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The Journal of the

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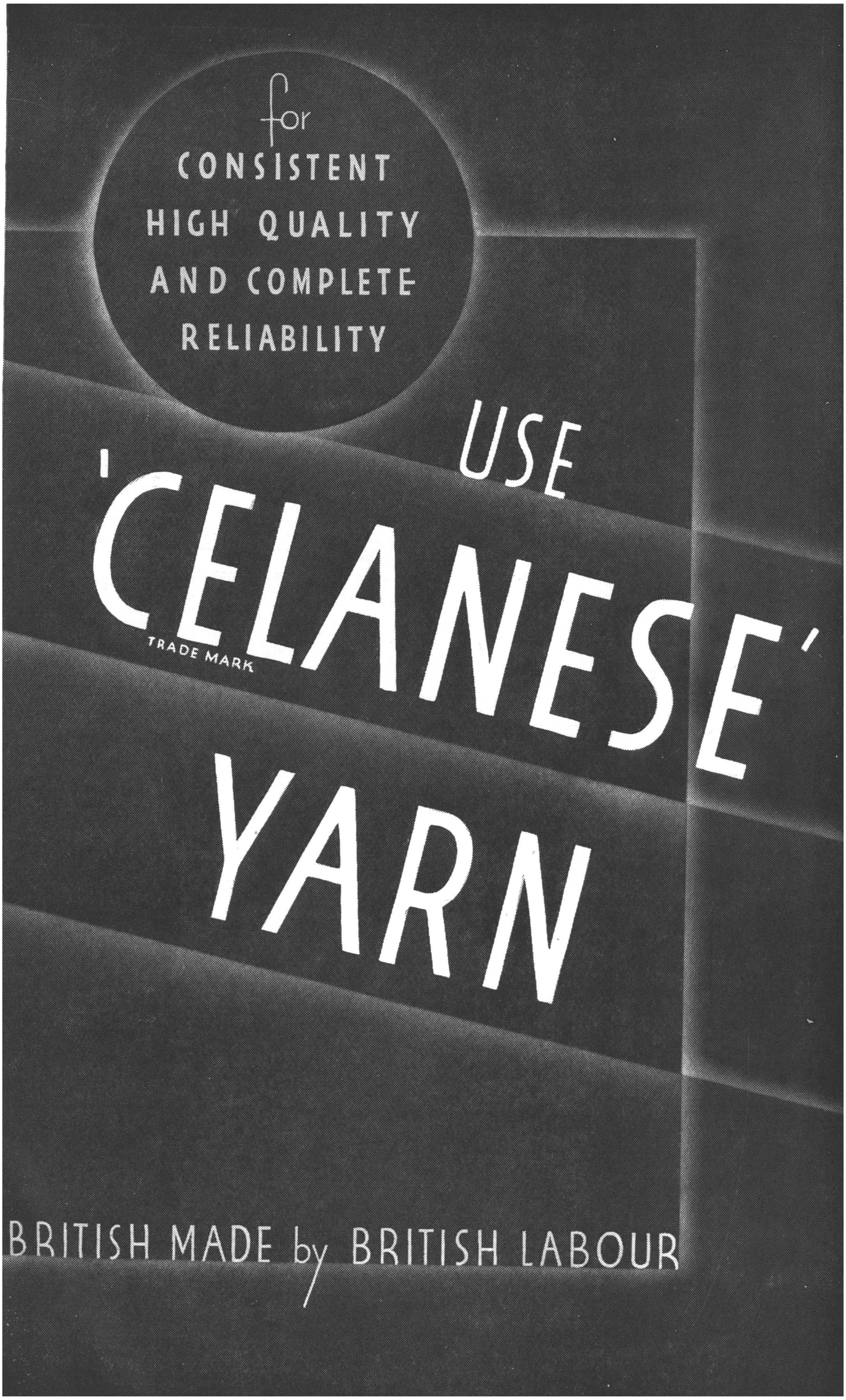
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THE JOURNAL *of the* TEXTILE INSTITUTE

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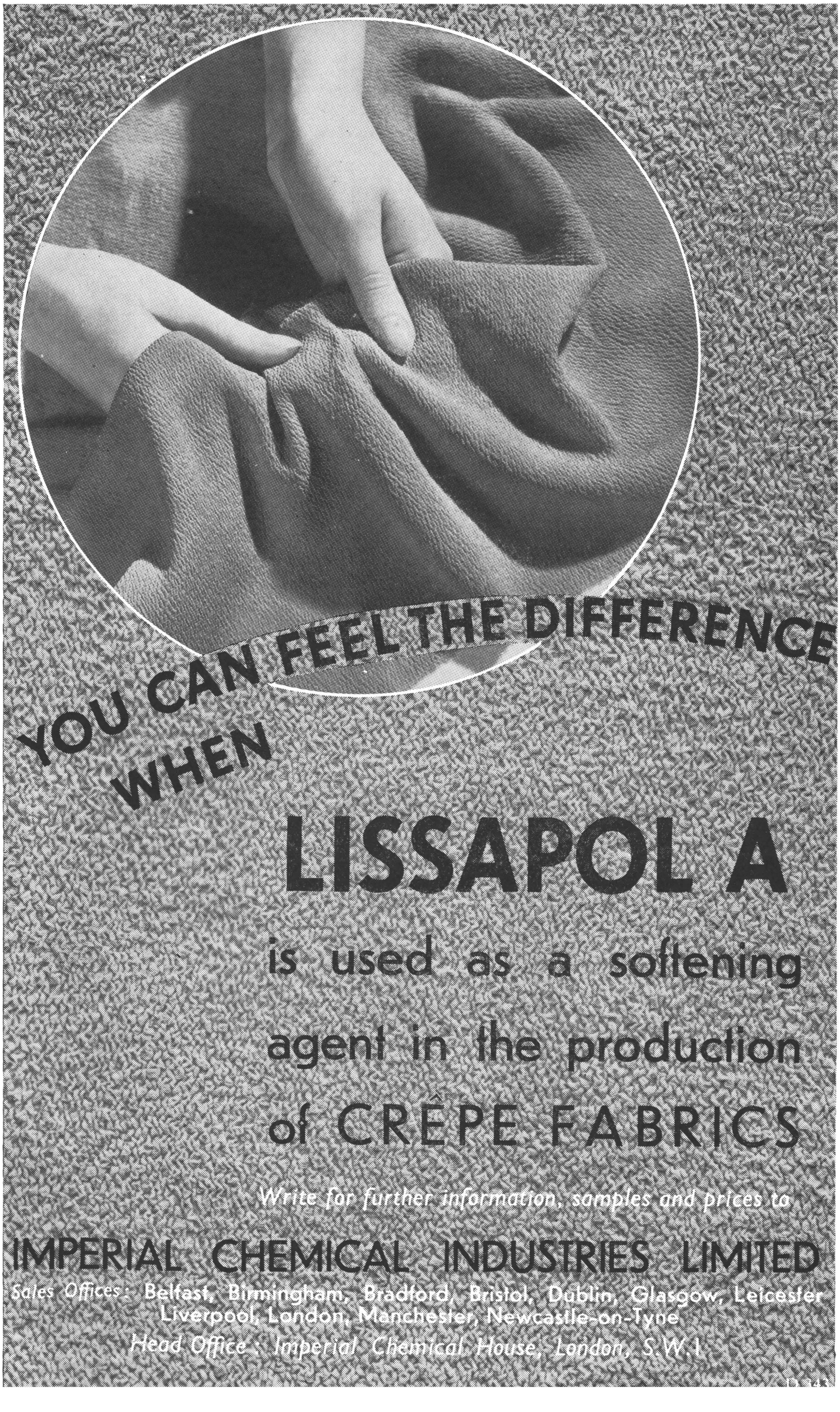
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NOTICES—INSTITUTE MEETINGS

Wednesday 7th February *Manchester*—3 p.m. Meeting of Selection Committee, at Institute.
Wednesday 21st February *Manchester*—3 p.m. Meeting of Council, preceded by meeting of Finance and General Purposes Committee.

LANCASHIRE SECTION

Friday 9th February *Preston*—7.30 p.m. At Harris Institute, Corporation Street. Paper, "Recent Investigations on the Loom", by Mr. W. A. Hanton, M.Sc.Tech.

MIDLANDS SECTION

Wednesday 14th February *Derby*—7.30 p.m. At Derby Technical College. Joint Lecture with Society of Dyers and Colourists, Midlands Section, "Textiles purchased by British Railways; and their application", by Mr. Wm. Pritchard, of L.M. & S. Railway Textile Research Department.

LONDON SECTION

Thursday 8th February *London*—7.30 p.m. At Barrett Street Trade School. Public Lecture, "Fastness in Textiles", by Mr. C. M. Whittaker, B.Sc. (Joint Meeting with Society of Dyers and Colourists.)
Wednesday 21st February *London*—7 p.m. At 104 Newgate Street, E.C.1. Informal, "The Hosiery Trade", by Mr. John Chamberlain, F.T.I.
Wednesday 28th February *London*—7 p.m. At 104 Newgate Street, E.C.1. Informal, "Standard Lancashire Fabrics", by Mr. L. J. Mills, F.T.I.

Other Organisations

Batley and District Textile Society—
Thursday 15th February *Batley*—7.30 p.m. Lecture, "Oleines and their Uses", by Mr. John Schofield, B.Sc., F.Inst.P., at Technical College.
Saturday 17th February Visit to Textile Section, British Industries Fair, London.

Blackburn Textile Society—
Friday 9th February *Blackburn*—7.30 p.m. Lecture, "The Finishing of Crêpe Fabrics", by Mr. W. W. Wilkinson, at Technical College.
Friday 23rd February *Blackburn*—7.30 p.m. Lecture, "Electricity Supply for Industrial and other Purposes", by Mr. W. A. Royle, A.M.I.M.E., A.M.I.E.E., at Technical College.

Bradford Textile Society—
Monday 5th February *Bradford*—7.30 p.m. Lecture, "Worsted Yarns—Costing, Prices, and Marketing", by Mr. A. L. P. Gordon, F.S.S., at Midland Hotel.
Wednesday 14th February Visit to Messrs. Kellett, Woodman & Co. Ltd., Grange Shed, Bradford.
Monday 19th February *Bradford*—7.30 p.m. Lecture, "International Trade Agreements", by Mr. R. J. Inman, at Midland Hotel.

Burnley Textile Society—
Thursday 8th February *Burnley*—7.15 p.m. Lecture, "Dyeing", by a representative of Cornholme Dyeworks.
Saturday 10th February Visit to Cornholme Dyeing Co. Ltd., Cornholme.

Colne and District Textile Society—
Friday 2nd February *Colne*—7.30 p.m. Lecture, "Rayon", by Mr. J. Pennington, F.T.I., at Technical School.
Friday 16th February *Barnoldswick*—7.30 p.m. Lecture by Mr. J. F. Fletcher, F.T.I., in Rainhall Road School.
Saturday 17th February Visit to Messrs. Butterworth & Dickinson Ltd., Globe Iron Works, Burnley.

Halifax Textile Society—
Wednesday 7th February *Halifax*—7.30 p.m. Lecture, "The Scouring and Finishing of Woollen and Worsted Pieces", by Mr. J. Scholfield, at Building Trades Exchange.
Wednesday 21st February *Halifax*—7.30 p.m. Lecture, "The Workmen's Compensation Act", by Mr. Wm. Burgess, at Building Trades Exchange.

Haslingden District Textile Society—
Friday 9th February *Haslingden*—7.30 p.m. Lecture, "Negative Dobbies", by Mr. E. Oddie, A.T.I., at Grammar School.
Friday 23rd February *Haslingden*—7.30 p.m. Lecture, "The Making of a Cotton Waste Yarn (with Some Observations on Foreign Methods)", by Mr. Wm. Barcroft, at Grammar School.
Saturday 24th February Visit to Messrs. Pilkington's Ltd., Belgrave Works, Heywood.

Leicester Textile Society—
Friday 9th February *Leicester*—7.30 p.m. Lecture, "Designing and Making-up", by Mr. H. A. Buckler, at Victoria Hall.
Friday 23rd February *Leicester*—7.30 p.m. Discussion Night. Opening Speaker, Mr. W. H. Smith. Subject, "Hosiery Workers' Conditions (1833-1933)".

Huddersfield Textile Society—
Monday 12th February *Huddersfield*—Lecture, "Inventions: Old and New", by Mr. F. Lewin.
Monday 26th February *Huddersfield*—Lecture, "Cloth Finishing in the Low Trade", by Mr. Harry Hardy, A.T.I.

British Association of Managers of Textile Works—
Saturday 10th February *Manchester*—6.30 p.m. Lecture, "The Trend and Use of Artificial Silk", by Mr. G. S. Heaven, B.Sc., F.I.C., at The Athenæum, Princess Street.
Saturday 24th February Visit to Messrs. Metropolitan-Vickers Electrical Co. Ltd., followed by Lecture, "Modern Mill Driving and the Cost", by Mr. F. B. Holt.

Morley and District Textile Society—
Saturday 3rd February Visit to Messrs. Homfrays & Co. Ltd., Sowerby Bridge.
Thursday 8th February *Morley*—7.30 p.m. Lecture, "The Gledhill Shuttleless Loom", by Mr O. Blackburn, at Technical Institute.

Nelson Textile Society—
Friday 2nd February *Nelson*—7.30 p.m. Lecture, "Modern Fire-Fighting Methods", by Supt. Burns, at Technical School.
Saturday 3rd February Visit to Messrs. Kellet Woodman & Co. Ltd., Grange Shed, Bradford.
Thursday 22nd February *Nelson*—7.30 p.m. Lecture, "Tape Sizing", by Mr Stonewall Jackson, at Technical School.

Keighley Textile Society—
Monday 5th February Visit to works of Messrs. F. W. Carr & Sons, Peel Mills, Keighley.

Oldham Technical Association and Old Students' Union—
Saturday 10th February *Oldham*—Film to be shown by arrangement with Cook & Co., "Thirsty Cotton", at Municipal Technical College.
Thursday 22nd February *Oldham*—Lecture, "Machine Tools", by representative of John Holroyd & Co. Ltd., at Municipal Technical College.

Rochdale Cotton Spinning Mutual Improvement Society—
Tuesday 6th February *Rochdale*—8 p.m. Lecture, "Electrification in Textile Mills", by Mr. R. H. Friend, A.M.I.E.E., at Barlow Street.
Tuesday 20th February *Rochdale*—8 p.m. Lecture, "Rope Driving", by Mr. J. Leigh, B.Sc., A.M.I.Mech.E., at Barlow Street.
Tuesday 27th February *Rochdale*—8 p.m. Lecture, "The Story of Cotton", by representative of Messrs. Platt Bros. & Co. Ltd., at Barlow Street.

Rochdale Textile Society—
Saturday 24th February Visit to Messrs. W. H. Pownall Ltd., Daisy Works, Manchester.

Shipley Textile Society—
Friday 9th February *Shipley*—Lecture, "Everyday Problems in the Weaving Shed", by Mr. Geo. Shackleton, A.T.I., at Technical School.
Saturday 17th February Visit to Airedale Combing Co. Ltd., Shipley.

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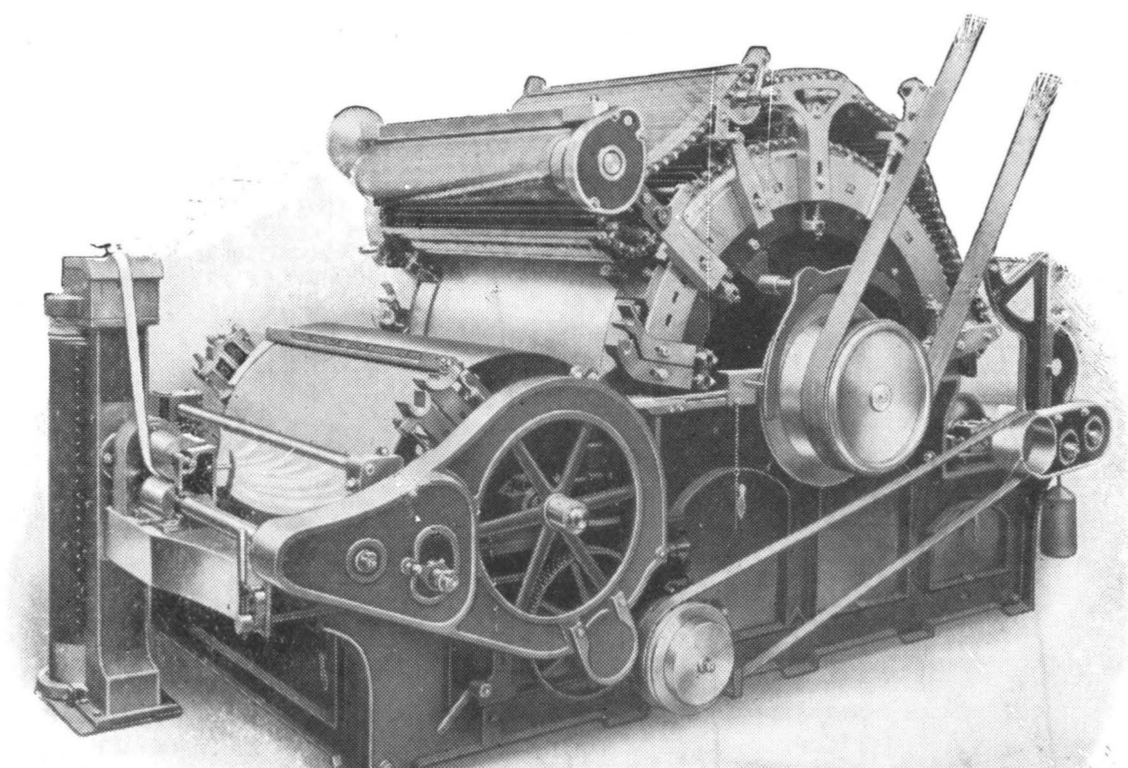

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THE JOURNAL OF THE

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Vol. XXV | JANUARY 1934 | No. 1

PROCEEDINGS

Midlands Section

Meeting at the College of Art and Technology, Leicester, on Thursday, 16th November 1933; Mr. T. Morley in the chair.

