounds (4) intramolecular forces (association and polymerisation),(5) the vitreous state, (6) chemistry of complexes, and (7) analysis. The references number 234. C.

Eye: Anomalous Trichromatism. J. H. Nelson. *Proc. Phys. Soc.*, 1938, **50**, 661-702.

The detailed characteristics of several anomalous observers with respect to trichromatism are given and an attempt is made to relate the different types of colour-vision to one another. A statistical survey of a number of observers chosen at random has also been carried out, to discover where the observers whose characteristics have been determined came in relation to other observers, and to ensure that all the observers chosen were not of the same type. The Wright colorimeter was used to determine the spectral coefficients, luminosity and mixture curves and hue-discrimination data. To determine the saturation-discrimination by adding small quantities of spectral colour to white, certain additions were made to the Wright colorimeter combination. For the statistical survey the Ishihara cards were used as a purely qualitative test, to determine whether the observer was deficient in colour sensitivity, and for division of the observers into their distinctive classes use was made of the Nagel anomaloscope. From the results it appears that anomalous trichromatism is an intermediate state between dichromatism and normal trichromatism. In the case of the protanomalous this transition seems to be of a continuous nature, but for the deuteranomalous there is a subsidiary maximum in the distribution curve. [Protanomalous observers are those having the maxima of their luminosity curves displaced towards the blue, and deuteranomalous towards the red, relative to normal vision.] C.

Eye: Intensity Discrimination. S. Hecht, J. C. Peskin and Marjorie Patt. *J. Gen. Physiol.*, 1938, **22**, 7-19.

An apparatus is described for measuring visual intensity discrimination over a large range of intensities, with white light and with selected portions of the spectrum. It is used in measurements of the intensity ΔI that makes a just perceptible difference when added for a short time to a portion of a field of intensity I to which the eye has been adapted. For white and all colours $\Delta I/I$ decreases as I increases to an asymptotic minimum at very high intensities. With white light, the plot of log. $\Delta I/I$ against log. I shows an abrupt change

on passing from low to high intensities, the two regions corresponding with the functions of the rods and cones, respectively. Measurements in five parts of the spectrum also indicate a difference in spectral sensibility between rods and cones. The data are precisely described on the supposition that intensity discrimination is determined by the initial photochemical and chemical events in the rods and cones. C.

Injured Eye: Colour Sensations Produced by Ultra-violet Light. A. G. Gaydon. *Proc. Phys. Soc.*, 1938, **50**, 714-720.

The author describes the colour sensations produced on his eye, which has lost its crystalline lens, by the iron arc spectrum. The eye is sensitive to ultra-violet light of quite low intensity, the sensation between 3600 and 3100 A being blue not violet, and the behaviour is essentially similar to that in normal scotopic vision, the light appearing colourless and the peripheral region being more sensitive than the fovea. C.

Polydisperse Cellulose Derivative Sols: Dynamic Birefringence. Ch. Sadron and, in part, H. Mosimann. *J. Physique et Radium*, 1938, [vii], **9**, 381-383 and 384-386.

(1) Results obtained for monodisperse media are generalised in the case of solutions containing particles of different shape, and general formulæ are given, which furnish, from consideration of the properties of the constituents, the position of the neutral lines and the birefringence of a mixed medium. A numerical example of two constituents is given, which shows how the variation in the position of the neutral lines plotted as a function of the flow gradient can differ from that observed in a monodisperse medium. In the theoretical discussion it is supposed that there is no interaction between the various constituents of the mixture. (2) Curves for the dynamic birefringence are given for (*a*) a mixture of micellar and molecular cellulose acetate, (*b*) a mixture of methylcellulose and sodium thymonucleinate and (*c*) serum globulin. The results obtained agree fairly well with the calculated values, which shows that the study of the Maxwell effect in a colloidal medium permits of a rapid decision as to whether the medium is polydisperse or not. Measurements made on a fractionated nitrocellulose show that even a slight residual polydispersivity is sufficient to cause a perceptible disturbance for large values of the velocity flow gradient. C.

Three-dimensional Colour Co-ordinate System: Definition. R. H. Sinden. *J. Opt. Soc. Amer.*, 1938, **28**, 339-347.

The new co-ordinate system based on the Helmholtz colorimetric line element is defined and numerical results afforded by the Helmholtzian function within this frame of reference are compared with observed data and also with the consequences of another theoretical construction. Helmholtz's derivation of his two basic equations is predicted on three explicit assumptions in regard to the nature of the colour-sense mechanism as follows—(1) There are three specific sensations of colour. (2) Each elementary colour sensation individually conforms to the Weber-Fechner principle. (3) The aggregate effect upon the visual consciousness of changing the intensities of more than one elementary colour sensation at a time is given by the square root of the sum of the squares of the separate effects due to each sensation alone. C.

Electron Microscope. Messrs. Siemens and Halske. *Engineering*, 1938, **146**, 474-475.

An illustrated description is given of the Siemens electron microscope and its scope. Bacteria and clay and crushed ore particles are shown at magnifications of 10,000 to 25,500 diameters. C.

Electrical Insulating Materials: Surface Resistance. G. Bublitz. *Archiv Tech. Mess.*, 1938, Lief. 87, T 124-126.

Methods for measuring the surface resistance of solid insulating materials are briefly described and curves are discussed that show the influence of temperature, nature of the surface and moisture on the surface resistance. C.

Ultrasonic Radiation: Absorption in Aqueous Solutions. W. Buss. *Ann. Physik*, 1938, [v], **33**, 143-159.

Investigation of a sonic field by means of an optical interferometer afforded no measure of the sonic intensity, but an electrical arrangement, dependent on changes in capacity due to the sonic irradiation pressure on a condenser was found

effective. The arrangement is described in detail in connection with measurements of the absorption of ultra-sonic waves, of frequencies 2100-6500 k.Hz., in solutions of sugar, glycerol and various salts and in carbon tetrachloride. The enhanced absorption observed in solutions of sugar, glycerol and magnesium sulphate, and the decreased absorption in solutions of Na and NH_4 chlorides, in comparison with the value for water, cannot be accurately calculated from the absorption formula of Stokes and Kirchhoff. C.

Cellulose: X-ray Structure. S. T. Gross and G. L. Clark. *Z. Kristallographie*, 1938, **99**, 357-366 (through *Sci. Abstr.*, 1938, **A41**, 800).

X-ray patterns of tunicin, bacterial cellulose, and *Valonia ventricosa* are consistent with the Meyer and Mark unit cell. C.

Cereal Amylases: Activity. M. J. Blish, R. M. Sandstedt and E. Kneen. *Cereal Chemistry*, 1938, **15**, 629-657.

A review of work on the α- and β- amylases of cereals is given. The important factor limiting the degree of autolytic saccharification in flour is the quantity of the readily available starch. Flours contain small, variable amounts of this susceptible starch, the major portion of the total starch being intact starch grains not available to β-amylase. The quantity of available starch, however, can be increased by fine grinding, or by the addition of the raw starch biocatalyst, present in malt. The action of β-amylase ceases when about 60 per cent. of the "soluble" starch is saccharified. The dextrinogenic α-amylase allows saccharification of soluble starch beyond 60 per cent.; the greater its concentration the higher is the conversion level, according to the law of diminishing returns. Therefore the addition of malt to wheat flour (1) furnishes α-amylase, permitting saccharification of susceptible starch beyond 60 per cent., and (2) provides a catalyst that stimulates an appreciable saccharification of the raw starch. Although the amount of α-amylase tends to parallel the quantity of the raw starch catalyst in malt, there is good evidence indicating that the two catalysts are not identical. There is also parallelism between Lintner value and α-amylase content in malts, and the yeast manometric type of method appears to have possibilities as a suitable means for estimating the diastatic potentialities of malt. C.

Potato Starch: Degradation by α-Amylase. J. Blom, B. Braae and A. Bak. *Z. physiol. Chem.*, 1938, **252**, 261-270.

Full details are given of a series of studies on the products formed in the digestion of potato starch by α-amylases. Dextrins and maltose are formed, the quantity of the latter being determined from the difference in reducing power of the sugars before and after fermentation with yeast. The production of maltose reaches a maximum of 23 per cent. of the theoretical amount when 40 per cent. of the starch is hydrolysed. Increasing quantities of maltose inhibit hydrolysis by α-amylase. C.

Proteolytic Enzymes: Production of Ammonia by—. M. Damodaran and P. Ananta-Narayanan. *Biochem. J.*, 1938, **32**, 1877-1889.

A systematic study is presented of the formation of ammonia and the hydrolysis of peptide linkages during the action of pepsin, trypsin, erepsin and papain on casein, edestin and gliadin. It is shown that amide and peptide hydrolyses do not by any means run parallel. With each enzyme, in the earlier stages of action, when the rate of peptide hydrolysis is at its highest, ammonia liberation is hardly noticeable and becomes significant only after the products of digestion have accumulated to some extent. On the other hand, when the most active stage of proteolysis is past and formaldehyde titrations are increasing only very slowly, the liberation of ammonia continues at a steady rate. It is therefore assumed that the ammonia formed is not directly connected with proteolytic action but arises from the decomposition of the primary products of protein cleavage similar to the γ-peptides of glutamine. It is also probable that this secondary decomposition is not enzymic in nature but is brought about by the acidic or alkaline reactions involved. The results for the action of papain on casein are entirely different from those obtained with the animal proteases. Production of ammonia appears to be a definite function of the enzyme. C.

Wheat Gluten: Effect of Proteoclastic Enzymes on Solubility. R. H. Harris. *Cereal Chemistry*, 1938, **15**, 690-707.

The effect of proteoclastic enzymes on the solubility of wheat gluten in sodium

salicylate solutions has been investigated. Generally speaking the inclusion of an enzyme hastened dispersion of the gluten, the effect being increased with increasing enzyme concentration. The effect of potassium bromate on proteolytic activity was also studied. Bromelin and pancreatin appeared to exert the greatest influence on gluten dispersion, but takadiastase appeared to decrease the solubility. Yeast water, which possessed no proteolytic activity itself, showed a decided activating effect on the flour proteases and malt diastase had a very noticeable influence on gluten solubility and is distinctly proteolytic in action. Pepsin was the only enzyme investigated which did not show repression by moderate concentrations of bromate, but several of the enzymes gave indications of possible activation by bromate when the chemical was present in relatively small quantities. C.