MODERN METHODS OF UNDERWEAR MANUFACTURE

A lecture on the above-named subject was delivered to members of the Midlands Section of the Institute by Mr. A. Wilfred Swann, of Leicester. The lecturer divided his subject into three parts, dealing first with underwear of the past, next with present-day garments, and finally venturing into discussion of styles and fabrics of the future; parts one and two were adequately illustrated by samples. He pointed out that the older types of garments were nowadays considered heavy and cumbersome but that good quality was usually associated with these goods. Modern underwear might be said to commence with the introduction of Directoire or closed style knickers about 1908 and, up to the war, this trade was practically confined to German firms. The fabrics used were made on Terrot type machines and usually knitted from two threads 40/1's cotton with a loop of condenser cotton at the back laid over every three needles. The fabric was finally brushed on a Gestner-type raising and knapping machine. Elastic was inserted by sewing machines into the top and legs. Shortly after the war a change to even lighter fabrics began and this aspect is still characteristic of underwear. About 1920, continued Mr. Swann, British Celanese Ltd. introduced underwear of Celanese yarn made on a Terrot type machine and these sold well. Interlock-machine-made fabrics came also into prominence and such well-known trade names as "Meridian", "Vedonis", and "Velvetex" were associated with these goods. When some four years ago, the patents on these machines expired, large numbers of them were installed and fabrics made thereon are made up into vests, combinations, men's and boy's shirts and pants. Cotton is used principally but dulled rayon is coming into this use now.

The lecturer also referred to a machine for the automatic insertion of elastic, the use of which every buyer insisted upon, and pointed out that improvements in the machine now enabled the elastic to be replaced easily. Reference was also made to recent developments in the direction of securing a closer fit in underwear and more particularly in knickers. Two examples of these garments were shown.

Dealing with the future and tendencies in manufacture and method, Mr. Swann gave particulars of some of the latest ranges of garments available. He also referred to the introduction of "Lastex" yarn which, inserted in the fabric by means of a new type of knitting machine, makes a clinging type of garment which does not need additional elastic.

Mr. Swann received subsequently the hearty thanks of the meeting for his interesting paper.

On Wednesday, December 13th, a party of members of the Midland Section of the Institute paid a visit of inspection to the Brook Mills of Messrs. G. H.

Heath & Co. Ltd., at Sandbach, Cheshire, the arrangements being carried out by Mr. T. A. Purt, Honorary Secretary of the Section. Silk-throwing was demonstrated, from the imported silk to the finished yarns. Col. G. N. Heath met the visitors and the inspection proceeded in small groups, the various processes being fully explained en route, including yarn clearing devices and the operation of self-lubricating rings. Tea was provided in the works canteen, and on the motion of Mr. J. Chamberlain (Leicester) a hearty vote of thanks was accorded to Col. Heath, who, in acknowledging the vote, said he welcomed the visit because he appreciated the value of interchange of visits between the various sections of the industry.

Scottish Section

MEETING AT EDINBURGH

A meeting of the members of the Scottish Section of the Institute took place at the Edinburgh School of Salesmanship on Thursday, December 21st. An invitation was extended to students of the textile classes conducted at the school and there was a good attendance. Mr. J. P. Beveridge (Dunfermline) occupied the chair and welcomed Mr. W. Wilkinson, O.B.E., F.T.I., who contributed an address on the subject of "Problems in Weaving". Mr. Wilkinson dealt particularly with the weaving of poplins, warp satins, voiles, and crêpes, describing the weaving requirements in closest detail. He also referred to experimental work which he had more recently carried out involving the use of Lastex thread, and exhibited a number of specimens of resultant woven material.

At the conclusion of his address, Mr. Wilkinson, by way of illustration of various aspects of weaving operations, presented a cinema display with explanatory observations.

Mr. Angus Robertson (Dunfermline) moved a vote of thanks to the lecturer and expressed warm appreciation of the very clear and unmistakable manner in which the various operations of weaving had been described. The vote was heartily accorded as was also a similar vote to the principal of the school.

London Section

Meeting at the London Rooms of the Institute, 104/5 *Newgate Street, on Monday,* 20*th November* 1933*; Mr. John Howard in the Chair.*

FABRICS FOR INDUSTRIAL PURPOSES

Mr. R. S. Meredith was the lecturer on this occasion, said the Chairman, and he was sure members would have an interesting evening.

The lecturer, thanking the Chairman for his presence and kind introduction, said he hoped members afterwards would raise as many points for discussion as possible. He first asked for consideration as to the proper functioning of fabrics for industrial purposes. He pointed out that when he first entered the industry he had been astonished at the ignorance of the manufacturer of the ultimate use of the textiles they produced. No direct contact between the manufacturer and the maker-up existed; it was indeed difficult for the manufacturer to ascertain the precise function that any given fabric had to perform. To-day the position was almost completely changed and makers-up could purchase direct from the manufacturer. The road to co-operation was being cleared though obstructions, caused largely by want of confidence, still existed. The lecturer pleaded for more consultation between the two sections of the industry, as each had much to learn from the other. As an illustration of his point that the manufacturer and maker-up ought to know more of each other's share in the industry, Mr. Meredith referred to the growing demand for tents and pointed out that the canvas employed could make or mar a holiday. He said that tent material, whether flax or cotton, should be so constructed that when subject to rope strains it gave its best functioning value. The conditions under which the fabric was used in a correctly-made and correctly-erected tent altered the construction as delivered. He contended that rope-strain put the main pull in the warp direction and transferred much of the warp crimping into the weft; it reduced the number of yarns weft-ways and increased the number warp-ways in any given measurement. Such fabrics made by our grandparents for sails had to be such that the original strength of the canvas weft-way was 50% that of the warp. It was also so constructed as not to tear readily. Mr. Meredith then referred to certain committees appointed to consider fabrics for the manufacture of tents, marquees, hangars, etc. for Government departments. He had served on several of these Committees and he submitted that this meant that, at long last, it was being recognised that to secure the best fabric structure it was necessary to know the purpose for which it was intended. He gave instances of the utilisation of fabrics under conditions to which they should **not** have been subjected. He urged that the class of raw material, the preparation of the material, the spinning, weaving, finishing, the maker-up, and the user of the finished article should co-operate in the production of fabrics for industrial purposes.

Turning again to tent ducks the lecturer gave particulars of some experiments carried out to show what changes in the construction of a fabric took place when under tension. "Two split lengths of flax tent duck—a Government standard quality—were seamed together with a run and fell seam—the usual seam for tentage—and had tabled sides, to give relatively what is done in making-up tentage. The piece was exposed and stretched for 28 days in the open and showed the following remarkable changes.

(1) Weight decreased from 13·67 to 13·49 oz. per sq. yard.
Warp stretched by 1·16 in. in every foot.
Warp counts, increased from 38 to 42 per inch.
Weft counts, decreased from 28·5 to 24·25 per inch.
Warp crimp of yarns, decreased from 23·7% to 9·7%.
Weft crimp of yarns, increased from 3·5% to 11%.
Warp breaking strength (2 in. strips), increased from 401 to 508 lb.
Weft breaking strength (2 in. strips), decreased from 667 to 560 lb.

Cotton duck was also tested in exactly the same way with the following results—
Weight decreased from 13·46 to 13·2 oz. per square yard.
Warp stretched ·78 in. in every foot.
Warp counts, increased from 45 to 47 per inch.
Weft counts, decreased from 41·5 to 38 per inch.
Warp crimp of yarns, decreased from 22% to 14·5%.
Weft crimp of yarns, increased from 6 % to 11·5%.
Warp breaking strength (2 in. strips), increased from 340 to 391 lb.
Weft breaking strength (2 in. strips), decreased from 321 to 286 lb."

If this duck had been made correctly it would have had a much greater weft strength in the new material, so as to allow for the considerable change in structure and therefore in tensile strengths which take place when it is called upon to function.

The lecturer urged the importance of the tearing test in application to tent ducks and similar fabrics on the grounds that such tests disclose both lack of strength and bad construction. In such fabrics what was wanted was a construction which gave the best results in use—different uses would then give some indication as to requirements in construction. Without all the knowledge required for a complete judgment erroneous conclusions would be reached. Mr. Meredith repeated that he sympathised with the laundry industry when blamed for damaging fabrics in laundering. In his view the cause of much laundry damage was adulteration of fabrics by mixing fibres in yarn or cloth. Fibres react differently under similar conditions and tend to wear each other out. He strongly deprecated proposals to increase weft extensibility which he was sure would increase the difficulties encountered in the making-up and laundry industries.

DISCUSSION

The Chairman drew a distinction between the distribution methods of 40 years ago and those of to-day. He claimed that then "quality" was the selling factor, but that now "design, colour, or fashion" regulated sales. He thought that sail-makers had learnt by years of experience and by always aiming at a better construction for the purpose in view. He gave instances of fabrics in which trade had been lost by adulteration and by reduction in "quality", such as that in corduroy for railway employees, which he regarded as one of the biggest losses sustained by the Lancashire trade. He said that to-day it was nearly impossible to buy a good suit of army overalls.

Mr. L. J. Mills referred to the statement made by the lecturer that rope-pull on a tent fabric when applied in the warp direction transferred much of the warp crimping to the weft. He suggested that this effect was perhaps due to the fact that ducks were wider in the cloth as woven than in the reed. He thought the point was of importance. He also suggested that increased weft strength would increase the cost of the cloth. He agreed that co-operation between all concerned, from the user to the spinner, was essential. He contended that the user would, in course of time, define what he wanted because he knew what he wanted.

Replying to Mr. Mills, the lecturer said that his main theme was the existence of economic barriers to doing what you want and what you knew ought to be done. Combination throughout the trade would provide a check upon waste and adulteration. He agreed that if the user knew exactly what was wanted he could take steps to secure it, but offered as an example of the ignorance of the maker-up the typical shirt which was so ill-designed as to wear out in certain parts long before the whole garment; seven-eights of a shirt had to be thrown away because one-eighth was worn out. This was an instance of a soundly-constructed fabric being made up incorrectly. He contended it was further proof of the need for co-operation.

Further contributions to the discussion were made by various members of the audience, dealing with the points raised by Mr. Mills and the lecturer. It was contended that price was the governing factor and that the manufacturer had to make cloth to a price knowing the goods so supplied were not suitable for their intended use. The starch collar was blamed for wearing out the shirt. Pre-laundering of a shirting length was recommended as a preventative measure against shrinkage. This shrinkage was also described as contraction and not shrinkage which, a speaker claimed, was a phenomenon peculiar to wool.

Proposing a vote of thanks to the lecturer, Mr. Mills said he feared the discussion had gone beyond the field covered by the lecture. He suggested that a further discussion might be arranged. The proposal was seconded and carried with acclamation. Mr. Meredith briefly responded.

NOTES AND NOTICES

Election of Council of the Institute

A list of the vacancies which arise on the Council of the Institute before the holding of the Annual General Meeting, fixed to take place at the Institute Headquarters, Manchester, on the 16th May next, was presented at the December meeting of the Council and approved for publication. Ten of the thirty elected members retire annually, but are eligible for re-election unless disqualified by reason of non-attendance. In due course, forms will be issued to members of the Institute for nomination of candidates for the 1934 vacancies. The following is a list of names of elected members, with the order of retirement—

1934	1935	1936
Barnes, H. C. (A.T.I.)	Beanland, R. J. H. (F.T.I.)	Barwick, F. W. (F.T.I.)
Davis, Wm.	Binns, H. (F.T.I.)	Boothman, W. T. (F.T.I.)
Lishman, W. W. L.	Greg, H. Gair	Bromiley, H. (F.T.I.)
Nisbet, H. (F.T.I.)	Read, J. (F.T.I.)	Crompton, W. B. (F.T.I.)
Stevenson, A. W. (F.T.I.)	Richardson, H.	Kershaw, S. (F.T.I.)
Strong, J. H. (F.T.I.)	Scott-Taggart, W. (F.T.I.)	Kershaw, W. (F.T.I.)
Vernon, W. (F.T.I.)	Slater, F. P.	Jaques, H.
Wilkinson, W. (F.T.I.)	Speakman, J. B. (F.T.I.)	Morton, W. E. (F.T.I.)
Wright, F. (F.T.I.)	Stott, T. S.	Watson, S. (F.T.I.)
	Thompson, G. H. (F.T.I.)	Withers, J. C. (F.T.I.)

Annual General Meeting

The 24th Annual General Meeting of Members of the Institute has been fixed to take place at Headquarters, 16 St. Mary's Parsonage, Manchester, at 3 p.m. on Wednesday, the 16th May next, immediately subsequent to the ordinary Council Meeting which is to take place at 2 p.m. on the same day. At the Annual Meeting the report of Council, and the balance sheet and accounts for 1933 will be presented for acceptance. The result of the forthcoming ballot for Council election will be declared and a President will be elected for the ensuing year. At December meeting of Council, it was unanimously decided to invite Sir William Clare Lees to accept nomination for re-election, but, owing to pressure of calls upon his services, Sir William has intimated that he will be quite unable to continue to occupy the presidential chair.

Next Annual Conference

At the December meeting of the Council of the Institute, a decision was reached in favour of the selection of a textile industrial centre as the place for the holding of our Annual Conference in the latter part of Whit-week in the current year. In consequence of receipt of many representations from members that the policy associated with the last two conferences should be adhered to, the whole matter was reviewed at the January meeting of Council. It was decided—notice of motion having been tendered—to rescind the December resolution as to place selected and it was further agreed unanimously that the event shall take place at Grange-over-Sands, provided, of course, that satisfactory local arrangements can be effected. The Secretary was instructed to proceed without delay in the matter of securing accommodation. The Publications Committee and the Selection Committee of the Institute have already considered arrangements for contributions of Lectures or Papers. The general subject chosen for the occasion is that of "Conversion of Yarns into Fabrics", a field covered by Section III of the Journal Abstracts and by Section III of the Institute's Examination (Part II) in General Textile Technology. Members are asked to note the dates of this year's Conference—May 23rd to 27th, Wednesday to Saturday.

The Textile Institute

The title of our Institute appears to be remarkably attractive in the United States of America. In recent years, we have offered a respectful plea for the avoidance of duplication of the title, mainly with the object of prevention of confusion which might arise thereby, to the detriment of all interests involved. A few years ago, the Cotton Textile Institute of America was formed and we were unsuccessful in our overtures in favour of alternative title. More recently, the Silk Association of America Inc. announced the formation of a new organisation with the title of Textile Institute attached. In this instance, a communication from our Institute, pointing out the undesirability of duplication, received favourable consideration and we were graciously informed that an alternative title had been chosen. At the January meeting of our Finance and General Purposes Committee, the Secretary called attention to an article in *The Textile World* (*U.S.A*). advocating the promotion of an organisation to be called "The Textile Institute". The objects, as set forth in the article, appeared to be quite different from those of our own Institute. Under the circumstances, it is sincerely hoped that repetition of our title may be avoided. A letter addressed by the General Secretary to the Editor of the Journal mentioned was approved by the Committee and it is hoped and confidently expected that the plea will prove successful in this instance.

Lancashire Section—Social Gathering

It is many years since a social gathering was held in connection with the Lancashire Section of our Institute. The decision of the Section Committee to include such an event in the programme of the current session was therefore regarded as an innovation. A week or ten days before the holding of the Dinner-Dance at the Manchester Limited's rooms, the prospects of a good attendance were none too promising. Later, however, acceptances quickly reached satisfactory proportions, and the final attendance totalled 141 persons. Mr. T. E. Mitchell (Chairman of the Section Committee) presided over the dinner. The President (Sir William Clare Lees) was unable to attend but kindly contributed a donation towards the expenses. Messrs. H. S. Butterworth (Chairman of the Council of the British Cotton Industry Research Association), Dr. A. Coulthard (Institute of Chemistry), Mr. J. J. Butler (Federation of British Industries), Mr. H. N. Whalley (British Association of Managers of Textile Works), and Mr. John A. Cox (Director of Education, Bolton), attended as guests. In proposing the toast of "Our Guests", Mr. Mitchell warmly welcomed the visitors and Mr. Butterworth suitably responded. Dancing was indulged in until 11.30 p.m. and the proceedings proved most enjoyable. Small prizes were offered and awarded in the course of the evening. Messrs. Athey, Curtis, Nisbet, and Robinson, acted as stewards, whilst Mr. Frank Nasmith kindly served in the capacity of announcer.

Institute Membership

At the January meeting of the Council, the following were elected to Membership of the Institute—H. A. Hancock, B.Sc.(Lond.), Ministry of Agriculture, Spinning Division, Botanical Section, Giza, Egypt (Director of Experimental Spinning Station and Laboratory); H. Lloyd, 19 Godliman Street, London, E.C.4 (Manufacturers' Agent); G. Marshall, Aysgarth, 26 Longden Avenue, Crosland Moor, Huddersfield (Asst. Lecturer in Woollen Yarn Manufacture, Huddersfield Technical College); H. L. Parsons, B.Sc.(Lond.), Baxter Bros. Ltd., Research Department, Dundee (Head of Research Department)—transference of representative membership from N. Duncan; G. G. Pinder, Asa Lees & Co. Ltd., Soho Iron Works, Oldham (Director)—transference of representative membership from Henry Lawton; H. Raraty, 192 Northenden Road, Sale, Manchester (Sales representative, White, Child & Beney Ltd.)—transference of membership from H. G. Bolland; D. C. Snowden, 39 Kirkbrae, Galashiels, Scotland (Asst. Lecturer, Scottish Woollen Technical College); J. C. Thompson, "Straightacres", Eccleshill, Bradford (Textile Chemical Manufacturer). *Junior*—R. N. Williams, "Flawforth Lodge", Ruddington, Notts. (Sales and Technical Representative, J. H. Fenner & Co. Ltd.).

Honorary Membership—Ashley, Sir Percy, K.B.E., C.B.; Import Duties Advisory Committee, Caxton House (West Block), Tothill Street, London S.W.1.

INQUIRIES

Cotton Doubling

The undermentioned inquiry has been received by the Institute's Information Bureau and as it appeared to be of general interest is here printed. It is hoped that members who can do so will communicate to the Editor any information available either for transmission to the inquirer privately or for publication in a subsequent issue. The inquirer writes—

"I should greatly appreciate your assistance on three points in connection with cotton doubling. I have spent some time searching the literature but cannot come across what I want. The points are—

Balanced Twist—What is it and what use is it in practice ?

Maximum turns per inch in 2-fold yarns before the yarn becomes weaker.

Maximum strength of doubled yarn—Is it obtained by slow speed and heavy travellers ?

REVIEWS

"This Money Business." By Barnard Ellinger. Published by P. S. King & Son. (6s. net.)

The increasing disposition of economists to attribute greater importance to currency factors in the operation of the industrial system has in recent years had a twofold result: it has, in the first place, produced a large crop of highly complex currency theory and, in the second place, it has led to a veritable spate of books dealing with the working of the monetary system and designed to make clear to the ordinary man what is fundamentally an intricate matter. Most of the popular books on currency must be accounted failures, for they seek to combine with a description of monetary mechanism the theoretical considerations which the author favours and, in the nature of things, monetary theory cannot be simplified for general consumption.

Mr. Ellinger, however, has succeeded where so many others have failed, partly because of his great practical experience in many branches of the affairs of which he writes and partly because he has very wisely limited his task to an outline of the machinery of banking and finance and has not sought to combine with it a treatment of monetary theory. There could indeed be no better introduction to the whole question than that which is provided in this volume. The conscientious citizen who feels that his duty leads him to attempt to understand this branch of the economic system, which appears to have so many political implications, could have no better guide through the maze than Mr. Ellinger. The student could have no better introduction to a wider study of monetary problems for he will find here, succinctly described and aptly illustrated, a compressed picture of the working of the gold standard, of the operations of the money market, of the significance of central banks, and of the activities of deposit banks.