Pentosans: Determination. Elizabeth E. Hughes and S. F. Acree. *J. Research Natl. Bureau Stnds.*, 1938, **21**, 327-336.

The authors have studied the conditions under which the yield of furfuraldehyde from xylose can be raised to the theoretical, so as to improve the determination of pentosans. The recommended procedure is hydrolysis with 12 per cent. hydrochloric acid saturated with salt and continuous distillation in a current of steam. C.

Amylose (β): Preparation by Electro-dialysis. S. Redfern. *Cereal Chemistry*, 1938, **15**, 712-715.

Details are given of an electrodialyser made of wide glass tubing and carbon electrodes that can be used in a vertical or horizontal position for the preparation of β-amylose. Ground starch is suspended in water, dissolved by addition to boiling water, and the solution is cooled to 30° C. (not lower, otherwise retrogradation occurs), and placed in the middle cell of the dialyser. A potential of 750 volts is applied, the lower carbon rod being the anode. The initial current of about 50 milliamps. falls during the first day to about 2 milliamps. and the potential is then increased to 1500 volts. The water in the end cells is changed several times daily. In about a week the solution separates into two distinct layers, the upper clear half being an approximately 2·5 per cent. solution of β-amylose. C.

Starch: Oxidation by Bromine. G. Felton, F. F. Farley and R. M. Hixon. *Cereal Chemistry*, 1938, **15**, 678-689.

Gelatinised corn starch was oxidised by bromine in the presence of calcium carbonate. The insoluble residue was dried, ground, suspended in water and titrated to *p*H 4-5 with dilute hydrochloric acid. The resulting suspension was neutralised to litmus with sodium hydroxide and the precipitated calcium salt of the oxidised carbohydrate analysed for Ca, reducing power and uro ic acid content. The specific rotations were also measured on all samples. The following types of oxidations are established. (1) Oxidation of the primary alcohol groups, as estimated by the carbon dioxide evolution, reached a maximum when 6 equivalents of bromine per glucose unit were used. (2) Oxidative production of non-uronic carboxyl groups, as measured by the Ca content in excess of that calculated to neutralise the uronic acids present. (3) Secondary alcohol oxidation to ketone groups, as measured by reducing value. (4) Oxidation of glycol groups, indicated by the decomposition of the reducing units in the late stages of oxidation and by the molecular degradation of the starch molecule as established by the decrease in optical rotatory power and the increase in Ca content. The oxidation of α-amylose followed the same course as that of β-amylose, but the latter required only one quarter of the time. It appears therefore that the chief differences between α- and β-amylose are physical and not chemical. C.

Cellulose, Starch and Gelatin Solutions: Effect of Ultra-violet Radiation on Viscosity. J. Löbering. *Z. Elektrochemie*, 1938, **44**, 743-747.

A report of a lecture on the kinetics of polymerisation and the viscosity of high-polymerides. Mention is made of a quartz viscometer in which the effect of ultra-violet radiation on viscosities could be studied; the driving pressure could be increased to 3 atm. and the liquid apparently directed to different capillaries. It is reported that an effect of radiation was not observed with liquids of normal behaviour. Similarly, solutions of starch in water, or paraffin in carbon tetrachloride, in which the pressure/flow relation is abnormal, were not affected by

radiation. Other anomalous solutions, however, namely cellulose in phosphoric acid or sulphuric acid, cellulose acetate in acetone or methylene chloride, and gelatin or agar in water, suffered a decrease of viscosity on irradiation and the viscosity anomaly tended to disappear in time. C.

Fructose: Photo-chemical Reactions in the Ultra-violet. G. Ehrhardt. *Helv. Chim. Acta*, 1938, **21**, 985-1003.

Investigation has been made of the entire absorption spectrum of fructose and, for the middle and short-waved ultra-violet, of (1) the rate of reaction and the after-effect of irradiated fructose solutions as a function of concentration, (2) the relationship between the magnitudes of the speed of reaction plus after-effect and the number of irradiated quanta—the quantum yields, and (3) the results obtained in the middle ultra-violet compared with the short-wave region. Energy measurements are based on a photographic blackening method. The absorption spectrum of fructose comprises those of a keto and a half-acetal form. Experiments in the short ultra-violet show dependence of the rate of reaction of highly concentrated solutions on their time of standing, due to the formation of resistant molecular complexes. The quantum yield is dependent on concentration and time of standing of the solutions, a diminishing effect being observed with increasing concentration of fructose. Similar experiments in the middle ultra-violet showed a rate of reaction in inverse proportion to the intensity of the colour of the solution and that quantum yield is dependent on concentration and mode of preparation. C.

High Molecular Weight Compounds: Light Scattering. W. Lotmar. *Helv. Chim. Acta*, 1938, **21**, 953-984.

An apparatus in described, based on Cornu's method, for measuring the degree of depolarisation, Δ, up to 0·0005, the values by this method being independent of the concentration over a larger region than with other methods. Values of Δ are given for a number of proteins and cellulose derivatives, including four methyl-celluloses, five nitro-celluloses and a cellulose acetate, and for starch, polyvinyl alcohol, rubber, silver sol and gamboge sol. The results are in accord with theory in that (1) there is no connection between degree of depolarisation and particle form with dielectric colloids, (2) the Δ_V values are of the same order of magnitude as for low-molecular organic gases and vapours, (3) the Δ_V values are small with isotropic non-spherical particles even in the region where d is roughly equal to λ, and (4) the molecular field is without influence in concentrations below 1 per cent. A determination of particle shape on the basis of concentration-depolarisation in concentrated nitrocellulose solutions gives a smaller particle length than that corresponding to the molecular length, and a comparison of the Δ_V values of high-molecular methyl- and nitro-cellulose and rubber with correspondingly smaller molecules supports the view that this is due to the mobility of the molecules. The decrease of Δ_U observed in the case of casein and the increase in the intensity of scattering on addition of salt can be explained by dehydration or by a special aggregation of the particles. It would be expected from consideration of the fluctuation theory of the scattering of light, that on dilution of a solution of elongated particles the intensity would decrease in proportion to the dilution. Comparisons of scattering intensities of chain-polymeric homologues show in contradistinction to Raleigh's law, that the intensity tends to a limiting value with increasing chain-length. Comparative intensity measurements on nitro-cellulose solutions appear to give such a saturation effect. (Δ_V= depolarisation for vertically polarised incident light, Δ_U for unpolarised light). C.

Acrylic Acid and Methacrylates: Raman Spectra. D. Monnier, B. Susz and E. Briner. *Helv. Chim. Acta*, 1938, **21**, 1349-1355.

Raman spectra are given of acrylic acid, of the monomeric and the solid polymeric methyl methacrylate and of the monomeric and solid polymeric ethyl methacrylate. In order to study the process of polymerisation investigations have been undertaken of a partially polymerised and stabilised product. The Steinheil spectrograph was used in the experiments, the dispersion being 30 A/mm. for a wave-length of 4600. Excitation was by the line 4358A, and the exposure was about 48 hours. The continuous background had a tendency to increase with polymerisation and to diminish it a Schott filter GG3 was used. An epidiascope was also used to detect clearly rays of weak intensity. A few

new lines have been observed and measured; the frequencies are recorded to a precision of 5 to 7 cm.$^{-1}$. The chief result is the strong diminution in the intensity of the frequency of the double bond with polymerisation, the reverse being observed for frequencies of the CH_2 group. This can be explained by attributing the polymerisation to the formation of chains, by rupture of the ethylene double bond. C.

Dark Coloured Surfaces: Photographic Colorimetry. E. v. Angerer and J. O. Brand. *Z. tech. Physik*, 1938, **19**, 254-259.

Müller's method of "displaced spectrum lines" is applied to the determination of the dependence on wave-length of the light reflected by pigmented surfaces. The method is developed so that both spectra are exposed at the same time or so that by sub-division of a continuous spectrum several points of measurement can be obtained. The method is illustrated by measurements on the remission spectrum of a dark green postage stamp. The curve obtained gives the most probable course of the distribution of the intensity. It demonstrates the well-known fact that the eye perceives a surface to be strongly coloured when the differences in the reflection of the different wave-lengths are still relatively small. The scattering of the points is small in spite of the dark colour and the monochromatic illumination. C.

Organic Liquids: Determination of Molecular Dispersion with the Abbe Refractometer. H. Waldmann. *Helv. Chim. Acta*, 1938, **21**, 1053-1065.

Examination of the optical constants of about 100 organic compounds of different classes shows that the refractive indices n_F and n_C can be extrapolated from the refractive index n_D and the mean dispersion n_F-n_C measured by the Abbe refractometer from the relation $(n_{..}-n_C)/(n_F/n_C) = Q = 0{\cdot}286$. Extreme values of Q are 0·321 and 0·257. This permits a rough calculation of molecular dispersions from measurements by the Abbe instrument. The method is illustrated by reference to water, isobutylamine, caprylic acid, piperidine, cetyl iodide, *d*-limonene, pyridine, benzene, benzonitrile, benzophenone, α-naphthol and cinnamic aldehyde. C.

Low-humidity Dew-point Potentiometer: Description and Application. A. K. Frank. *General Electric Review*, 1938, **41**, 435-437.

A dew-point potentiometer and auxiliary apparatus is described for use in making determinations of dew points as low as —100° F. on compressed gases. Town's gas and flue gases may be tested with this instrument, but not to such low dew points. A list of useful industrial applications are suggested. C.

Water: Evaporation into Still Air. B. F. Sharpley and L. M. K. Boelter. *Ind. Eng. Chem.*, 1938, **30**, 1125-1131.

The evaporation of distilled water from a pan, 1 ft. diameter., into still air at 53 per cent. R.H. has been measured for water temperatures between 63° and 93° F. by a method involving an optical interferometer device for registering the change in surface level. In the critical region corresponding with a temperature of 69·4° F. the buoyant effects of the mixture at the water surface and at a distance are equal. Above the critical region, the unit evaporation rate in pounds per sq. ft. per hour, may be expressed by the equation $e = -0{\cdot}024 + 65(c_{vw} - c_{v\infty})$, and the critical region by $e = 18{\cdot}75\ (c_{vw} - c_{v\infty}$ where c_{vw} is the concentration of water vapour on the gas side of the gas/liquid interface and $c_{v\infty}$ is the concentration of water vapour in the atmosphere at a distance, both in pounds per cubic foot. C.