In a final chapter Mr. Ellinger discusses the possible courses which were open to Great Britain after the abandonment of the Gold Standard in September 1931. As between those who advocate a return to the gold standard, either on the old or a new parity, and those who advocate a more deliberately controlled currency policy, he holds the balance evenly but he strongly emphasises the danger of a too precipitate return to a gold standard system, a view which subsequent events have proved to be correct. J.J.

Leinenweberei. Von F. Bühring, A. Schneider, M. Kaulfuss, and H. Schreiber. Technologie der Textilfasern. v. Band, 1 Teil, 3 Abt. Published by Verlag von Julius Springer, Berlin. (Price 32 RM.)

This volume on linen weaving, which is part of the series Technologie der Textilfasern, edited by Dr. R. O. Herzog, completes the section dealing with flax, the first volume of this section being devoted to fibre production and the second to spinning. Fabrics woven from flax cover a very wide range of weight and type of cloth and in consequence the methods involved in preparation and weaving vary quite appreciably in certain details. The editor has adopted the method of dividing the subject into three main sections, each one written by a specialist in that section. The first part of the book, 182 pages, deals with the weaving of light goods and fancy cloths, and contains chapters describing the preparation of warp and weft for the loom, the general arrangement of the loom, the usual methods of shedding with tappet, dobby and jacquard, heddle and harness arrangements, the making of pattern cards for the fancy weaves, and cloth inspection, measuring, and cropping. Then comes an interesting and (to the English reader) more unusual chapter on general management and organisation of weaving, in which such points as space and power requirements, loom production and more-looms-per-weaver system, and costing are discussed. The inclusion finally of a short chapter on cloth finishing is certainly very useful and helps to complete the subject, but on the same basis one fails to see why brief details of cloth bleaching should not have been given. The second part of the volume, some twenty pages, is devoted to handkerchief weaving and contains a description of a loom with revolving shuttle box, as well as a short account of preparatory methods and weaving technique special to handkerchief manufacture. The third portion of the book, 50 pages, concerns the weaving of heavy cloths (such as comprise the bulk of the Scottish trade), and besides giving details of the preparatory and weaving methods contains a chapter on impregnation finishing processes, such as waterproofing, rubberising, and fireproofing. There is also brief mention of the ordinary mechanical finishing methods.

On the whole, the subject matter of the book is well balanced. In the chapter on jacquard shedding, the Verdol machine is given prominence presumably because of its more extensive use on the Continent than over here. As will be obvious from the fact that there are only 256 pages, and yet over 300 diagrams and photographs, the text is concise and by no means exhausts any branch of the subject. A great amount of the conciseness is obtained by confining attention to one or two typical mechanisms or processes in the discussion of each point, and the free use of diagrams and photographs and tables of figures. The whole result is that the continuity throughout the work is excellently maintained and the reader obtains a clear bird's-eye view of the subject, as well as adequate information on each point.

As mentioned above, the illustrations are very numerous and are excellently done, both line drawings and photographs, especially in Part I of the book. There are many tables, giving typical production figures for various processes, calculations of efficiency, speeds of running looms under various conditions, costing figures, etc., all of which add greatly to the practical aspect of the work. The book, like its companions in the series, is very well printed and bound.

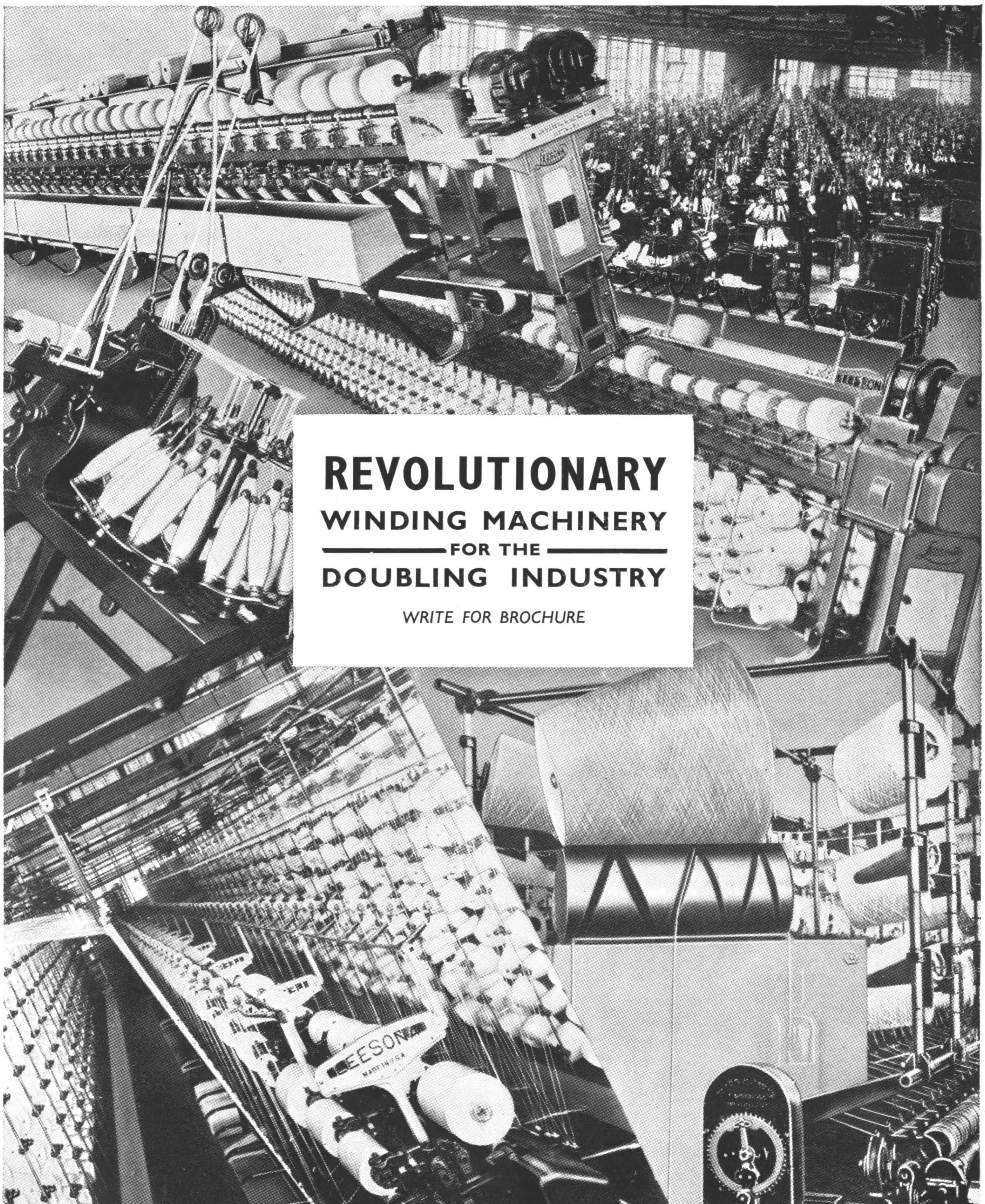
H.B.

Handbuch der Azetylzellulosen. By Oskar Krausch. Published by J. F. Lehmann, Munich, 1933. (Pp. 274. Price 20 M.)

This book is really a bibliography of the literature on the preparation, properties, and applications of the cellulose acetates, and as such will be very useful to the research worker for the quick orientation of the work done to date on any particular problem connected with cellulose acetates. It contains a very useful list of trade names under which cellulose acetates are known in various countries as well as a very comprehensive list of patents. The descriptive matter, as one would expect from the nature of the book, is very meagre. R.G.

Zelluloseazetate und die anderen organischen Ester der Zellulose. By D. Krüger. Published by Theodor Steinkopff, Dresden and Leipzig, 1933. (Pp. 391. Price 20 R.M.)

As one would expect, the greater part of this book is devoted to cellulose acetate, only the last two chapters being allotted to the other esters. Moreover the adjective "organisch" apparently excludes cellulose nitrates and xanthates which receive no treatment at all. Only one chapter deals with the technical applications of cellulose acetate, acetate being given the most prominent, but by no means exclusive, place. The book is therefore only indirectly of textile interest, but it is the most complete account to date of the chemical and physical properties of these substances, and as such will form an extremely useful work of reference to the textile chemist. R.G.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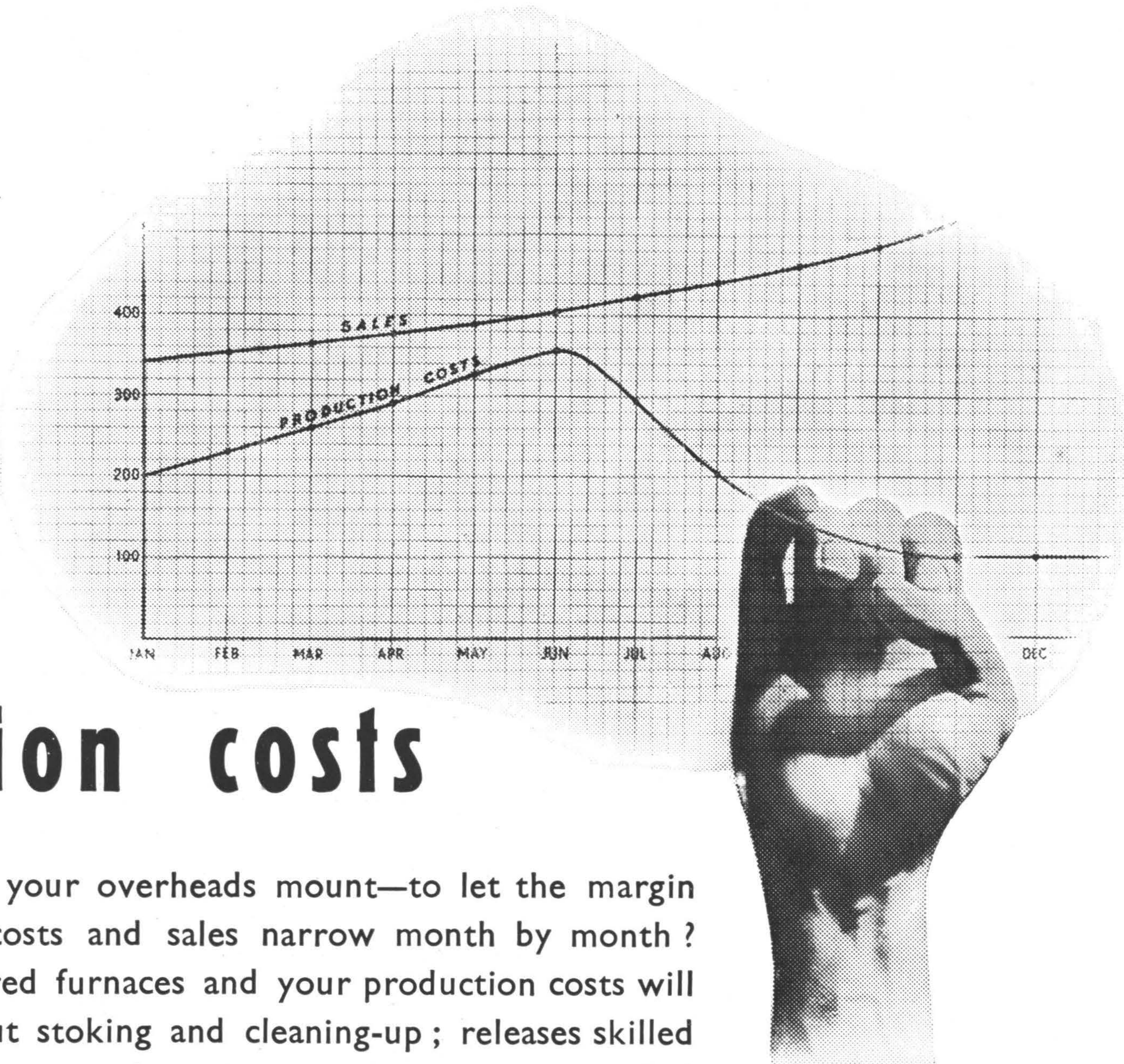

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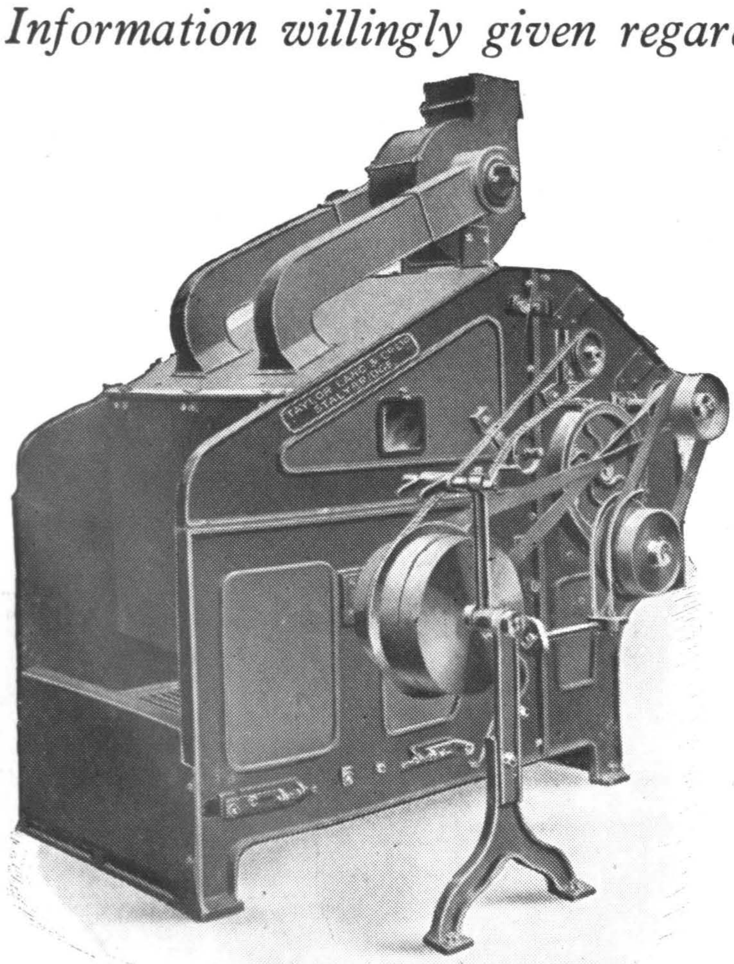

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THE JOURNAL OF THE

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TRANSACTIONS

1—THE FOUNDATIONS OF YARN-STRENGTH AND YARN-EXTENSION

PART V—THE PREDICTION OF THE SPINNING VALUE OF A COTTON FROM ITS FIBRE-PROPERTIES

By A. J. TURNER, M.A., D.Sc. and V. VENKATARAMAN, M.A.
(Indian Central Cotton Committee Technological Laboratory)

SUMMARY

The present paper deals with the problem of predicting the spinning value of a cotton from its fibre-properties. Previous work is discussed, particularly certain suggested relationships between spinning value and staple length alone or in conjunction with fibre-strength, and also between spinning value and fibre-weight; reference is also made to two other suggested methods of attacking the problem on quite different lines.

Criteria for judging spinning value are discussed, and the criterion finally adopted is the highest standard warp count, i.e. the highest count that can be spun from the cotton with standard twist to give a specified standard strength.

The tests at the Technological Laboratory are described for (1) spinning value, and the following fibre-properties—(2) length, (3) weight per inch, (4) ribbon-width, (5) strength, (6) convolutions, (7) rigidity, and (8) clinging-power. The results are given for two series: Series I, in which properties (1) to (7) were determined for 95 samples, and Series II, in which properties (1) to (8) were determined for 45 samples of Indian cottons.

From these results the attempt has been made to derive prediction formulæ for spinning value in terms of the fibre-properties, by means of the method of correlation. This method is briefly explained, together with some of its limitations. It is found that the total correlation coefficient is 0·87 for fibre-length and spinning value, and −0·75 for fibre-weight per inch and spinning value; the partial correlation coefficient of fifth order for the Series I samples is 0·70 for fibre-length and spinning value, and −0·36 for fibre-weight per inch and spinning value. From these results it is clear that the spinning value of Indian cottons is much more accurately assessable from the fibre-length than from the fibre-weight.

The accuracy of the prediction formulæ has been tested by comparing the actual spinning values with those calculated from the fibre-properties by the aid of the formulæ. Using the prediction formula based on fibre-length alone, the difference between actual and predicted spinning values is not greater than 20% in 69% of the cases; the corresponding percentages of cases for other prediction formulæ are 53% for fibre-weight alone, 76% for fibre-length and fibre-weight together, with no better result when either fibre-strength or ribbon-width is also included; and only 80% when all six properties are included. As the prediction-formula based on six fibre-properties is thus hardly any more accurate than the prediction-formula based on only the two properties of fibre-length and fibre-weight, it is concluded that the greater labour entailed in determining either the ribbon-width, strength, convolutions, or rigidity, is not worth while except for some special reason.

Finally, various anomalies between the actual and predicted spinning values are discussed, and a number of reasons advanced to explain them, and to indicate the lines along which future research might profitably be directed.

Appendix I gives a detailed description of the method of simple and multiple correlation used in obtaining the prediction formulæ, and the formulæ employed in making the necessary calculations; the method of making these calculations is explained. Many prediction formulæ are given, both simple and multiple, and

the degree of significance to be attached to the constants in these formulæ is also indicated in a number of cases. Two other methods, used as checks, for determining the constants of the prediction formulæ, are also briefly described. A note is given on the coefficient of multiple correlation, measuring the correlation between spinning value and all the fibre-properties combined, and having a value for the Series I samples of 0·93, from which it appears that 86·5% of the variation of spinning value is accounted for mathematically by the six fibre-properties, leaving 13·5% to be accounted for otherwise.

Appendix II gives a description of a short method for revising the total correlation coefficients to include further results as they become available in successive seasons.

Appendix III consists of tables of experimental results.

Appendix IV consists of tables showing how actual and predicted values compare.

Appendix V consists of tables of all the total and partial correlation coefficients calculated in the course of the investigation.