Cellulose Hydrate: Lattice Distention by Absorption of Water. I. Sakurada and K. Hutino. *Sci. Papers Inst. Phys. Chem. Res., Tokyo*, 1938, **34**, 1164-1173.

X-rays spectrograms on mercerised ramie are described that show that the lattice of sharply-dried cellulose hydrate differs slightly from that of the usual air-dried product. The change is reversible. The X-ray diagrams found by other authors are compared in a table. The lattice constants of the thoroughly dried cellulose hydrate agree with the results of R. Andress, while the data from the air-dried compound are almost identical with the findings of Meyer and Mark. The (101)-plane of cellulose hydrate is distended by 0·3A and the volume of the unit cell increased by 4 per cent. by adsorption of water. Other planes are scarcely affected. A calculation of the amount of water combined with cellulose hydrate

gives 0·35 mol. per C_6 unit, that is about half the water in the air-conditioned material is actually in combination. No lattice change was observed in experiments with native cellulose. C.

Analysis of Groups of Experiments. F. Yates and W. G. Cochran. *J. Agric. Sci.*, 1938, **28**, 556-580.

When a set of experiments involving the same or similar treatments is carried out at a number of places, or in a number of years, the results usually require comprehensive examination and summary. In general, each set of results must be considered on its merits, and it is not possible to lay down rules of procedure that will be applicable in all cases, but there are certain preliminary steps in the analysis which can be dealt with in general terms. These are discussed in the present paper and illustrated by actual examples. It is pointed out that the ordinary analysis of variance procedure suitable for dealing with the results of a single experiment may require modification, owing to lack of equality in the errors of the different experiments, and owing to non-homogeneity of the components of the interaction of treatments with places and times. W.

Solvent-extracted and Normal Olive Oils. G. Dorta. *Olii minerali, grassi e saponi, colori e vernici*, 1938, **18**, 67-68 (through *Chem. Abs.*, 1938, **32**, 8178).

Solvent-extracted olive oils are characterised by the presence of certain resinoids or paraffinic substances (or their oxidation or polymerisation products), which are unsaponifiable and raise the pour point. A procedure is outlined for a correct determination of the cloud and pour points of variously extracted olive oils. It is pointed out that 5% of solvent-extracted oil in normal olive oil causes turbidity at 20°. A clouding of the unsaponifiable at 29-28° justifies a suspicion of the presence of small quantities of solvent-extracted oil. W.

Oleins: Oxidation. J. Clavel. *Teintex*, 1938, **3**, 521-522.

Storage of olein in iron containers increased appreciably both its tendency to oxidise and its mineral matter content. W.

Physiology of Human Hairs. A. Basler (with R. Beck, G. Gohl, R. Hoheisel and H. J. Otte). *Z. Biol.*, 1938, **99**, 80-91 (through *Brit. Chem. Abs. A* III, 1938, p. 814).

The firmness of human hair roots was studied under various conditions, the load required for depilation being taken as a measure. Experiments were made on various regions of the body. The influence of sex, age, active and passive hyperæmia, and electric stimulation, was studied. The "firmness" of an average hair, during its development, increases from 15·4 g. to 31·8 g. and then decreases to 29·6 g. Movements of the hairs were recorded photographically, and the time relations of pilometer reflex contractions examined. W.

Influence of Cobalt on Pine Disease in Sheep. H. H. Corner and A. M. Smith. *Biochem. J.*, 1938, **32**, 1800-1805.

Pine disease in sheep in the Cheviot region of Scotland is a nutritional anæmia which can be cured and prevented by the administration of cobalt in the form of cobalt chloride. The disease is not due to a deficiency of iron or copper or manganese. The beneficial results previously obtained from the feeding of iron compounds may be attributed to the presence of cobalt in the iron compounds used. The administration of 1 mg. cobalt per day for 14 days is sufficient to prevent the disease on severe pining land for a period of 6 months. A similar quantity is effective as a cure. W.

Aqueous Imbibition of the Ovokeratin of Selachians. C.-T. Baudouy. *J. Chim. Phys.*, 1938, **35**, 268-275.

The swelling and imbibition of the proteins constituting the ovular capsule of the selachians, generally called ovokeratin, has been studied under different conditions. It is found that they swell and take up water more readily than the true keratins (e.g. hair), but less readily than the sulphur proteins of the collagen type (e.g. elastin). W.

Patent

Sulphuric Acid Heat of Absorption Hygrometric Apparatus. F. W. Haywood, C. H. Bosanquet, J. L. Pearson and Imperial Chemical Industries, Ltd. B.P. 491,154 of 26/2/1937.

In determining the moisture content of a gas by measuring the heat of absorption in sulphuric acid, a thermometer irrigated with the acid is subjected to a

gas current of such cross-section that the outer portion thereof escapes the action of the absorbent, and preferably not more than 33 per cent. of the moisture is absorbed from the whole of the gas passed. The relative rates of flow of the gas and the acid are such that the greater part of the heat of absorption is carried away by the gas, and the rate of gas flow is selected so that small variations do not affect the sensitivity of the instrument. The apparatus comprises two mercury thermometers inserted in passages in a block of metal through which the gas is passed in series. The second thermometer is surrounded by a coil of platinum wire and irrigated with sulphuric acid from a syphon. C.

10—ECONOMICS

British Cotton Spinning Industry Statistics, 1938. The Spindles Board. *2nd Annl. Rept. Spindles Board*, 1938, 10 pages.

The following tables are presented. (I) Spindle capacity, excluding waste spinning, 14/9/1936 to 14/9/1938 in half-yearly periods; the latest total is 41,224,630 mule-equivalent spindles in 505 mills. (II) Production of singles yarn; the half-yearly totals in the above periods have changed from 413,923,000 to 319,812,000 lb. for American-type yarn, 141,520,000 to 117,452,000 lb. for Egyptian-type yarn, and 8,663,000 to 8,798,000 lb. for cut staple rayon and mixture yarns. (III) Analysis of singles yarn production by counts. (IV) Machinery activity in running mills, expressed as a percentage of full-time running; the percentage has fallen from 92·4 for the 6 months ending 14/9/1937 to 66·1 for the latest period. (V) Unused spindle capacity; the percentage of total spindle capacity has risen from 9·2 for the 6 months ending 14/9/1937 to 34·0. C.

Czechoslovak Cotton Industry: Effect of Partition. Economic Service Joint Committee of Cotton Trade Organisations. *Textile Weekly*, 1938, **22**, 615-6.

Through the cession of the Sudeten areas, about 40 per cent. of the cotton manufacturing industry of Czechoslovakia has passed to Germany. The industry employed about 115,000 persons in 1930, and in 1937 produced 220 million lb. of yarn and about 800 million sq. yds. of cloth. There were 4,400,000 mule-equivalent spindles and 104,000 looms. Details of exports are tabulated. C.

French Cotton Industry: Prospects. R. Skliar. *Cotton Trade J. Internat. Edn.*, 1938, 72, 78.

The wide fluctuations in raw cotton imports from 1932-37 are shown in a table and discussed and recent figures for yarn and cloth imports and exports are given. Spinners' margins have been reduced since the Spring of 1937 but mills are reported to have many orders on their books. C.

German Cotton Industry: Development. Economic Service, Joint Committee of Cotton Trade Organisations. *Textile Weekly*, 1938, **22**, 653-4.

Statistics are given to show the effect of the addition of Austria and the Sudeten areas to Greater Germany on the cotton industry. The increase of population is about 15 per cent. but the increase in the magnitude of the cotton industry 25-30 per cent. There is a risk of the productive resources, especially in spinning, being excessive and a specially stimulated expansion of export trade may be expected. C.

Japanese Cotton Industry: Development. (1) G. Kodera. (2) T. Kawasaki. *Cotton Trade J. Internat. Edn.*, 1938, 52, 54-5.

The following notes are taken from a series of several items by Japanese authorities. (1) Statistics show the Japanese proportion of world spindles (8·1 per cent.) and looms (11·8 per cent.), the production of yarn and cloth 1930-1937, and the growth of the industry in 10-year periods from 1887. (2) The balance of trade between Japan and the United States is discussed and the imports of Indian, American, Egyptian and other cottons by Japan since 1927-28 are tabulated. C.

Japanese Cotton Industry: Development. M. V. Dani. *Indian Textile J.*, 1938, 48, 426-428.

Tables of statistics are given to show the growth of the Japanese cotton industry from 1866-1894, 1894-1907, 1914-1920, and in recent years. At the end of June 1937, the Japan Cotton Spinners' Association controlled 13,474,102 spindles and 104,666 looms. The official estimate of all looms in Japan at the end of 1934 was 376,704. C.

Raw Cotton, Yarn and Cloth Prices, 1936-7 and 1937-8. *Cotton* (*M/cr*), 1938, 44, No. 2134, p. 19.

Weekly quotations are tabulated from August 6th 1937, to July 29th for American futures. middling American spot cotton, F.G.F. Sakel spot, 32's American twist, 60's Egyptian twist, and $8\frac{1}{4}$ lb.-shirtings, with corresponding weekly prices for 1936-37 for comparison. C.

Textile Price Indices, September and October, 1938. W. H. Slater. *Textile Weekly*, 1938, **22**, 569.

The Index numbers for September and October are—Raw cotton, American 67·27, 71·67; Egyptian 74·50, 81·40; Yarns, American 104·9, 104·3; Egyptian 99·9, 101·1; Cotton piece-goods, 114·9, 115·4; "All cottons", 99·2, 100·9; Wool group, 123·9, 124·8; "Other textiles," 73·1, 74·0; "All commodities," 117·1, 117·9 (1913=100). C.

Textile Production Statistics, August and September, 1938. *Board of Trade J.*, 1938, **141**, 422, 558.

Raw cotton delivered to mills in August and September amounted to 98 and 84 million lb. The index of wages paid in the wool industry was 93·3 and 97·7 per cent. (of 1930). Rayon yarn and waste production was 9·31 and 11·78 million lb. Deliveries of silk for home consumption were 357,000 and 642,000 lb. C.

Textile Wholesale Prices: October, 1938. *Board Trade J.*, 1938, **141**, 606, 609.