I—INTRODUCTION

The ultimate and crucial test of any scientific hypothesis is its capacity for predicting what consequences will follow from a given series of facts. It is the central problem of the Technological Laboratory to discover such an hypothesis in the form of an equation which will enable the spinning value of a cotton to be predicted from its fibre-properties. In Part I[1] of the present series of papers a list was given of the various factors which might reasonably be thought to have some influence on yarn-strength; in Part II[1] the relationship was discussed between yarn-strength and fibre-strength, though other fibre and yarn properties were inevitably discussed at the same time. The property of clinging-power has been discussed in Part III[2]; but except for this we have not discussed in detail the fibre-properties of a large number of cottons in relation to the strengths of the yarns that have been spun from them. The importance of fibre-length has been discussed in detail by Gurney,[3] whose discussion is, however, entirely theoretical; in all essentials his views are in harmony with those expressed in Part II. Balls,[4] in his most recent work, gives some results from which he draws the conclusion that the importance of fibre-length has in the past been greatly exaggerated, and that long cottons are suitable for fine spinning, and for strong yarns, not because they are long but because they are generally fine, though this association between length and fineness is not inevitable. On the other hand, attempts have sometimes been made to predict the strengths of the yarns that can be spun from a given cotton, by means of the following simple formula,[5] which takes into consideration the property of fibre-length only—

$$S = \frac{K\{1 \pm \cdot 11a \pm \cdot 01b\}}{C}$$

In this formula

S = (unknown) lea strength (lb.);

K = a constant $\begin{cases} 1600 \text{ for carded yarns;} \\ 1750 \text{ for combed yarns;} \end{cases}$

a = difference in staple measured in sixteenths of an inch above or below one inch (use positive or negative sign according as the staple length is greater or less than one inch);

b = difference in yarn counts above or below 28's (use positive or negative sign according as the count is greater or less than 28);

C = counts of yarn of which the strength is sought.

Another formula based on the fibre-length alone can be derived from certain formulæ given by Winterbottom[6] for selecting the length of staple required for a given count; he states that the formulæ are based on "the lengths of staple in most common use, to show what lengths of fibres may be used . . . . for counts ranging from 10's to 120's in mule twist and weft as well as 100's in ring yarn of ordinary quality." The formulæ are

Length of staple in inches

$$\text{for ring twist} = 0{\cdot}35\sqrt[3]{\text{count}}.$$
$$\text{for mule twist} = 0{\cdot}325\sqrt[3]{\text{count}}.$$
$$\text{for mule weft} = 0{\cdot}30\sqrt[3]{\text{count}}.$$

"By use of the foregoing formulæ the suitable length of staple may be ascertained in the absence of better information."

It may be observed that when the staple length is known, these formulæ enable the highest suitable count to be predicted, for they can all be put in the form

$$\text{Count} = \text{K} \times (\text{staple length})^3.$$

$$\text{where K} = \begin{cases} 23 \text{ for ring twist,} \\ 29 \text{ for mule twist,} \\ 37 \text{ for mule weft} \end{cases}$$

A more complicated formula, taking into account not only the fibre-length but also the fibre-strength, has been used by H. H. Willis,[7] who states "the data on fibre-length and strength, as obtained by laboratory methods, were correlated* with data on yarn strength as obtained by manufacturing tests, and a formula was derived for estimating the breaking strength of 28's yarn. This estimating formula has since been applied to some 43 lots of cotton representing varieties grown in North Carolina, South Carolina, and Texas, ranging in staple length from $\frac{13}{16}$ to $1\frac{1}{4}$ inches. Of these 43 lots tested by this method, only 13 showed a variation of more than 6% between the actual and estimated strengths of 28's yarns. The foregoing preliminary data indicate that fibre-length accounts for 61% of the yarn strength and that fibre-strength accounts for 11% of the yarn strength." In the article (abstract) from which this quotation is taken, details are given only for nine lots of North Carolina cottons ranging in staple length from 0·785 to 1·14 in. The differences between the cottons are comparatively small, and although for seven out of the nine cottons the total range in the actual lea strength is less than 7%, yet the estimated lea strength of one of them, Trice (Oxford), is 12·5% too low and that of another, Acala (Oxford), is 7·5% too high, so that the formula is obviously not very satisfactory even when applied within a narrow range of similar cottons. Willis recognises this in commenting—"This method of estimating yarn strength has not yet been fully developed and will no doubt be subject to slight change as more extensive tests are conducted and as various factors influencing yarn strength, as yet undetermined, are measured with some degree of accuracy."

As pointed out in "Technological Reports on Standard Indian Cottons,"[8] however, no complete explanation of spinning value can be given in terms of fibre-length alone, as attempted in the formulæ of Sheldon and Winterbottom; and Willis himself recognises that fibre-length and fibre-strength together are not alone sufficient for the purpose. From values of total correlation between

* The meanings of "correlation" and "correlation coefficient" are discussed on page T12.

fibre-strength and yarn-strength it would appear that there is but little con-connection between them. This was pointed out in Part II, wherein it was shown[9] that, for 14 Indian cottons, "the correlation coefficient between the lea count-strength product and the mean fibre-strength is −0·305, and that the correlation coefficient between the count-strength product and the ratio of the fibre-strength to the fibre-weight per inch is only +0·048, "a value which indicates that the count-strength product is not correlated with the ratio of fibre-strength to fibre-weight per inch."

Barritt[10] quotes the results of Burd for 10 Sea Island cottons, for which the correlation coefficient between yarn-strength and fibre-strength is −0·41, whereas the correlation coefficient between yarn-strength and the ratio of fibre-strength to fibre-weight per inch is +·031—results similar to those given in Part II. Barritt himself gives the results of tests on 14 samples of Sakel cotton, and found that for them the correlation coefficient between lea count-strength product and the fibre-strength was +0·79, whereas the correlation coefficient between the lea count-strength product and the ratio of fibre-strength to fibre-weight per inch was 0·55. It is noteworthy that the results both of Burd and Barritt relate to very restricted ranges of cottons, and in this respect differ from the results given in Part II for Indian cottons; and the warning there given that the few results must be regarded with caution applies with even greater force when the range of cottons is very restricted.

Tests on a much wider range of 15 samples of cotton have been described by Morton,[11] who states that "in order to simplify the investigation somewhat, an attempt was made to eliminate the effect of hair-length by choosing cottons of nominally the same staple," though actually Morton found that the cottons differed somewhat in fibre-length. "These cottons were spun into a range of different counts and twists, and the results of the strength tests on the yarn were examined in relation to certain of the measurable characters of the raw material, viz. fibre-weight, fibre-length, and fibre-strength." The following are among the results which Morton obtained; in considering these results it should be remembered that for such a small number of samples none of the correlation coefficients referred to can be regarded as statistically significant if it is less than 0·59.

For 24's spun with twist factor 4·0—

Correlation coefficient between lea breaking-length and fibre-strength, −0·61.

Correlation coefficient between lea breaking-length and ratio of fibre-strength to fibre-weight per inch, 0·18.

These results resemble those given in Part II, the correlation of yarn-strength with fibre-strength being fairly large and negative, and that with the intrinsic strength being small and positive.

Correlation between lea breaking-length and mean fibre-length, 0·39.

Correlation coefficient between lea breaking-length and fibre-weight per inch, −0·70.

(In this case the correlation coefficient is much higher for fibre-weight per inch than for fibre-length, but it must be remembered that the range of fibre-lengths was deliberately restricted.)

From some other values given by Morton it is interesting to note that the values of the correlation coefficients are different for different counts, even when all the counts are spun with the same twist-factor, 4·0, thus—

Correlation coefficient between lea breaking-length and fibre-weight per inch, for 24's −0·70; for 40's −0·79.

Correlation coefficient between single thread breaking-length and fibre-weight per inch, for 24's, −0·71; for 40's, −0·80.

According to O. Johannsen,[12] "erroneous results may be obtained in judging the spinning value of a cotton on staple length and strength alone. In an example, an 18's single yarn was spun from a variety P which gave a better staple diagram and a stronger staple than a second variety A spun into a similar 18's yarn. The yarn spun from P possessed higher breaking strength and extensibility than the yarn from A, but when twisted into a 15-fold yarn (5/3) gave a lower breaking strength test than a corresponding 15-fold yarn spun from A. Assuming that the strength of a fibre-structure depends upon the friction between individual fibres and on the specific strength of the material, and that the frictional strength is the more effective the greater the surface of friction, the density of the hairs in the two twist yarns was examined. The twist of P variety cotton was found to have a lower number of hairs per cross-section than the twist of A variety, and it is concluded that the decrease of friction surface on account of the stronger and coarser hair is the cause of the surprising inferiority of the P variety. The deduction is drawn that it is safe to assume that a higher individual hair strength will give a better yarn only when comparing hairs of equal fineness."

Reference has already been made to recent work of Balls,[13] who concludes that "once the fundamental difficulty of instability in singles has been overcome, the relation between cotton and yarn becomes quite reasonable and not very intricate. Fineness by weight acts twice over, as does also slipperiness, while the strength of the cellulose wall itself is the chief remaining factor; the one character of cotton which we have been able in the past to measure easily, namely, length, is definitely less important than any of these three." And in summing up the results of the fibre and spinning tests on 13 American cottons, he claims that "so far as the strength of yarn is concerned, that explanation (of it in terms of fibre-properties) now seems to be complete." But while he maintains that the properties of any other type of yarn could have been predicted, he does not as a result of his investigations actually put forward any prediction-formula.

An investigation on quite different lines has been published by Bühler,[14] who aims not only at assigning the intrinsic spinning value, but also the monetary market value. His system, however, is an empirical one which is based on an arbitrary though comprehensive allocation of points for the various qualities of the cotton, as follows—

	Symbol	Points for Weighting	
1—For Staple and Regularity—			
Mean Staple	A	5	12
Maximum Staple	B	4	
Difference (Maximum—Mean) ...	C	3	
2—For Cleanliness—			
Maturity			
(*a*) Mature Fibres %	E	2	12
(*b*) Unripe Fibres	F	2	
(*c*) Dead Fibres	G	2	
Content of Foreign Matter			
(*a*) Total	J	3	
(*b*) Seed content	K	3	
3—For Strength—			
Broken and Damaged Fibres % ...	H	1	6
Breaking Strength	D	5	
			30
4—For Colour	Co	3	3

Bühler shows the application of his system to a series of 11 cottons ranging from Uppers to Oomras. The values of each of the 10 properties (A to K) are given for each cotton, and all the cottons are then ranked for each property. Each value of rank (1 to 11) is then weighted according to the system of points given above, and the average weighted rank (D_g) of each cotton determined for all the properties together apart from colour.

The reciprocal of this average rank $\left(\frac{1}{D_g}\right)$ for any cotton gives a coefficient to apply to U_s, "the basic cost-price for middle quality," to determine the value of that cotton apart from colour; a correction is then applied for colour, a scale of coefficients $\left(\frac{1}{Co}\right)$ being drawn up based on the colours of the American standards (ignoring all the other constituents of grade); these coefficients range from 1 for Middling Fair to 1/7 (0·143) for Low Middling, but are modified somewhat for the degree, if any, to which the cotton is tinged. The formula for the spinning market value (M_w) thus becomes—

$$M_w = U_s + U_s\left[\frac{1}{D_g} + \left(\frac{1}{D_g}\cdot\frac{1}{Co}\right)\right]$$

Finally, allowance is made for the fact that short fibres (taken as those less than 10 mm.) are lost in processing, so that if K_f is the percentage of short fibres, the actual market value for spinning purposes (SP) is given by

$$SP = M_w - (M_w \cdot K_f)$$

Clearly, Bühler's method suffers from some several limitations. Firstly, it may be noted that the agreement between the calculated and observed prices for the 11 cottons discussed by him can hardly be regarded as satisfactory. Secondly, the method is not applicable to an individual cotton, as a whole series must be available in order that the ranking method may be applied; in this respect, as Bühler indicates, the method resembles the trade method, and the difficulty might be overcome by adopting a series of standards of each season's crop by which to rank any other sample. Thirdly, it is not clear how the basic value U_s is fixed: for the cotton whose actual market value for spinning purposes is represented by U_s we must have—

$$D_g = \left(\frac{1}{Co} + 1\right)\left(\frac{1}{K_f} - 1\right)$$

And as the values of K_f for the 11 cottons described range from 0·03 to 0·09, the values of $\left(\frac{1}{K} - 1\right)$ range from 32 to 10; and as $\left(\frac{1}{Co} + 1\right)$ cannot be less than 1, D_g cannot apparently be less than 10—a value higher than the highest value obtained (8·7) for any of the 11 cottons; and moreover this does not seem to agree with his explanation that for the cotton forming the basis of comparison, "all the coefficients were assumed to be unity." Fourthly, the allocation of the points for the different cotton properties is arbitrary. It is, of course, the chief object of the correlation method of the present paper to determine the relative importance of the properties measured. As Bühler recognises, "The value-figures for the individual groups must in particular be the subject of further investigation and more extensive treatment."

Finally, Foster and Gregory[15] have suggested a quite different method of attacking the problem of predicting spinning value. As the strength of an *element* of yarn depends upon its weight and twist, from a knowledge of this relation and also of the variation in the weights of the elements along a yarn, it should be possible to predict the strengths of weak places and their distribution, and hence the strength of any length of the yarn. Their method is therefore directed towards finding how the variation in weight (i.e. the irregularity) depends upon the properties of the cotton, and how the strength of the yarn varies with the weight and twist at the place of break. This method, though *prima facie* it appears to be less direct, may ultimately prove more successful in solving the difficulties presented by anomalous results of the correlation method (see page T25), in fulfilment of their claim that although "this method appears to be even more empirical than the correlation method, . . . actually it promises to yield far more fundamental knowledge of the spinning processes and so lead to a spinning equation which will be more thoroughly understood." No results of an investigation by this method have been published.

We see from the foregoing review that no very comprehensive investigation has so far been published dealing with the relation of a number of fibre-properties to spinning value; and we now pass on to describe the work carried out at the Technological Laboratory. As pointed out in a previous paper,[16] "Our ideal would be the formulation of an equation, so that by inserting therein the appropriate ascertained values for the various properties, we should at once be able to determine, by solving the equation, the counts for which the cotton would be suitable under the standardised conditions. Thus if we represent the length of staple by x, the ribbon-width by y, the area of cross-section by z, and so on, we should have the general equation for the evaluation of C, the finest count for which the cotton is suitable—

$$C = F\,(x, y, z, \ldots\ldots)$$

Unfortunately, little or nothing is known about this function."

In the present investigation, owing to the complexity of the problem, we have been compelled as a beginning to assume the simplest possible form of the function on the right-hand side of the equation x, i.e. that the function is of a linear type, or that the highest standard warp counts = (a × fibre-length) + (b × fibre-weight per inch) + ... where a, b, ... are constants. As will be seen later, this assumption of linearity is certainly not really justifiable, but by deriving an approximate formula of prediction we may use it on the material in hand, and afterwards proceed to examine the causes of the departures of the predicted from the actual values, as there is no doubt that the subsequent examination of the anomalies should throw considerable light on the factors concerned in spinning value.

II—CRITERIA FOR JUDGING SPINNING VALUE

The questions arise—What criterion should be used to judge the spinning value of a cotton ? What method of testing should be used for the yarns ? As indicated above (p. T2), the Sheldon formula—and apparently Willis's also —is based on the lea strength of 28's yarn; but leaving aside for the moment the fact that the lea test is sometimes condemned as being an unsatisfactory measure for grading cottons, there is the difficulty that many cottons could not be spun commercially into 28's counts. Moreover, it is certainly doubtful whether this method would distinguish between two cottons at the other end of the spinning-value scale, i.e. if a cotton A is slightly better in lea strength at 28's counts than another cotton B, it is by no means certain that cotton A would also be better than cotton B in say 120's counts. Some support is given to this view by Morton's correlation coefficients between fibre-weight and single-thread and lea strengths, these being higher for the

40's yarns than for the 24's, so that as the fibre-weights are of course the same for both counts there may be some differential effect between the cottons in proceeding from the 24's to the 40's counts. It is concluded, therefore, that the index of yarn quality, lea strength at 28's counts, is only applicable to a very narrow range of cottons.

It is emphasised by Balls[17] that the determination of yarn-strength, for any one length of test-specimen only, is unsatisfactory as a measure of cotton quality, and may indeed be misleading because different comparative results might be obtained merely by altering the length of the test-specimen; this is a consequence of differences between the yarns in their strength-irregularity. An example of such an effect has been given by one of the present authors,[18] in which an apparently anomalous result in some tests of tearing strength was traced to a difference in irregularity of the yarns; the yarns were of the same count and twist, and had the same strength when tested on 18-in. lengths, but different strengths when tested on 3-in. lengths*. Although Balls's[17] "general conclusion is that the lea test is a rational one," he does not accept it as the sole criterion of yarn quality because it is made on a fixed length; and yarns should apparently be tested at many different lengths before a conclusion is drawn as to the spinning quality of the cotton. This of course is a very laborious proceeding, and must be regarded as impracticable under present conditions. Actually, at the Technological Laboratory, it has always been the practice to test the standard cottons on two different lengths of specimen, viz. on 12-in. lengths in single thread tests, and on 120-yard lengths in lea tests, though these two tests are not of course strictly comparable.

In view of these difficulties in connection with the relation of yarn strength to spinning-value, and the consequent difficulties that arise in the attempt to correlate the spinning-value with the fibre-properties, the criterion of spinning-value used in the present paper is the "highest standard warp count," an account of which is given in the next paragraph.

Highest Standard Warp Counts

The highest standard warp count, which has always been used at the Technological Laboratory as a convenient single index of spinning-value, has been described in earlier publications,[20] and is, briefly, the finest count of warp yarn that can be spun economically with a standard medium twist and with only a few breakages in spinning, and have a certain standard strength; the strength referred to is the lea strength, for which the following standard scale was adopted for the different counts.

Count	Lea Strength	Count-Strength Product
Up to 14	90	1260
16	81	1296
18	73	1314
20	67	1340
22	62	1362
24	58	1394
26	54	1404
28	51	1428
30	48	1440
32	46	1472
34	44	1496
36	42	1512
38	40	1520
40	39	1560

* The theory of the effect of specimen length on the result of a strength test has been very fully worked out by Peirce[19] in terms of the irregularity of strength.

The application of this table is based on the fact that it requires a *higher* count-strength product as the counts become finer, whereas any particular cotton, if spun into various counts, all having the same twist-factor, will give a *lower* count-strength product as the counts become finer. It follows, therefore, that if we spin a particular cotton into too low a count, its count-strength product will be above that required by the table for that count; and as we spin the cotton into finer and finer counts there comes a time when the yarn of a particular count has a count-strength product just equal to that required by the table for that count—and it is this particular count which is designated "the highest standard warp count." In practice a cotton is spun only into two or three counts, chosen usually so that at least one is below and one above the highest standard warp count; by bracketing the highest standard warp count in this way it is a simple matter to estimate its actual value with a considerable degree of accuracy. In assigning the highest standard warp count to a cotton, it was originally intended to take into account not only the lea strength but also the single thread strength and the number of yarn breakages in spinning. But in point of fact it has been only on comparatively rare occasions that the lea test and the single thread test have given substantially different indications of the highest standard warp counts, and in most cases it has then appeared preferable to give greater weight to the lea-test result, both because it is the standard of reference in the industry and because it is much less subject to sampling errors, even when 1200 tests of single-thread strength are made for each cotton. Furthermore, experience has shown that, owing to the comparatively small scale of working, it is unwise to attach too much importance to any but fairly large figures for yarn breakages, and when the figures are large the strengths of the yarns probably give equally good indications of bad spinning quality in the count in question.