The index numbers for September and October are—Cotton 81·4, 82·8; Wool 99·7, 100·5; Other textiles 68·4, 69·2; All articles 98·4, 99·1 (1930=100). Monthly average prices show an upward trend, especially for raw cotton. C.

World's Cotton Crop: Production and Consumption Statistics. *Cotton Trade J. Internat. Edn.*, 1938, 134-5.

The following tables, from official sources, are assembled together. (1) Production of commercial cottons, by countries, from 1909-10 to 1937-38. (2) Cotton spinning spindles of the world, 1932-37. (3) Production, exports, home and foreign consumption, and carry-over of American cotton, 1928-37. (4) Monthly consumption of American and "foreign" cotton in the world, 1933-34 to 1937-38. (5) Geographical division of exports of American cotton, to end of April, 1938. (6) Exports from various N. American ports. (7) Annual consumption of cotton, wool, rayon, silk and linen in the United States, 1920-37. (8) Spindleage and production data for American mills. C.

World's Cotton Crop: Production and Utilisation. 1915-16 to 1936-37. A. B. Cox. *Cotton Trade J. Internat. Edn.*, 1938, 16-17.

A series of tables of statistics and diagrams are given to provide a comparison of the production and consumption of American cotton against "foreign" cotton from 1915-16 to 1936-37. World mill consumption of "foreign" cotton has increased by 7,174,000 bales since 1927-28, but consumption of American cotton has decreased by 2,205,000 bales. C.

American Cotton: Export Trends. A. B. Cox. *Rept. 18th Int. Cotton Congress*, 1938, 281-287.

The author discusses the future of United States exports of cotton under the headings (1) quantity, (2) quality, (3) restriction of production, (4) World prices and (5) foreign exchange. According to the author no economic programme based on restriction of production to gain prosperity can last indefinitely. C.

Brazilian and Ecuadorian Textile Industries: Activity. *Textile World*, 1938, 88, No. 11, 51.

About 750,000 bales of cotton are raised annually in the northern states of Brazil and about 1,250,000 bales in the southern states. About 900,000 bales are exported, of which Great Britain takes about one-third. The annual out-turn of silk cocoons amounts to 15,000,000 lb. The silk is used locally. Brazil contains about 500 manufacturing establishments out of a total for the South American continent of nearly 1,250. The Brazilian cotton industry includes 338 mills operating 2,532,342 spindles and 81,158 looms. The woollen industry includes 20 establishments with 27,710 spindles and 888 looms. The knitting industry is credited with 5,170 knitting machines, and in addition operates 29,400 cotton spindles. The silk industry comprises 82 mills with 2,846 looms and sufficient machinery to turn out 3,500,000 pairs of silk hosiery annually. There are two rayon yarn producers with an output of 3,500,000 lb. There are also about 10

jute mills operating 3,960 looms. The cost of living in Brazil is high and wages are low, but an 8-hour day and 48-hour week are enforced by law. A spinner in the Sao Paulo district operates only about one-quarter of the number of spindles commonly operated in the United States. The majority of the cotton mills make coarse goods and most of the machinery in use is of British make. An American cotton spinning mill is being planned for Sao Paulo which will spin 60's to 120's combed yarn from Brazilian cotton on 10,000 American-made spindles. Ecuador has 12 cotton mills, 4 woollen mills and 3 knitgoods plants. The woollen mills make cotton mixtures chiefly and one of the knitgoods plants also produces rugs. Textile employees number about 3,500. Some effort to grow cotton is reported and the out-turn in 1936-7 was 10,600 bales. The cotton is consumed locally but some has lately been exported to Germany. C.

Cotton and Rayon: World Production. Hussein Bey Enan. *Rept. 18th Int. Cotton Congress*, 1938, 208-212; Discussion, p. 65.

Tables are given showing the production of rayon and raw cotton from 1930 to 1936-37 for the chief countries, and the relationships between these commodities are reviewed for England, U.S.A., Italy, Germany, Japan, Belgium, Poland, Austria and Greece. In spite of the rapid increase in rayon production throughout the world, there is also an increase in the consumption of cotton. It is suggested that Egyptian cotton growers and spinners should combine for better advertising of the products made from Egyptian cotton. C.

French Cotton Industry: Effects of the Forty-hour Working Week. M. R. Angliviel de la Beaumelle. *Rept. 18th Int. Cotton Congress*, 1938, 295-302; Discussion, 100-102.

The effects of the forty-hour working week in the French cotton industry are reviewed with statistics. The following conclusions are drawn. (1) Hourly output per operative is almost unchanged. (2) There has been slight increase in the employment of operatives, due mainly and perhaps exclusively to a temporary revival in the market. (3) There has been a new rise in the cost of production, already overloaded, involving a sharp fall in consumption. C.

Textile Production Statistics, October 1938. *Bd. Trade J.*, 1938, **141**, 678.

Raw cotton delivered to mills in October amounted to 98 million lb. (107·4 per cent. of 1930); the index of wages paid in the wool textile industry was 101·8; production of rayon yarn and waste was 11·75 million lb. (289·1 per cent.); and deliveries of silk for home consumption were 392,000 lb. (149 per cent.). Some recovery is noted from the low figures for September in the cotton and wool sections. C.

United States Commercial Treaty. *Bd. Trade J.*, 1938, **141**, 689-716.

The schedules of commodities affected by the trade agreement with the United States are set out in detail. C.

11—INDUSTRIAL WELFARE, INDUSTRIAL PSYCHOLOGY, AND EDUCATION

Textile Dermatitis: Medico-legal Review. C. M. Whittaker. *J. Soc. Dyers and Col.*, 1938, **54**, 447-454.

A report of a lecture on the author's experience, with the Committee on Alleged Dermatitis, of claims for damages by wearers of textiles. Examples are cited of the difficult position of dyers and manufacturers but there are indications that the defence of idiosyncrasy is gaining ground in medico-legal opinion. C.

Textile Research in United States: Organisation. C. Schlatter. *Amer. Dyes. Rept.*, 1938, **27**, 563-567.

A general review of the development of research in industry, with a plea for organised textile research in the United States. It is calculated that the American chemical industry spends on research a sum equivalent to 2·4 per cent. of its invested capital, the electrical industry 1·5 per cent., and the textile industry only 0·7 per cent. American textile production is worth roughly 2,600 million dollars by 7000 mills, or 370,000 dollars per mill. If 1·5 per cent. of the sales revenue were devoted to research it would only supply 5,550 dollars per mill, a strong argument for co-operative research. C.

Alphabetical Index to Advertisements

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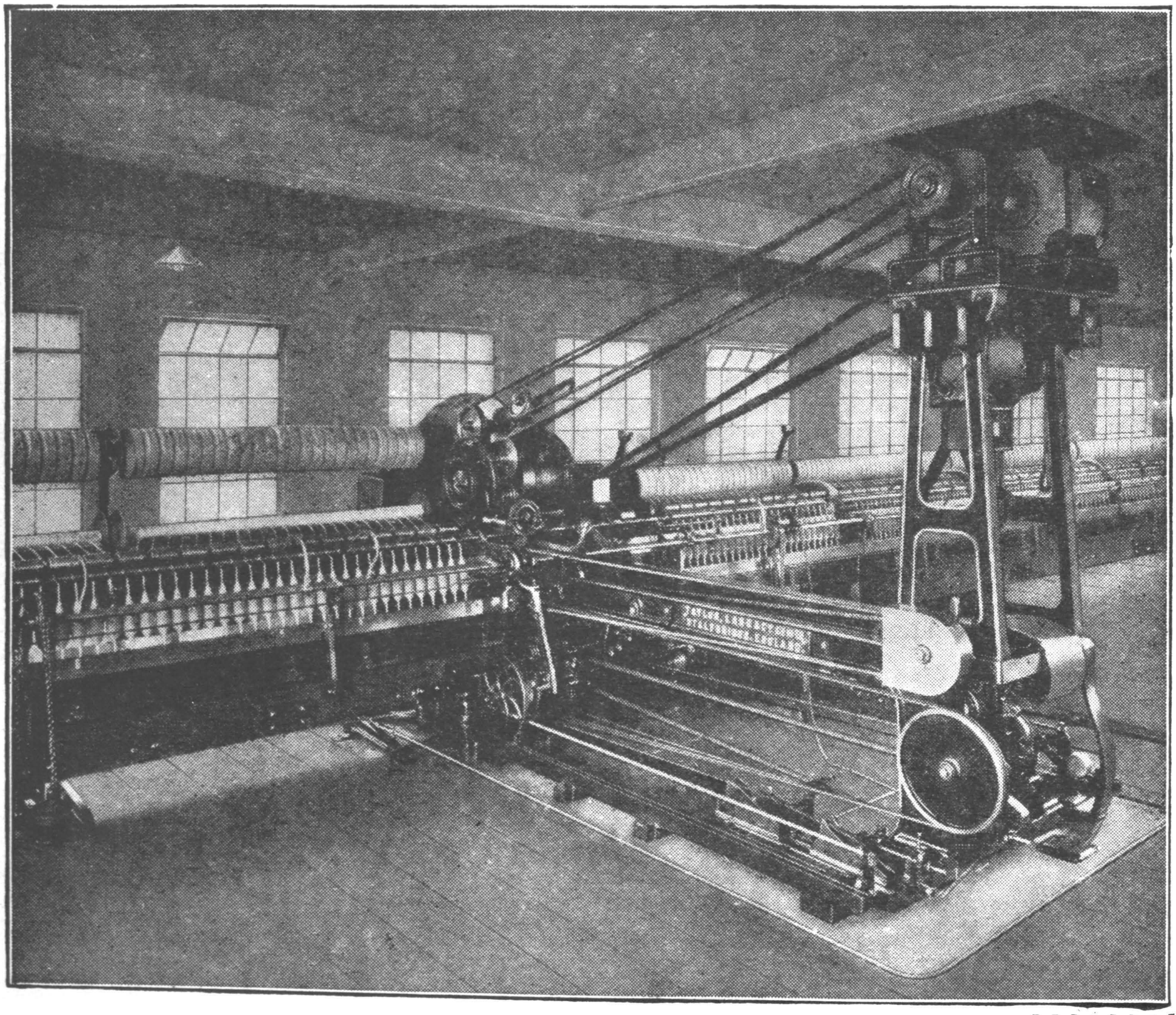

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