III—TESTS AT THE TECHNOLOCIGAL LABORATORY

The tests on which the present analysis is based have been made on the standard Indian cottons, of which a full account is given in "Technological Reports on Standard Indian Cottons, 1930."[21]

Sampling—The Technological Laboratory receives each season 24 lb. of each standard cotton for fibre and spinning tests. Of this, only a very small quantity can be submitted to the fibre tests, and special precautions are therefore taken to make the "sampling for fibre tests" as representative as possible. Small masses of the cotton are selected at random from various parts of the 24 lb. bulk, until a sample weighing about ½ lb. is obtained. This is thoroughly mixed by hand, and is then divided and re-divided until eight practically equal portions are obtained, from each of which a number of tufts (5 or 6) are taken to form the sample to be tested. A number of workers are engaged in the fibre-testing, and each of them does his own sampling from the ½-lb. sample; and as each test is made by at least two workers the degree of agreement between their results affords a general check both upon the accuracy of their sampling and of their testing. As this method deliberately includes the personal equations of different workers it has the consequence of increasing the standard error of any one mean value, but makes more reliable the comparison of different means, obtained in some cases by different workers; moreover, if the individual means obtained by two workers differ by more than 5% in the case of fibre-length or 10% in the case of fibre-weight, repeat tests are made by two other workers before the general mean is taken for the particular fibre-property. Similar repeat tests are carried out in the case of other properties when the two workers obtain appreciably different mean values. Details of the fibre and spinning tests are given in the two following sections.

Details of the Fibre Tests

Fibre-length—The mean fibre-length is determined by means of two different instruments, viz. (1) the Balls sorter and (2) the Baer sorter. Four determinations are made with the Balls sorter, and eight with the Baer sorter; the value taken for the mean fibre-length of each sample in the present paper is the average of the mean values obtained by the two methods.

Fibre-weight per inch—The mean fibre-weight per inch is determined by weighing, on a quartz-fibre torsion micro-balance, groups of 1 cm. lengths cut from the middle portions of straightened bunches of fibres. The number of fibres in a group for weighing depends on the coarseness of the cotton, ranging from 150 for very coarse cottons to 500 for the finest cottons; in all, some 4000 fibres of each sample are weighed. The value of the fibre-weight is corrected for the effect of humidity, and is shown as the mean fibre-weight per inch as at 70% relative humidity.

Fibre-strength—The mean fibre-strength is determined by two methods, viz. (1) the Balls Magazine Hair Tester and (2) the O'Neill Tester, as modified by Mann and Peirce[22]; 300 fibres are tested individually by each method—150 by each of two workers; the value taken for the mean fibre-strength of each sample in the present paper is the average of the mean values obtained by the two methods, corrected to 70% relative humidity.

Fibre-rigidity—The fibre-rigidity at 70% relative humidity is determined from measurements of the time of torsional vibration of a small cylindrical aluminium rod suspended at its mid point by the cotton fibre under test. The value of the fibre-rigidity is calculated from the following formula—

$$R = \frac{8\pi^3 Kl}{t^2}$$

where R is the fibre-rigidity in dyne-cm^2; K is the moment of inertia of the aluminium rod; l the length of the fibre; and t the period of torsional vibration.

The fibre-rigidity is determined for 150 individual fibres maintained strictly at 70% relative humidity, the fibres being the same as already used in the determination of ribbon-width and convolutions (see below).

Ribbon-width—The ribbon-width is determined by measurements under the microscope taken at 10 different points along the length of the fibre, each of these points being situated mid-way between a pair of successive convolutions; 150 fibres are measured in this way.

Convolutions—The number of convolutions is determined under the microscope at the same time that the ribbon-width is measured, using the same fibres; a convolution is regarded as due to the twisting of the fibre on its longitudinal axis through an angle of 180 degrees.

Clinging-power—The clinging-power is determined[23] by measurement of the force required to pull a group of 10 fibres through a pair of pads covered with parallel fibres of the same cotton, the pads being pressed together under a standard pressure; 25 groups of fibres are tested in this way.

Details of the Spinning Tests

As a general rule the spinning tests have been made on two 10-lb. samples of each cotton, each being spun into three types of yarn differing in counts or twist-factor; on each type of yarn there have been made 50 tests for lea strength and counts, and 200 tests for single-thread strength, extension, and counts, besides 100 tests for twist. Thus the assignment of each value of highest standard warp counts has been based on the results of 300 lea tests and 1,200 single-thread tests. These tests have been carried out on standard machines under standard conditions.

Extent of Data Obtained for Indian Cottons at the Technological Laboratory

The present paper gives the results of an analysis of the test-values obtained for no less than 95 samples that have formed the subject of "Technological Reports on Standard Indian Cottons."[20] These standard cottons, numbering 21, have for the most part been subjected to spinning tests since 1924; it was only in 1926, however, that a fairly complete system of fibre-testing was developed by which all the standard cottons have been tested for length, weight per inch, strength, width, convolutions, and rigidity. But samples for which these properties were determined in seasons previous to 1925-26 have also been included. As mentioned in Part III,[23] the clinging-power has also been determined for 45 samples, of which 38 were included among the 95 samples of Series I. One great objection that can be made to earlier discussions of the correlation between spinning-value and fibre-properties is that they refer to so few samples; the 95 samples is a much larger number than any previously discussed. Moreover, these 95 samples have been very extensively tested for far more properties than any set of cottons for which results have been published hitherto. The following are the approximate total numbers of tests done on each series of samples—

SERIES I

FIBRE TESTS

Property	No. of Tests
Fibre-length ...	380 Balls Sorter
	760 Baer Sorter
Fibre-weight ...	1,600 Weighings
Fibre-strength ...	60,000
Ribbon-width ...	14,250
Convolutions ...	14,250
Fibre-rigidity ...	14,250

YARN TESTS

Property	No. of Tests
Lea Strength	28,500
Lea Counts	28,500
Single-thread	
Strength	111,600
Extension	111,600
Counts	5,550
Turns per inch	57,000

SERIES II

FIBRE TESTS

Property	No. of Tests
Fibre-length ...	180 Balls Sorter
	360 Baer Sorter
Fibre-weight ...	700 Weighings
Fibre-strength ...	30,000
Ribbon-width ...	6,750
Convolutions ...	6,750
Fibre-rigidity ...	6,700
Clinging-power ...	1,125

YARN TESTS

Property	No. of Tests
Lea Strength	13,500
Lea Counts	13,500
Single -thread	
Strength	54,000
Extension	54,200
Counts	2,700
Turns per inch	27,000

The mean-values of the several fibre-properties and the spinning-values are given in Appendix III, Table I for Series I samples, and Table II for Series II samples.

After the testing of the 1927-28 cottons the correlation coefficients were worked out for the 51 samples available; in the following season another 22 sets of results became available, and the correlation coefficients were calculated for the 73 samples; similarly, the results became available for the

95 samples in 1929-30, for which the present analysis has been worked out. Since this was started, the results have become available for the two following seasons, and the correlation coefficients have again been worked out for each successive addition of samples. The simple method used for including the results of successive seasons, which aims at keeping the necessary arithmetic to a minimum, is described in Appendix II.

IV—ANALYSIS OF THE DATA: USE AND LIMITATIONS OF THE METHOD OF CORRELATION TO OBTAIN A PREDICTION-FORMULA

The method by which we have obtained our approximate formula for the prediction of spinning-value is known as the method of correlation. The routine application of this method is described in Appendix I. Here we confine ourselves to an explanation of the method, before proceeding to the discussion of the results to which it leads us. By saying that there is correlation between two or more quantities or qualities we merely mean that there is some connection between them; we define the *extent* of the connection by means of the correlation coefficient. For example, the production of a particular count of yarn is connected with the speed of the front roller of the spinning machine; true, it depends upon other things as well, but if we made an investigation of the productions of a large number of mills for this particular count we should in general find that the production was highest when the front roller speed was highest. We should hardly expect a direct proportionality between these two quantities because some mills might be using rollers of slightly different diameters, and certainly the mixings used by different mills would differ; moreover, the spinning machines would not all be of the same age or condition; for these reasons, even if the front roller speeds were the same for two mills for a particular count, it is unlikely that their productions would be exactly the same. But there would be the general connection between the front roller speed and the production, and this connection is indicated by saying that the production is correlated with the front roller speed. If we found that the average production of different mills was exactly proportional to the front roller speed, the correlation would be perfect; but in any actual case we should fall short of this perfect correlation. We therefore need some mathematical index to indicate the degree of correlation; this index is the correlation coefficient, usually represented by the letter r; r has the value 1 for perfect correlation, and some fraction of 1 for any correlation which is not perfect; further, if there is no connection at all between these two quantities or qualities, then these are said to be uncorrelated, and the correlation coefficient between them, as estimated from a large sample, would be practically 0. Obviously all degrees of correlation must be represented between 0 and 1. It may also happen, however, that an increasing value of one quantity may be associated with a generally decreasing value of the second quantity; in such cases the two quantities are said to be negatively correlated, and just as all positive correlation coefficients lie between 0 and 1 so all negative correlation coefficients must lie between 0 and −1.

It has already been stated that the production of a particular count of yarn is highly correlated with the front roller speed. But if we consider the production not of a single count of yarn but of many different counts, the situation becomes more complicated. If we were to spin counts of yarn, twice as fine, keeping the front roller speed and all other factors the same, the production would be only half as great, i.e. as the count number increases so the production decreases, and production and counts are therefore negatively correlated. If we consider both counts and front roller speed together, we clearly have the dependent variable (the production) depending on the two independent variables, the front roller speed and the counts. Obviously, if we were to take into consideration still more factors, our dependent variable, the production, would depend on so many more independent variables. We will now proceed to consider how such relations are expressed in a simple mathematical form, returning for this purpose to our problem of the prediction of spinning value from fibre-properties.

Table I, Appendix I (page T28), shows that if no regard were paid to the fibre-length, a sample of cotton might fall anywhere in the table and so spin anything from 5's to 44's; yet if we impose the restriction that the sample of cotton has a definite fibre-length, it can only fall in one of the various columns of the table, and for any one column the range of counts is decidely less than for the whole table. Moreover, this table reveals what is familiar to every cotton broker or spinner, viz. that, *on the average*, the shortest cottons are only suitable for coarse counts, whereas the longest cottons are suitable for fine counts; this fact is summarised by saying that the count spinnable is correlated with length of staple.

This average relationship can be represented fairly well by a straight line, known as a *regression line*, representing that—

Highest standard warp count = {a constant (b) × length} + {another constant (C)} ....(1)

The constant b in this equation is called a *regression coefficient*, and here means that for every change of length of one unit (say $\frac{1}{16}$ in.), the count changes, *on the average*, by b units in the same direction if b is positive (as it is for changes in fibre-length), and in the opposite direction if b is negative (as it is for changes in fibre-weight per inch). This, then, is a prediction-formula by which we could calculate the counts to be expected on the average from a sample having a certain fibre-length.

It should be noted, however, that whereas in column 3 of the table there are 5 samples with fibre-lengths between 0·66–0·69 in., and all these samples fall in one group spinning from 5's to 8's counts; yet in column 8 there are 19 samples, all having fibre-lengths between 0·86–0·89 in., but not all spinning the same range of counts, for 2 spin from 25's to 28's, 6 spin from 29's to 32's, 9 spin from 33's to 36's, and 2 spin from 37's to 40's. Evidently, then, if a sample has a fibre-length between 0·86–0·89 in., we still cannot say exactly what counts it will spin—the counts might be anything from 25's to 40's; this is because some other properties besides fibre-length affect the counts spinnable. At the same time, this range of counts is much less than the range of 5's to 44's that applies to the whole table. Another question therefore arises, viz. although the average values of count for various fibre-lengths can be represented fairly well by a straight line, how nearly do the *individual* values actually fall on this line? The answer is that this depends on the *degree* of correlation between the counts and fibre-length; the more nearly the individual values fall on the regression line, the higher is the degree of correlation; if there were no other factors but fibre-length affecting the count, all the individual values would actually fall on the regression line and the correlation would be perfect. The coefficient of correlation r is an index of this degree of correlation; as already indicated, for perfect correlation $r = 1$; thus, in our example of counts and fibre-length, we should say that if $r = 1$

the fibre-length is all important, and for a cotton having any particular mean fibre-length there is a definite highest standard warp count. But if $r = 0$, and there is no correlation between these properties, it would follow that a knowledge of the fibre-length of a sample would tell us nothing about the counts to which it could be spun. Actually, however, for highest standard warp counts and fibre-length, $r = 0{\cdot}87$, which indicates that fibre-length is an important property, but that other properties also have some effect on the highest standard warp count.

It is desirable therefore to extend the regression equation so as to include these other fibre-properties; if we include fibre-weight per inch, ribbon-width, fibre-strength, convolutions, and rigidity, we may write the new regression equation as—

Highest standard warp counts = {a constant (b_2) × length} + {a constant (b_3) × weight per inch} + ... + {a constant (C_1)} ....(2)

It should be observed that the correlation coefficient of 0·87 for highest standard warp counts and fibre-length may be so high, partly because coarseness of fibre (weight per inch) also affects the counts spinnable, and greater length is generally associated with less coarseness of fibre. The latter association affects the value of the regression coefficient b in equation (1); hence if we include weight per inch separately in our extended regression equation, we should use a regression coefficient for fibre-length which is independent of any association of fibre-length with fibre-weight per inch; in other words, in equation (2) the regression coefficient of length does not include any effect due to any other of the fibre-properties included in the extended regression equation; though it does, of course, still include effects due to fibre-properties not included in this regression equation. To distinguish the new regression coefficient of length from that of the other fibre-properties in the extended regression equation, it is written b_2 instead of b, and is termed a *partial regression coefficient*; the original b is a *total* regression coefficient because it includes the total effect of the fibre-length and of the other fibre-properties so far as they affect the regression of fibre-length. Equation (2) is similarly termed a *partial regression equation;* its significance is as follows—if cottons are selected having the same values for all fibre-properties mentioned in equation (2) except length, then for every change of length of one unit, the count changes *on the average,* by b_2 units.

As indicated above, the correlation coefficient of 0·87 between highest standard warp counts and fibre-length may be so high because of correlation between fibre-length and other fibre-properties; thus this coefficient is a *total* correlation coefficient. And just as a partial regression coefficient is used to indicate that the effects of one or more of these other fibre-properties on the regression coefficient for fibre-length have been eliminated, so a *partial correlation coefficient* is similarly used to indicate the degree of correlation between two properties when the effects of one or more other properties have been eliminated. It may be noted that a partial correlation coefficient may be less or greater than the corresponding total correlation between two properties. For example, the total correlation coefficient between highest standard warp counts and fibre-length is 0·87, but when the effect of the correlation with fibre-weight per inch is eliminated, the partial correlation coefficient between highest standard warp counts and fibre-length falls to 0·74; on the other hand, the total correlation coefficient between fibre-convolutions and fibre-rigidity is −0·13, whereas when the effect of the correlation with fibre-weight per inch is eliminated, the partial correlation coefficient rises to 0·45.

Finally, the question may be asked, when a number of fibre-properties are taken into consideration, do the variations in these account for the variation in highest standard warp counts ? Just as the coefficient of correlation r indicates the degree of correlation between the highest standard warp counts and a single fibre-property, so a *coefficient of multiple correlation* R is used to indicate the degree of correlation between the highest standard warp counts and all the fibre-properties taken into consideration; at the same time R indicates the degree of correlation between the actual values of the highest standard warp counts and the predicted values obtained from the regression equation for all the fibre-properties taken into consideration.

The relations on which the various calculations depend, and a more detailed explanation of the working, are given in Appendix I, which also contains a brief account of two alternative and somewhat simpler and shorter methods of calculating the partial regression coefficients. As there explained, all three methods lead, as of course they should, to the same regression equations for calculating the average highest standard warp counts from the various fibre-properties. These equations are—

For the Series I cottons—

$$X_1 = 71{\cdot}6\, X_2 - 70{\cdot}8\, X_3 - 20{\cdot}8\, X_4 + 17{\cdot}9\, X_5 + 0{\cdot}037\, X_6 + 4{\cdot}4\, X_7 - 14{\cdot}1$$

For Series II cottons—

$$X_1 = 42{\cdot}7\, X_2 - 66{\cdot}4\, X_3 - 49{\cdot}3\, X_4 - 18{\cdot}7\, X_5 + 0{\cdot}0277\, X_6 + 21{\cdot}8\, X_7 - 26{\cdot}2\, X_8 + 39{\cdot}5.$$

In these equations

X_1 = highest standard warp counts,
X_2 = fibre-length,
X_3 = fibre-weight per inch,
X_4 = ribbon-width,
X_5 = fibre-strength,
X_6 = fibre-convolutions,
X_7 = fibre-rigidity,
X_8 = fibre clinging-power.

In Appendix I are also given the simple regression equations for the average highest standard warp counts in terms of each fibre-property separately, ignoring the effects of the other fibre-properties instead of allowing for them as in the regression equations given above, which take into account all the measured fibre-properties at the same time. Other regression equations are given in the same Appendix I (page T33), which take into account some but not all of the measured fibre-properties, viz. (1) fibre-length and fibre-weight per inch; (2) fibre-length, fibre-weight per inch, and fibre-strength; (3) fibre-length, fibre-weight per inch, and ribbon-width; and (4) fibre-length, fibre-weight per inch, ribbon-width, and clinging power.

These regression equations, then, are the prediction-formulæ that we seek, to enable us to predict the highest standard warp counts from certain measured fibre-properties. But before proceeding further, it is essential to realise that these regression equations suffer from some severe limitations. In the first place, strictly speaking, they merely epitomise the data from which they are derived, and show what is the *average* highest standard warp counts for the given values of the fibre-properties of the samples tested—and even this involves the assumption that there is a true linear relation between the highest standard warp counts and the individual fibre-properties. This assumption is not really legitimate, as is clearly shown by Figs. 1–7, giving the regression curves for the highest standard warp counts and the seven individual fibre-properties, viz. length, weight per inch, ribbon-width, strength, convolutions, rigidity, and clinging power. It may be observed that in the first three cases both curves approximate to straight lines, whereas in the other cases the curves cannot be regarded as linear. In spite of this fact, the regression curves have been assumed to be linear in the present paper. If

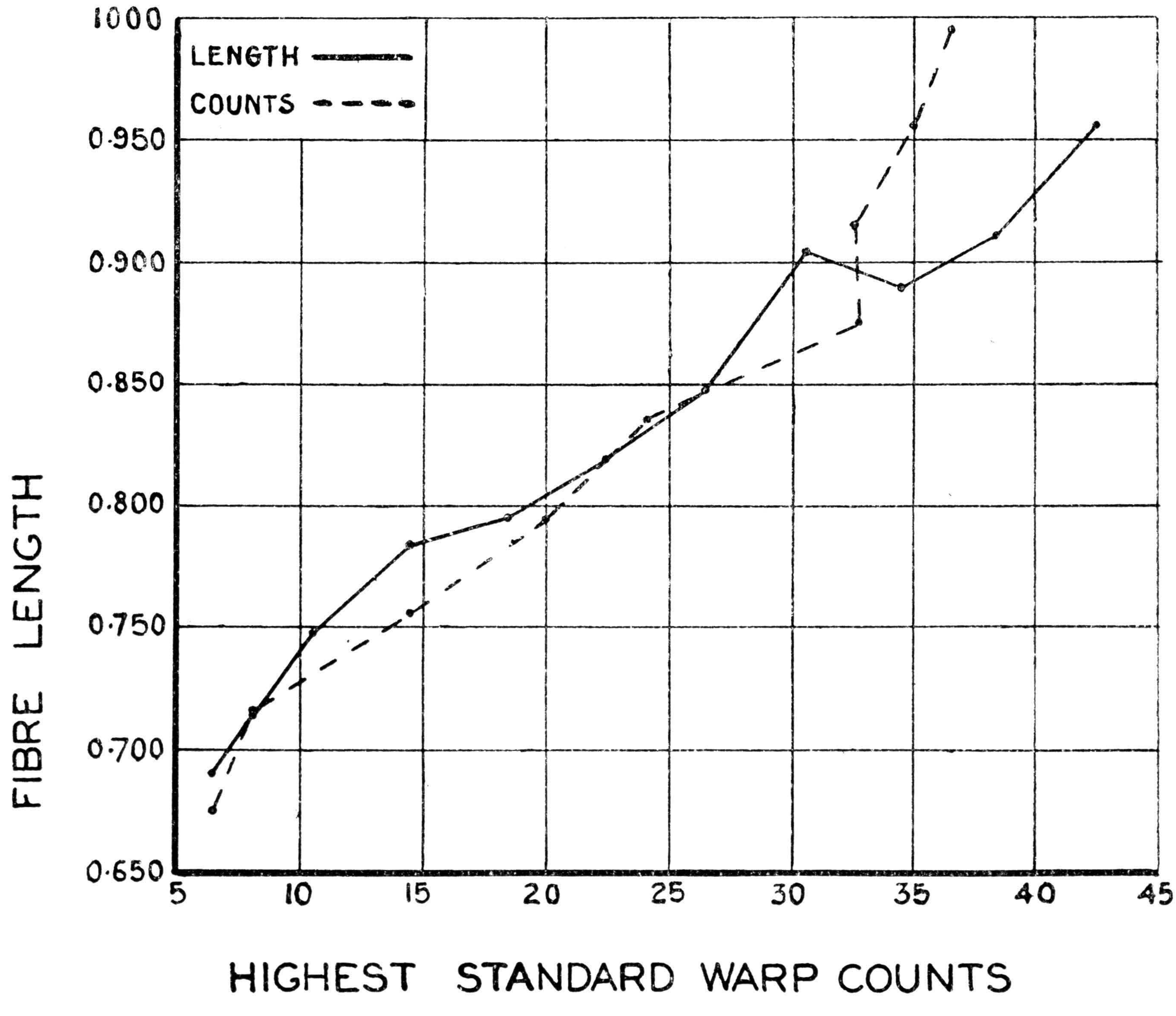

FIG. 1—Regression lines for length (on counts) and counts (on length).

then we regard these regression equations as our prediction-formulæ, it is evident that on substituting the appropriate values of the fibre-properties of some particular sample, we assume that this sample belongs to the same universe as those from which our regression equation was derived and even then we shall only obtain the *average* value of the highest standard warp counts for such a set of fibre-properties; and the actual value will differ more or less from this average value; the likely extent of such difference is indicated by the standard error of estimate of the highest standard warp counts, which may be calculated from the data; the actual differences in the present investigation will be discussed in the next section.

Secondly, it is to be observed that even in the tests of Series I the data refer only to 95 samples. Though this is a much larger number than has been the subject of other investigations, and the correlation coefficients do not seem to change much as the number of samples increases with the seasons, it is desirable to emphasise that this number of samples is exceedingly small for the application of the method of multiple correlation when the number of independent variables (the fibre-properties) is comparatively large, and, as Yule[24] observes, "when only a small number of observations are available, it is . . . . little use to deal with a large number of variables." Moreover, as the number of independent variables increases, the arithmetical calculations of partial correlation coefficients, etc. should be carried to a large number of decimal places in order to obtain a final accurate result for the constants of the regression equation—"probably something like one additional decimal place for each variable involved."[25] Such a procedure adds enormously to the great labour involved in the calculations, and in view of the facts already mentioned, has not been followed in the present investigation.

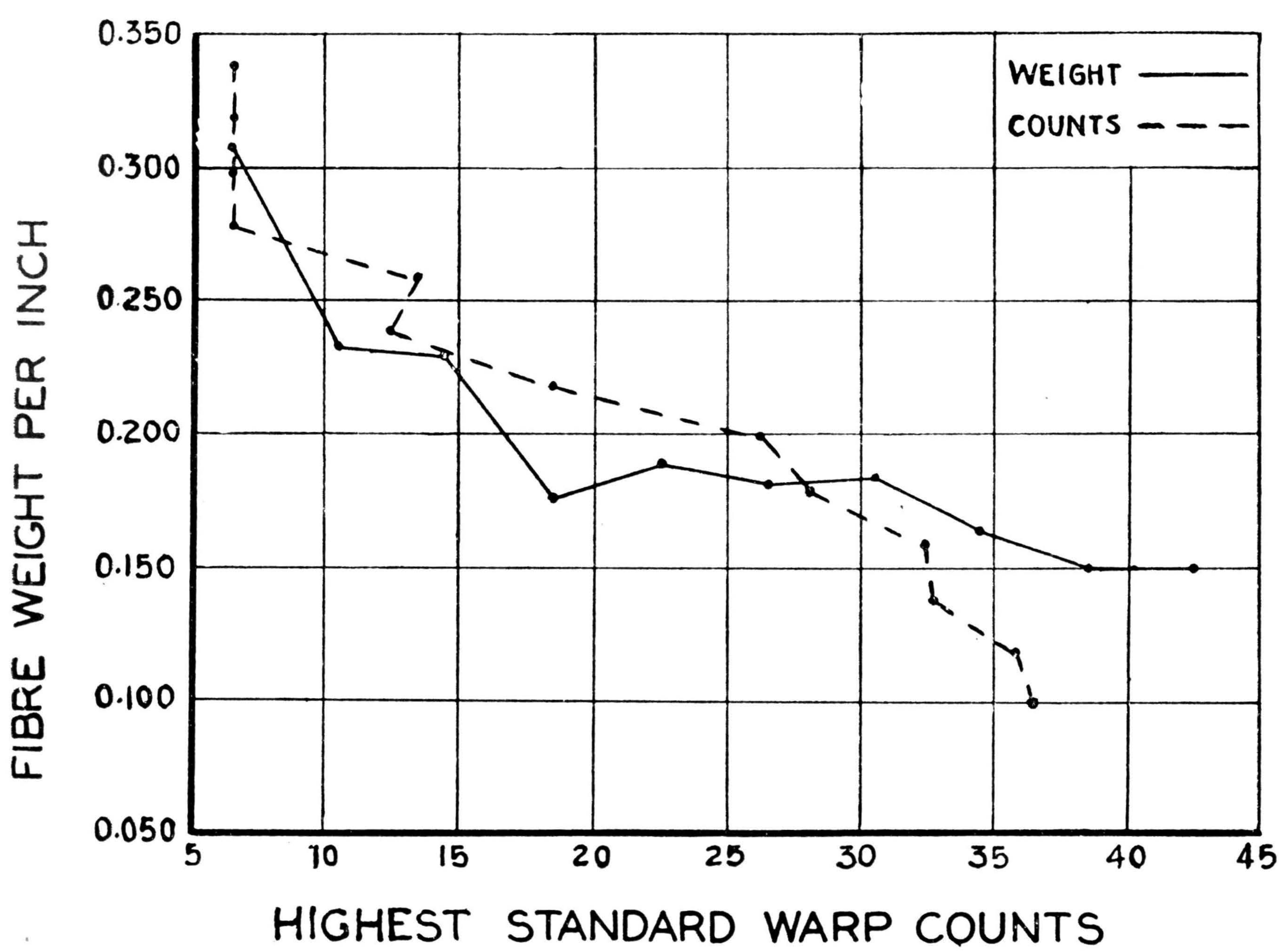

FIG. 2—Regression lines for weight per inch (on counts) and counts (on weight per inch).

Thirdly, although the number of samples of Series I was 95, the number of different varieties of cotton was only about 20, these forming the subject of tests in successive seasons. And while the seasonal repetition of the tests is desirable in order that the general prediction-formula may include any seasonal effects, the number of types of cotton to represent the universe of types, to which the theory of correlation relates, is of course restricted. At the same time, it may be noted that the standard Indian cottons do include all the types commonly grown in India, and represent a wide diversity of type and also of district and conditions of growth.

V—VALUES OBTAINED FROM THE DATA FOR CERTAIN COEFFICIENTS OF CORRELATION AND REGRESSION

As will be seen from the following table, the total correlations between the highest standard warp counts and the various fibre-properties have not changed much as more values have become available in the successive seasons—

Correlation Coefficients between Spinning-Value and Fibre-Properties as the number of Samples increases in Successive Seasons

Seasons up to and including ...	1927–28	1928–29	1929–30	1930–31	1931–32
Number of Cotton Samples ...	51	73	95	110	134
Total Correlation between Highest Standard Warp Counts and—					
Fibre-length	+0·83	+0·85	+0·87	+0·87	+0·87
Fibre-weight per inch	−0·80	−0·81	−0·80	−0·79	−0·79
Ribbon-width	−0·75	−0·73	−0·69	−0·71	−0·71
Fibre-strength	−0·38	−0·39	−0·33	−0·34	−0·35
Convolutions	+0·49	+0·47	+0·46	+0·46	+0·45
Fibre-rigidity	−0·71	−0·69	−0·67	−0·69	−0·70

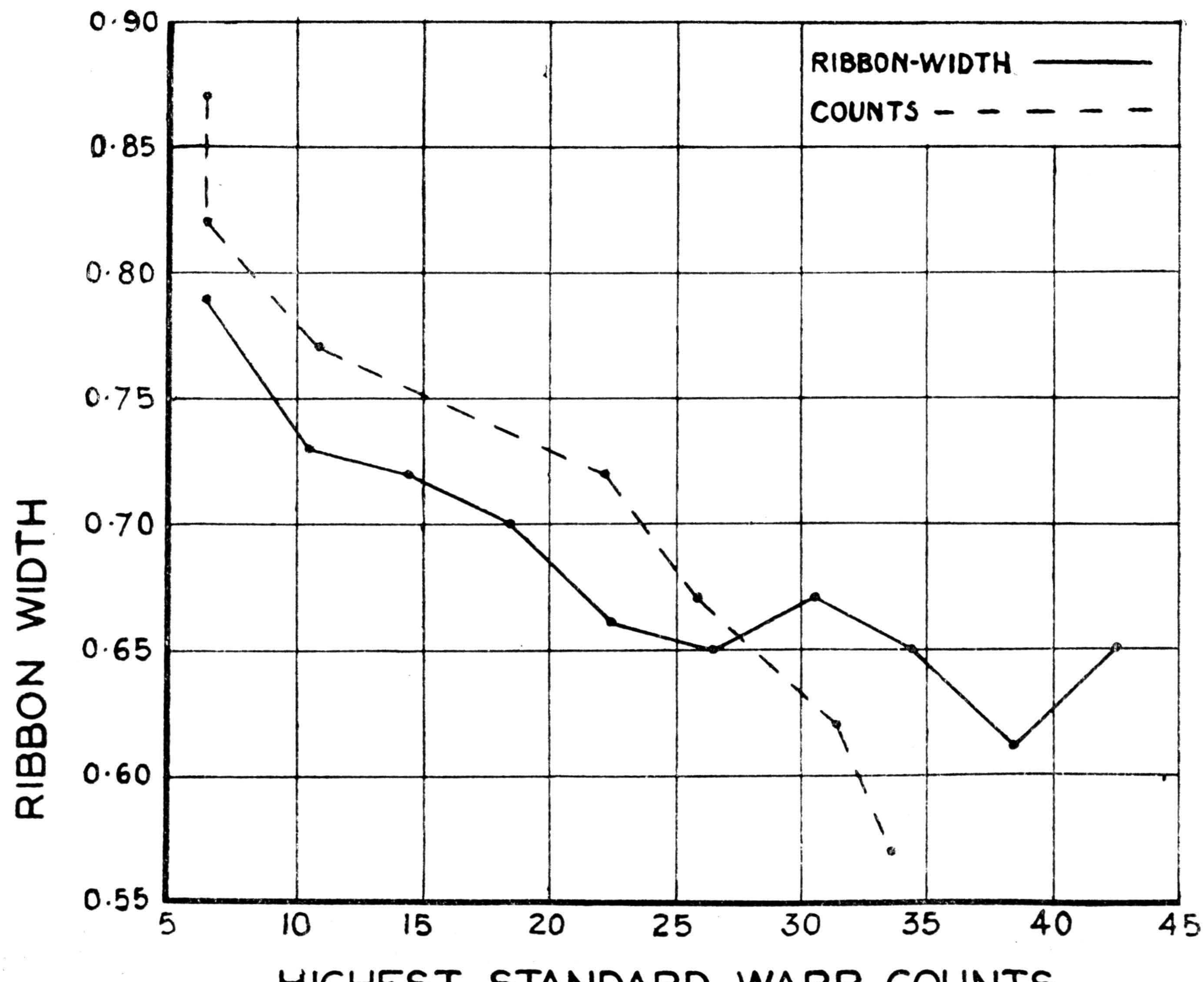

FIG. 3—Regression lines for ribbon-width (on counts) and counts (on ribbon-width).

In connection with these results it may be noted that the fibre-weights have been determined by a different method in 1930–31 and 1931–32, and although a correction has been applied to them with a view to making them comparable with those of previous seasons, it has been considered undesirable to use them for the complete analysis given in this paper; even if the additional data had been used they would have caused only very small changes in the correlation coefficients. Further, in view of these changes being so small, it appears that the values now given may be accepted with considerable confidence as applying to the complete range of cottons at present grown in India.

As it is the practice of the Laboratory to determine the fibre-length and fibre-weight of all cottons submitted by the Agricultural Departments of the various Provincial Governments of India, as well as the spinning-values of

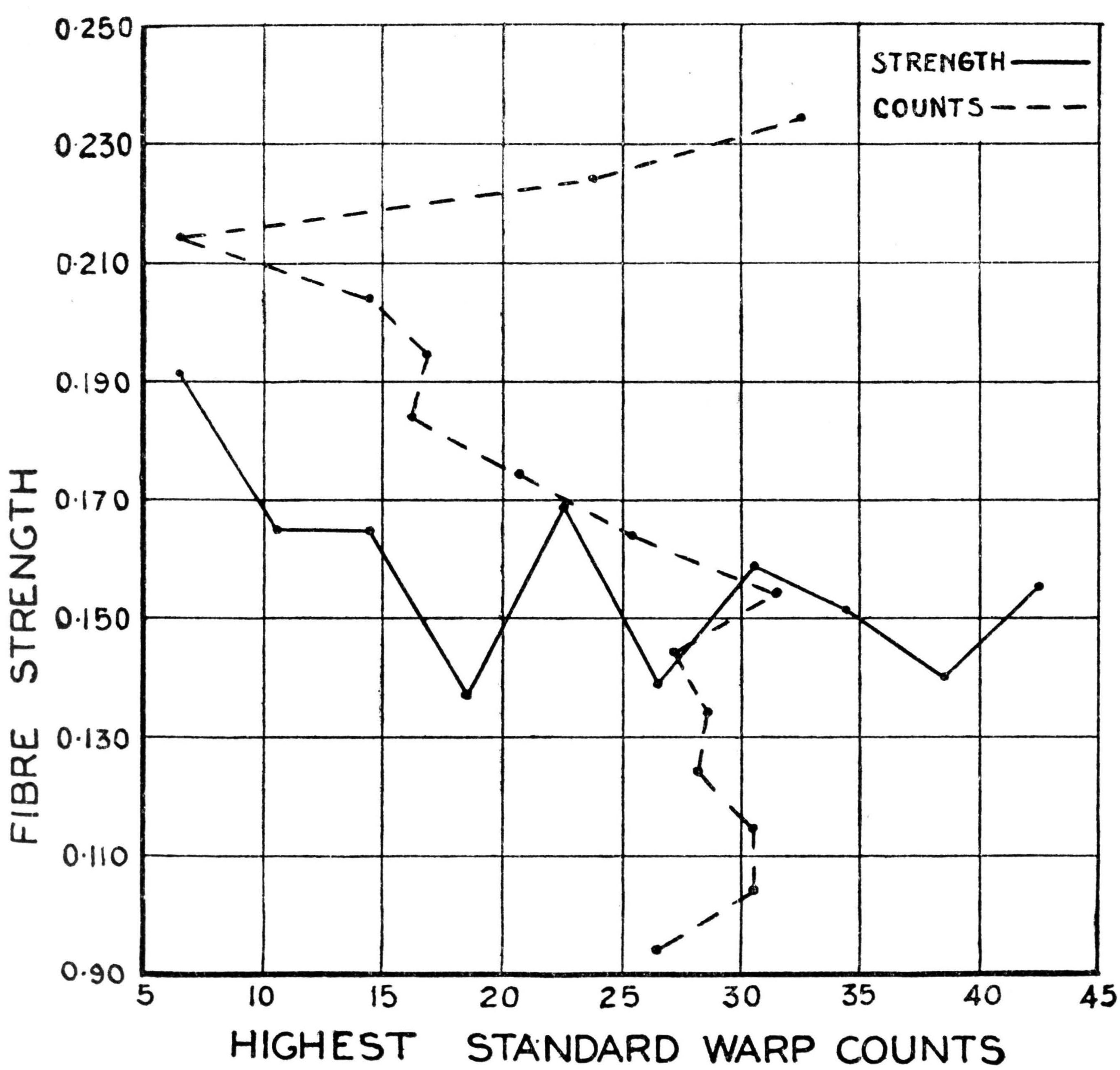

FIG. 4—Regression lines for strength (on counts) and counts (on strength).

the cottons, much additional information is available for calculating the correlation coefficients between these particular properties. Some difficulty is encountered in combining the results for these samples with those for the standard Indian cottons, in that the mean values for the standard cottons have in most cases been obtained from twice as many tests as those for the Agricultural Department samples. In the following table we accordingly give the correlation coefficients for these non-standard cottons, both separately

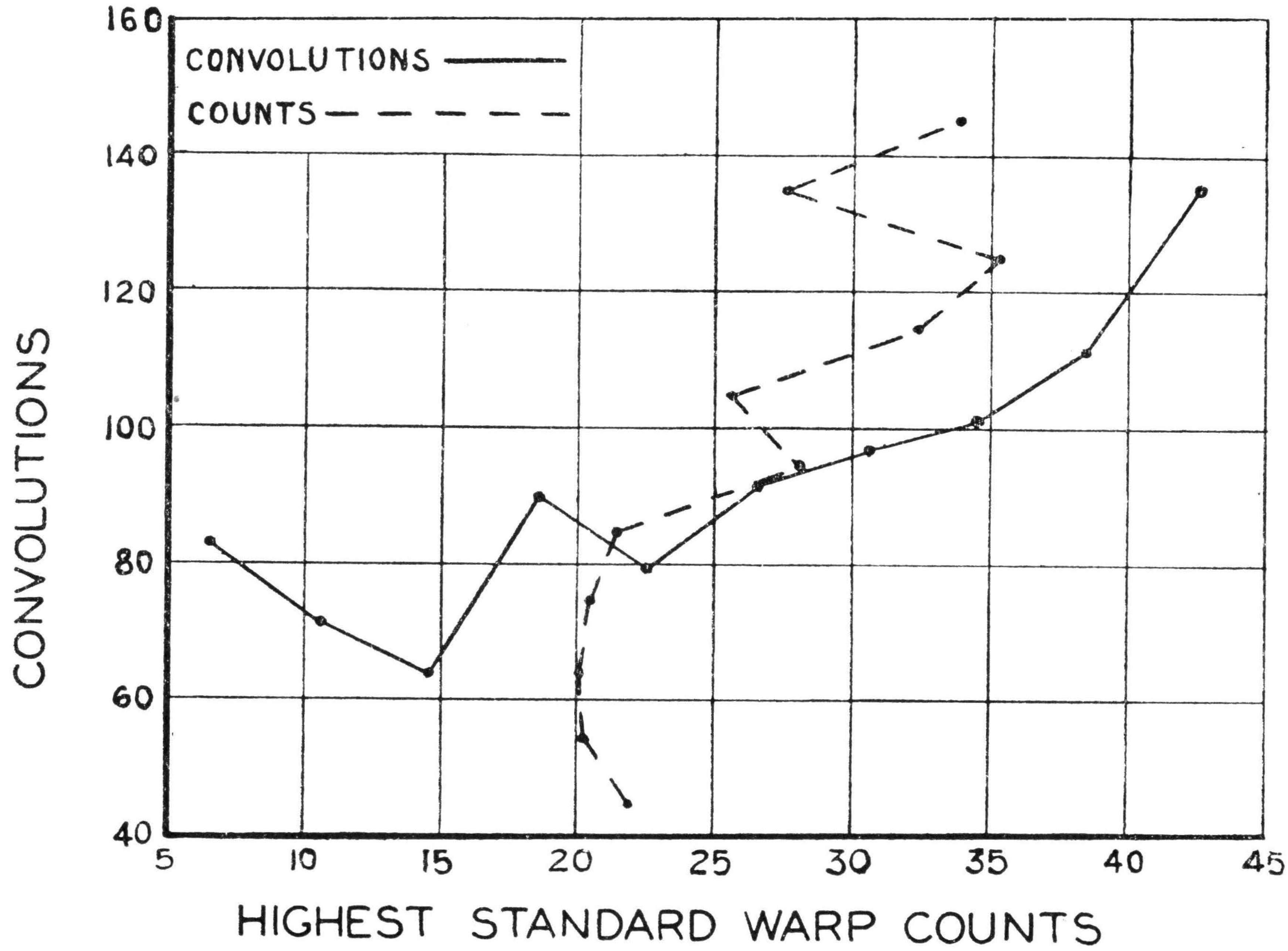

FIG. 5—Regression lines for convolutions (on counts) and counts (on convolutions).

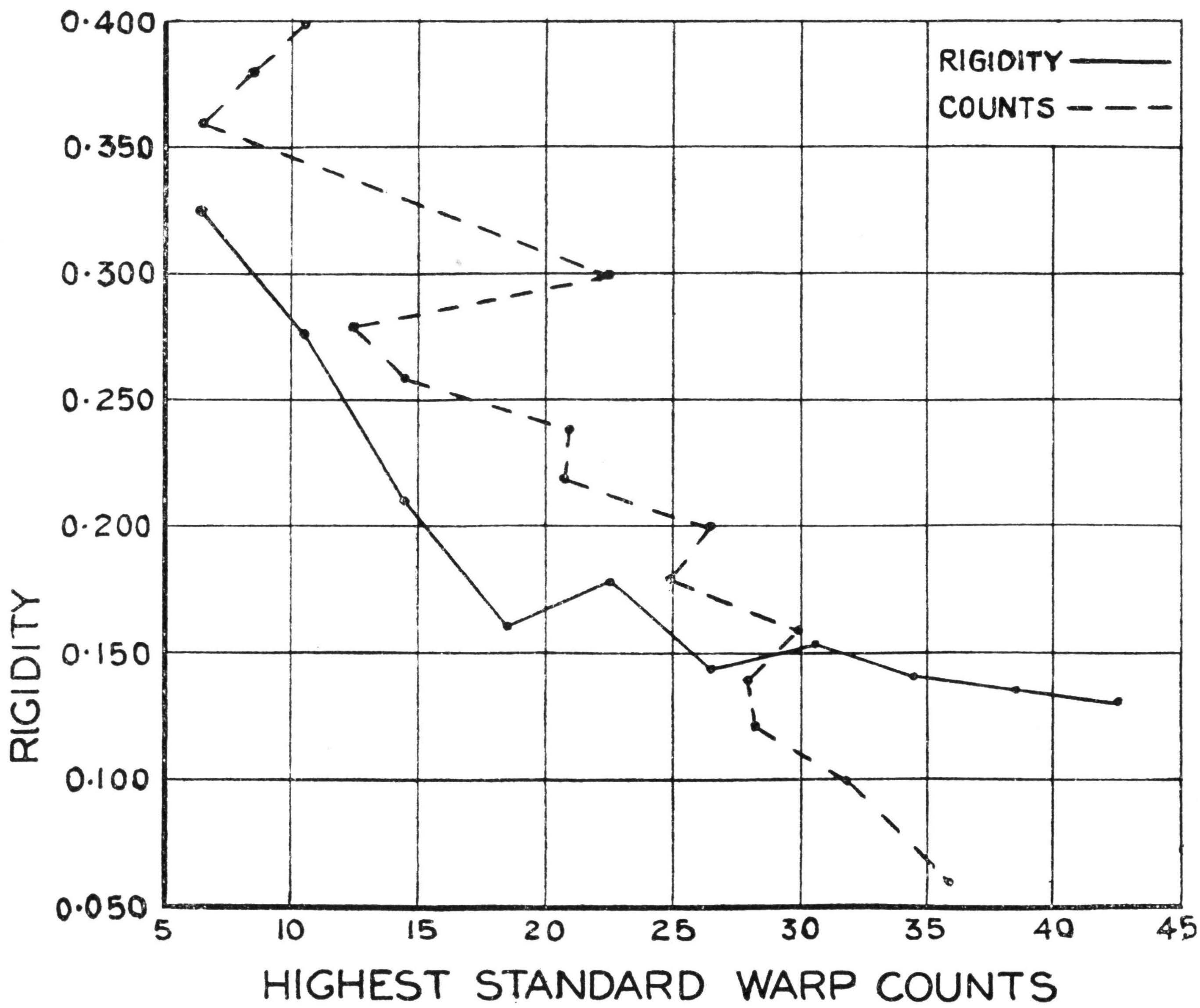

FIG. 6—Regression lines for rigidity (on counts) and counts (on rigidity).

and also combined with those for the standard cottons to which double weight has been assigned where necessary.

Number of Samples	95 (Standard Samples)	274 (Non-standard Samples)	460 (Equivalent non-standard Samples)
Correlation between			
H.S.W.C. and Fibre-length	0·87	0·86	0·87
H.S.W.C. and Fibre-weight per inch ...	−0·80	−0·71	−0·75
Fibre-length and Fibre-weight per inch	−0·68	−0·58	−0·62

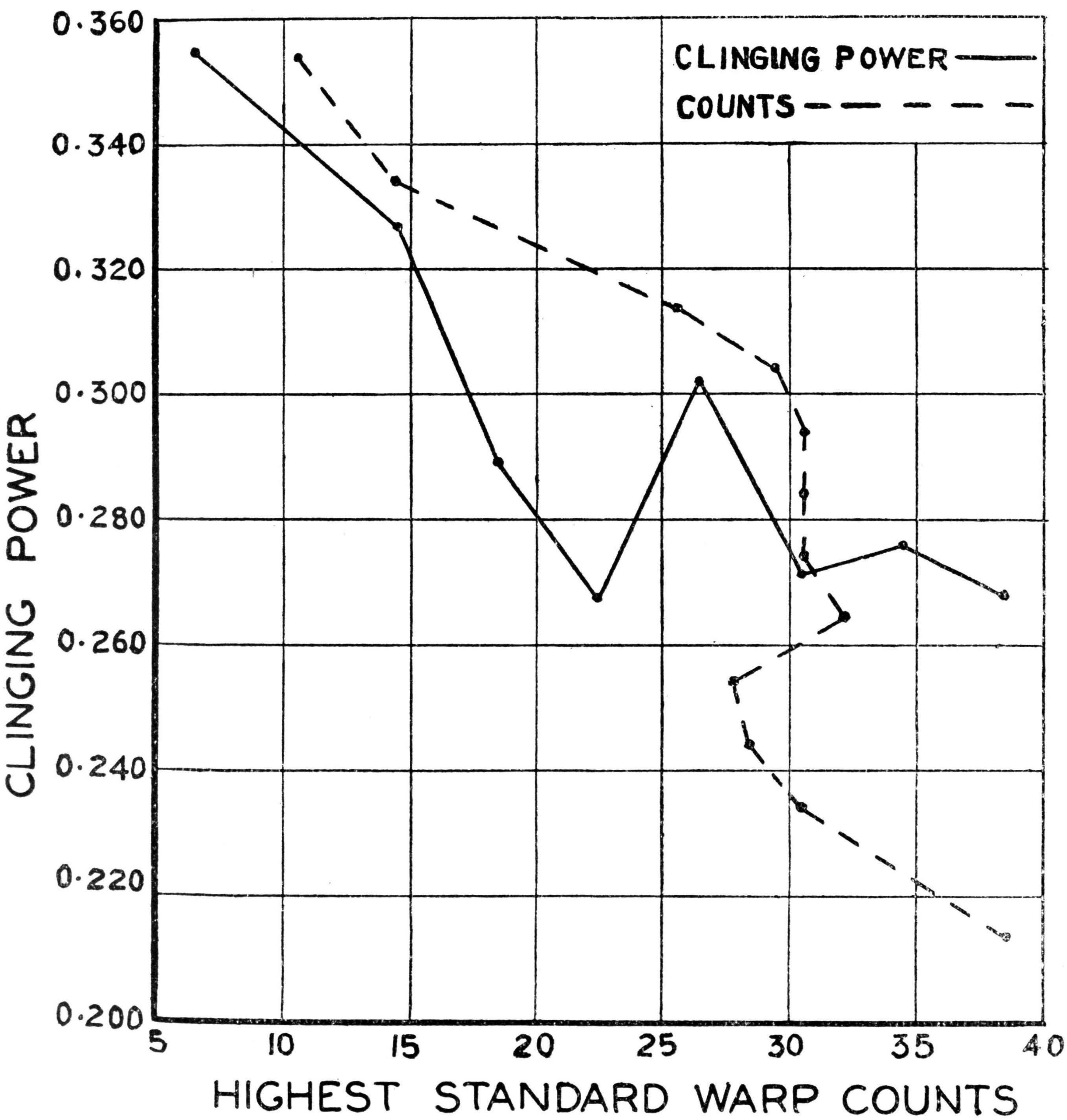

FIG. 7—Regression lines for clinging power (on counts) and counts (on clinging power).

These correlation coefficients are very high and are all statistically significant. Though almost entirely restricted to Indian cottons, they are based on much more extensive data than has been published hitherto; unfortunately, they cannot be compared with the correlation coefficients given by Morton,[10] as he correlated the fibre-properties with yarn strengths and not with the highest standard warp counts.

In the present paper we have also calculated the more interesting partial correlation coefficients, which show the effects to be attributed to the several fibre-properties when unaffected by some or all of the other properties measured. These partial correlation coefficients are given in Tables I and II of Appendix V; those obtained by eliminating the effects of the other five measured fibre-properties of Series I and the six measured fibre-properties of Series II, are as follows—

Partial Correlation Coefficient between Highest Standard Warp Counts and—	Series I (95 Samples) (5th Order)	Series II (45 Samples) (6th Order)
Fibre-length	0·70	0·52
Fibre-weight per inch	−0·36	−0·23
Fibre-width	−0·23	−0·44
Fibre-strength	0·10	−0·07
Fibre-convolutions	0·20	0·16
Fibre-rigidity	0·06	0·16
Fibre clinging-power...	—	−0·19

In each case the partial correlation coefficient is much less than the corresponding total correlation coefficient. Indeed, tests of statistical significance[26] show that, with 95 samples from a population in which there is actually no correlation between properties, the chance is 1 in 100 that the fifth order partial correlation coefficient will be as high as 0·27 by random sampling alone, and 1 in 20 that it will be as high as 0·21; with 45 samples from such a population, the chance is 1 in 100 that the sixth order partial correlation coefficient will be as high as 0·41 by random sampling alone, and 1 in 20 that it will be as high as 0·32. These statistical tests show that, for the 95 samples of Series I, only the partial correlations of fibre-length and fibre-weight per inch can be regarded as significant if the more stringent test be applied, though with the less stringent test the partial correlations of fibre-width and fibre-convolutions must also be regarded as just significant.

The same conclusion* is arrived at from a consideration of the partial regression coefficients of the regression formulæ that take into account all the fibre-properties measured, viz. the equations already given on page T15. We will confine our attention to the equation for the Series I samples, as the constants of this equation have been determined from the larger number of samples. The standard errors of the partial regression coefficients of this equation have been calculated, because the ratio of a coefficient to its standard error furnishes a measure of the statistical significance of the coefficient in question. The results are as follows—

Regression between Highest Standard Warp Counts and	Partial Regression Coefficient (5th Order)	Standard Error of Partial Regression Coefficient	Statistical Significance of Partial Regression Coefficient
Fibre-length	71·6	10·9	Significant
Fibre-weight per inch ...	−70·8	21·1	Significant
Fibre-width	−20·8	9·6	Doubtful
Fibre-strength	17·9	18·5	Not Significant
Fibre-convolutions	0·037	0·019	Doubtful
Fibre-rigidity	4·41	8·2	Not Significant

In this table the fifth order partial regression coefficients of fibre-length and fibre-weight per inch are alone classed as significant; these regressions are significant even with the more stringent test of significance that such a result would not be obtained more than 1 in 100 times as a consequence of random sampling; with the less stringent test of a result being regarded as significant

* It is of course inevitable that the same conclusion should be reached seeing that this consideration of the partial regression coefficients is merely an alternative method of dealing with exactly the same data.

when it would not occur more than 1 in 20 times merely as a consequence of random sampling, the partial regressions of fibre-width and fibre-convolutions are also significant.

It has already been remarked that the fifth order partial correlation coefficients are much smaller than the corresponding total correlation coefficients; the change, however, is much less in the case of the fibre-length than for any other property, and as the total correlation was itself highest for the fibre-length, the fifth order partial correlation is very much higher for fibre-length than for any other property. It follows, therefore, that so far as the partial correlation analysis can be applied to these data, it leads to the conclusion that fibre-length is much the most important property of Indian cottons in determining the degree of fineness to which they can be spun, and that fineness of the fibre itself is usually of importance chiefly because of its common association with length.* Further, these results lead to the very important conclusion that in general it is only worth while determining the values of the properties of fibre-length and fibre-weight per inch. And it will be seen later (page T24), that from these two properties alone it is possible to predict the highest standard warp count almost as accurately as from all the fibre-properties that have been measured in the course of this investigation.

VI—ACCURACY OF THE PREDICTION-FORMULA FOR SPINNING VALUE AND A DISCUSSION OF CERTAIN ANOMALOUS RESULTS

When we have obtained our prediction-formula, the question arises, how trustworthy is the formula ? We can test it in two simple ways as follows—First, we may determine the fibre-properties of a number of other cottons and see how the spinning-values calculated from these fibre-properties compare with those determined by actual spinning; and secondly, we may apply the formula to the results from which the formula has actually been derived, and again see how the calculated spinning-values compare with the actual for the individual samples. The second method is of course a less severe test because in the nature of the case the calculated and actual spinning-values must agree on the whole, and the restriction is obviously imposed that the test-sample does belong to the same universe as the samples from which the formula has been derived; so that all that this method really does is to reveal the cases that diverge widely from the average. Its utility lies in this, however, that it does reveal such anomalous cases, for which a complete theory of spinning-value, in terms of fibre-properties, has to account.

In the present investigation the second method has been applied systematically, and in Appendix IV, Table I for the Series I samples, and Table II for the Series II samples, are given the highest standard warp counts as actually obtained, and as calculated from the various prediction-formulæ derived for Series I and Series II according to the particular fibre-properties taken into consideration.

If we consider first the prediction-formula derived from the fibre-length alone, for which the correlation coefficient is highest, we note that in fact the

* It should be observed that this conclusion, that fibre-length is more important than fibre-weight in determining spinning value, may be at least partly due to the impossibility of setting ⅞-in. rollers sufficiently close to permit of the shortest cottons yielding their best results. Hence it would obviously be unwise, on the evidence of the present tests, to extend this conclusion to longer cottons which are suitable for much higher counts than those spun in these tests, and for which the most suitable settings could always be employed.

prediction-formula usually gives quite fair agreement with the experimentally determined highest standard warp counts, to this extent justifying the formulæ of Sheldon, Winterbottom, and Willis; in 51% of the cases the divergence between the actual and predicted highest standard counts does not amount to more than 10% of the actual value; in 69% of the cases the difference does not exceed 20%. But there are a few cases of extreme discrepancy, the most glaring being for Gadag I of 1924-25 compared with 1926-27; the actual values of highest standard warp counts were 20's and 38's in these two seasons, whereas the prediction-formula for fibre-length would ascribe 22's for both seasons. The fibre-weight per inch is less highly correlated with the highest standard warp counts than is the fibre-length; and for the fibre-weight per inch it is only for about 33% of the cases that the divergence between the actual and predicted highest standard warp counts does not amount to more than 10% of the actual value. Nor does the fibre-weight per inch enable us to account for the exceptional case of Gadag I referred to above, for in this case the prediction-formula ascribes 32's for the actual 20's of 1924-25, and 29's for the actual 38's of 1926-27.

From Tables I and II of Appendix IV it is found that when both fibre-length and fibre-weight per inch are taken into consideration, the prediction-formula agrees with the actual results within 10% in 44% of the cases, and within 20% in 76% of the cases. No better results are obtained when either fibre-strength or fibre-width is included in addition; even when all six fibre-properties are considered together, the result is not much better than when only fibre-length and fibre-weight per inch are considered—or even fibre-length alone—the prediction-formula in this case agreeing with the actual results to within 10% in 49% of the cases and to within 20% in 80% of the cases. A slightly closer agreement is given by the results for the 45 samples of Series II, when seven fibre-properties are considered, as in this case the prediction-formula agrees with the actual results to within 10% in 53% of the cases, and to within 20% in 96% of the cases.

The results for Series I samples are summarised, with others, in the following table showing the percentages of samples of which the actual highest standard warp counts are within 10% and 20%, respectively, of the values obtained by means of the various prediction-formulæ, derived either for a single fibre-property, or for two or more fibre-properties together; as a basis of comparison, a similar calculation has been made to determine the percentages of samples for which the actual highest standard warp counts do not differ from the grand mean highest standard warp count by more than 10% and 20%, and these percentages are shown in the bottom line of the table as derived from "no formula."

Predicted Values derived from Prediction-Formula for—	Percentage of Samples for which the actual Highest Standard Warp Count does not differ from the Predicted by more than—	
	10%	20%
Length only	51	69
Weight per inch only	33	53
Length and Weight per inch	44	76
Length, Weight per inch, and Strength	44	75
All six fibre-properties	49	80
No Formula	18	29

From this Table it is again clear that the formula for "fibre-length only" is decidedly more accurate than that for "fibre-weight per inch only"; that the formula for length and weight per inch together is rather better than that for length alone (but only for the 20% level); and that the formula for all six fibre-properties is only slightly more accurate than that for length and weight per inch together. All the prediction-formulæ give much better results than using "no formula."

The question arises whether the differences in accuracy between the various prediction-formulæ are statistically significant. We can test this by means of the multiple correlation coefficients between highest standard warp counts and the several prediction-formulæ, for, as already pointed out (page T15), the multiple correlation coefficient for any prediction-formula also indicates the degree of correlation between the actual values of the highest standard warp counts and those predicted by the formula. The method of calculation of the multiple correlation coefficients is given in Appendix I (page T36); the total correlations in the case of the single properties of length and weight per inch, and the multiple correlation coefficients in the case of combinations of properties are as follows—

Predicted Values derived from Prediction-Formula for	Correlation Coefficient between Actual and Predicted Values of Highest Standard Warp Counts		Square of Correlation Coefficient in Column 2	
	r	R	r^2	R^2
Length only	0·87	—	·7569	—
Weight per inch only	−0·80	—	·6400	—
Length and Weight per inch (R′)	—	·9153	—	·8377
Length, Weight per inch, and Strength (R″)	—	·9175	—	·8418
All six properties	—	·9285	—	·8622

The squares of the values of the correlation coefficients show that 64% of the variation in spinning-value can be accounted for in terms of the total correlation with weight per inch alone, whereas 76% is accounted for in terms of the total correlation with fibre-length alone; when fibre-length and fibre-weight per inch are taken together, 84% of the variation in spinning-value can be accounted for, and no improvement is obtained by including fibre-strength also; with all six fibre-properties included there is a slight improvement, 86% of the variation in spinning-value being then accounted for, leaving 14% to be accounted for otherwise. Applying the tests of statistical significance to these correlation coefficients, we find all the differences between them are in fact statistically significant except the difference between R′ and R″, which is of course only to be expected from the fact that the inclusion of fibre-strength makes practically no difference to the accuracy of prediction obtained with the two properties of length and weight per inch together. Even the slight improvement obtained with all six fibre-properties compared with length and weight per inch together, is statistically significant, as it would be expected to happen by chance less than 1 in 100 times. But while the determination of four more fibre-properties does thus appear to lead to a real gain in accuracy of prediction of the spinning-value, yet, as previously indicated, the gain is so small that it cannot be considered worth the extra labour that it entails.

Anomalies—The fact that the actual and calculated spinning-values differ by more than 20% in 19 of the 95 cases with six fibre-properties and in 2 of the 45 cases with seven fibre-properties, shows that there remain many anomalies even when so many fibre-properties are taken into consideration. The two anomalous cases with seven fibre-properties are both of Gadag I, viz. 1924-25 and 1926-27 (Table II); the prediction-formula ascribes 28's counts to each cotton, whereas the former was actually found to be suitable for 20's and the latter for 38's. And if the properties of the two samples be compared in detail, it is very difficult to account for the difference in spinning-value; indeed, they have practically the same mean fibre-length, and it is the sample having a much lower hair-weight that has the inferior spinning-value. It is very interesting, however, to note that the cotton grader, when valuing the 1924-25 sample, considered it to be "inferior to 1923-24 sample and not a fair sample of Gadag cotton."

The same cotton presents other anomalies; thus the sample of 1926-27 may also be compared with sample B of 1927-28; the two samples have practically the same mean length, hair-weight, ribbon-width, and convolutions, but sample B has 15% greater fibre-strength, 18% greater fibre-rigidity, and 9% less clinging-power—and yet spins only up to 24's as against the 38's of the 1926-27 sample. Again, the 1928-29 sample closely resembles the 1926-27 sample in all fibre-properties, and yet spins only up to 26's as against 38's.

Even more anomalies are apparent when the six fibre-properties of the 95 samples are considered. Some occur among the low-count cottons, and may be partly attributed to the large effect of a difference of a single unit of counts at such low counts and to the assignment of counts being in integral values only. Gadag I is again responsible for a number of anomalies; another marked anomaly is presented by Punjab-American 285F in seasons 1925-26 and 1929-30. Most of the fibre-properties are almost identical in these two seasons and the prediction-formula assigns the same count to each, viz. 35's, though actually the 1925-26 sample was found suitable for 28's and the 1929-30 sample for 42's. In this case it is just possible that the difference is due to a difference in fibre-strength, as the 1929-30 sample is some 9% stronger—though, as the prediction-formula for six fibre-properties shows, such a difference in the fibre-strength does not in other cases lead to such a difference in the spinning-value.

Many other similar, if less conspicuous, anomalies might be pointed out. The existence of such anomalies demands an explanation. The difficulty, however, lies rather in deciding between a number of possible alternative explanations, to which reference may now be made.

In the first place, in the mathematical treatment it is assumed that the highest standard warp count is related linearly to each of the fibre-properties, and this is certainly not so for the properties of fibre-strength and fibre-rigidity.

Secondly, all the correlation coefficients that have been used in obtaining the multiple regression equation have been calculated from only the average values of the fibre-properties of the various cotton samples; but although the average values of any fibre-property may be the same for two cottons, the variabilities of the properties may be different, and these may contribute to a difference in spinning-value.

Thirdly, if reliance be placed on the regression equation for only the two properties of fibre-length and fibre-weight per inch (page T33), it may happen that two cottons have the same mean fibre-length and the same mean fibre-weight per inch, so that the prediction-formula would ascribe to them the same highest standard warp counts; and yet one may have a large diameter with a thin cell-wall, and the other a small diameter with a thick cell-wall—

differences of a fundamental kind that could hardly leave the spinning value unaffected. It is to distinguish such cases that a test for immaturity is most valuable.

Fourthly, the cotton fibres of the yarn are not exactly those that comprised the raw cotton, as in the various preparatory processes of spinning some lint is removed as waste, having a rather shorter mean length than the raw cotton, and other fibre-properties also are slightly different. Yet the raw cotton must be used in the determination of fibre-properties when these are required for the prediction of spinning-value. However, tests on this point have shown that the differences in fibre-properties between the yarn and the raw cotton are not serious, so that they may be regarded as merged in the errors of experiment and sampling.

Fifthly, although the value for the fibre-strength of any of the samples tested is an average that has been obtained by the testing of 600 fibres individually, it is not the same kind of average as the average values for fibre-length or fibre-weight per inch, for it merely represents the average strength of the weakest points in the 600 fibres; and most parts of any fibre are at least three or four times as strong as its weakest point.[27] But when fibres are twisted together to form yarn, the useful strength of a fibre may be decidedly higher than that of its weakest point; hence, not only the variability of strength from fibre to fibre, but also the degree of regularity of strength along each individual fibre may have considerable effect upon the yarn strength and the spinning-value of the cotton. This affords another reason, beside those given on page T25, for not making further determinations of fibre-strength on individual fibres; at the same time, it provides a reason for making some tests on the strength of twisted bundles of fibres.

It is possible that some of the anomalous results could be explained if data were available about the fibre-strength of twisted bundles and the degree of immaturity of the cottons, and if the degrees of irregularity of fibre-length and fibre-weight per inch were also taken into consideration. In any case it is evident that the investigation of these anomalous cases presents most hope of arriving at a solution of the main problem, so far as this is possible along the lines discussed in the present paper.

APPENDIX I

Note on the Use of the Method of Correlation for Finding a Prediction-Formula in Terms of Fibre-Properties

The general meaning of correlation, and the explanation of the correlation coefficient as a mathematical index of the degree of correlation, have already been given (page T12). The correlation coefficient between two variables X_1 and X_2 is written r_{12}, and its value is given by the formula $r_{12} = \frac{\Sigma x_1 x_2}{N\sigma_1\sigma_2}$, where σ_1 and σ_2 are the standard deviations of X_1 and X_2, N is the number of pairs of observations of X_1 and X_2, and x_1, x_2 are the deviations of the individual observations from their arithmetic means.* Standard deviation, mean, etc., have been defined in a previous Bulletin.[28]

For the purposes of the present paper, the correlation coefficients have been calculated by the direct application of this formula, this being the simplest

*It may be noted that, throughout, the notation adopted is to use capital letters such as X_1 to indicate observation values, and small italic letters with the same subscripts, such as x_1, to indicate the corresponding deviations of the individual observations from their arithmetic means.

procedure when the number of observations is comparatively small. These correlation coefficients have been obtained not only between the spinning value and the several fibre-properties but also between the various pairs of fibre-properties, as these are needed in subsequent calculations. For the 95 samples of Series I, with six measured fibre-properties, there are 21 of these correlation coefficients; for the 45 samples of Series II, with seven measured fibre-properties, there are 28 of these correlation coefficients. These correlation coefficients are given in column 1 of the Tables of Appendix V.

Table I

Fibre-length Class-intervals ...		0·66-0·69	0·70-0·73	0·74-0·77	0·78-0·81	0·82-0·85	0·86-0·89	0·90-0·93	0·94-0·97	0·98-1·01	Totals of Frequency rows	Mean lengths
Mid-points of Length Class-intervals ...		0·675	0·715	0·755	0·795	0·835	0·875	0·915	0·955	0·995		
Counts Class-intervals	Mid-points of Counts Class-intervals											
5- 8	6·5	5	3	—	—	—	—	—	—	—	8	0·690
9-12	10·5	—	2	3	1	—	—	—	—	—	6	0·748
13-16	14·5	—	—	5	4	2	—	—	—	—	11	0·784
17-20	18·5	—	—	—	4	—	—	—	—	—	4	0·795
21-24	22·5	—	—	—	5	7	—	—	—	—	12	0·818
25-28	26·5	—	—	1	1	4	2	2	—	—	10	0·847
29-32	30·5	—	—	—	—	2	6	6	3	1	18	0·904
33-36	34·5	—	—	—	—	1	9	5	1	—	16	0·890
37-40	38·5	—	—	—	1	—	2	1	4	—	8	0·910
41-44	42·5	—	—	—	—	—	—	1	—	1	2	0·955
Totals of Frequency-columns		5	5	9	16	16	19	15	8	2	95	—
Mean Counts		6·5	8·1	14·5	20·0	24·2	32·8	32·6	35·0	36·5	—	—

When the number of pairs of observations is at all large, the direct method of calculating the correlation coefficient becomes very laborious, and another method, depending on the grouping of the individual observations into definite classes, is used instead. And as this method throws further light on the correlation coefficient and its use in forecasting formulæ, its application to a simple case will now be explained. For this purpose reference may be made to Table I, in which are classified the results for the mean fibre-lengths and the corresponding highest standard warp counts for the 95 samples of Series I. It will be observed that each sample is classified for both properties at the same time, as the different columns represent different class-intervals of fibre-length, and the different rows represent different class-intervals of highest standard warp counts; and any particular entry in the table represents the number of samples falling in the class interval for fibre-length at the head of the column and also in the class-interval for highest standard warp counts at the left-hand side of the row. The total numbers of samples falling in the different "counts class-intervals" irrespective of their fibre-lengths, are shown in the second column from the right; the mean fibre-lengths for these several totals are given in the column on the extreme right. Similar results are shown in the two bottom rows for the total numbers of samples falling in the different "length class-intervals," and the corresponding mean counts for the several totals.

It will be noted that there are no entries falling in the top right and bottom left regions of Table I, and that all the entries fall, so to speak, near a line running from the top left to the bottom right-hand corner. This fact itself indicates that there is high correlation between fibre-length and the highest standard warp counts, short length being associated with low counts and greater length with higher counts. Moreover, as indicated on page T13, we may show these results graphically by plotting (1) the values of mean fibre-length (column 13) against the mid-points of the counts class-intervals (column 2); and (2) the values of mean counts (row 14) against the mid-points of the length class-intervals (row 2). If lines are drawn to join the plotted points, the line for (1) is the *regression line* of length on counts, and that for (2) is the *regression line* of counts on strength. Only in cases of perfect correlation are these lines coincident with one another. The lines are plotted in Fig. 1, from which it is again clear that the lines do nearly coincide, showing that the correlation between fibre-length and highest standard warp counts is very high. We may replace the lines joining the actual points by a single straight line for each regression line, drawn so as to give the best fit to the points. The equations to these straight lines of best fit are known as *regression equations*; and if x_1 represents the average value of highest standard warp counts for a given value x_2 of fibre-length, the regression of highest standard warp counts on fibre-length is given by the regression equation

$$x_1 = r_{12}\frac{\sigma_1}{\sigma_2}\cdot x_2{}^* \qquad \text{(1)}$$

as explained on page T13, when the highest standard warp counts and the fibre-lengths are measured from their mean values. Similarly the regression of fibre-length on highest standard warp counts is given by the regression equation

$$x_2 = r_{12}\cdot\frac{\sigma_2}{\sigma_1}\cdot x_1 \qquad \text{(2)}$$

The coefficients $r_{12}\cdot\frac{\sigma_1}{\sigma_2}$ and $r_{12}\cdot\frac{\sigma_2}{\sigma_1}$ in regression equations (1) and (2) above, are known as *regression coefficients*, as they respectively measure the regression of x_1 on x_2, and x_2 on x_1.

As the practical problem before us is the prediction of the highest standard warp counts from the fibre-properties, we shall obviously need only the regression equation (1) for this purpose.

One further point may be noted. The regression equations above apply when the highest standard warp counts and the fibre-lengths are measured from their *mean* values, i.e. x_1 and x_2 represent differences between the direct observational values and the respective mean values; thus if X_1 and X_2 are corresponding actual observational values, M_1 and M_2 the respective means, $x_1 = (X_1 - M_1)$, and $x_2 = (X_2 - M_2)$, so that the regression equation (1) may also be written

$$(X_1 - M_1) = r_{12}\cdot\frac{\sigma_1}{\sigma_2}\,(X_2 - M_2)$$

* This equation is really identical with the similar equation given on page T13. r_{12} here indicates the correlation between X_1 (i.e. property 1) and X_2 (i.e. property 2); the subscript "12" of r is therefore to be read as "one, two," not as "twelve."

In the case of the 95 samples of Series I, the average value of the highest standard warp counts, M_1, is 25, and the average value of all the fibre-lengths, M_2, is 0·84. Also, $r_{12} = 0{\cdot}87$, $\sigma_1 = 9{\cdot}7$, $\sigma_2 = 0{\cdot}078$.

$$\therefore (X_1 - 25) = 0{\cdot}87 \times \frac{9{\cdot}7}{0{\cdot}078} (X_2 - 0{\cdot}84)$$

$$\therefore X_1 = 108{\cdot}2\, X_2 - 65{\cdot}7.$$

By substituting any observed value of fibre-length on the right-hand side of this equation, we may calculate the corresponding predicted value for the highest standard warp count. Similar equations are given below for the prediction of highest standard warp counts from any one of the other measured fibre-properties, both for the samples of Series I and Series II. It should be noted that for the sake of simplicity and convenience in the subsequent treatment we shall frequently indicate the various properties merely by numerals, as follows—

1 = highest standard warp counts,
2 = fibre-length,
3 = fibre-weight per inch,
4 = fibre-width,
5 = fibre-strength,
6 = fibre-convolutions per inch,
7 = fibre-rigidity,
8 = fibre clinging-power.

Fibre-property	Regression Equation Series I	Series II
2—Length (X_2)	$X_1 = 108{\cdot}2X_2 - 65{\cdot}7$	$X_1 = 96{\cdot}7X_2 - 55{\cdot}2$
3—Weight per inch (X_3) ...	$X_1 = 57{\cdot}2 - 164{\cdot}1X_3$	$X_1 = 56{\cdot}3 - 158{\cdot}1X_3$
4—Width (X_4)	$X_1 = 100{\cdot}9 - 111{\cdot}6X_4$	$X_1 = 107{\cdot}2 - 120X_4$
5—Strength (X_5)	$X_1 = 41{\cdot}9 - 106{\cdot}7X_5$	$X_1 = 39{\cdot}2 - 78X_5$
6—Convolutions (X_6) ...	$X_1 = 10{\cdot}3 + 0{\cdot}165X_6$	$X_1 = 12{\cdot}6 + 0{\cdot}162X_6$
7—Rigidity (X_7)	$X_1 = 36{\cdot}9 - 63{\cdot}1X_7$	$X_1 = 37{\cdot}0 - 61{\cdot}5X_7$
8—Clinging-power (X_8) ...	—	$X_1 = 66{\cdot}3 - 130{\cdot}7X_8$

1—Highest Standard Warp Counts (X_1).

It may be noted that the equations are very nearly the same for Series I and Series II, and may be taken as applying generally to Indian cottons. But, as already pointed out, they sometimes give very divergent results when used as forecasting formulæ. Further, some curious consequences of these equations may be noted, arising from the fact that as no fibre-property can have a negative value, its minimum value is evidently zero. In all those equations in which a negative sign precedes the term in which the value for the fibre-property is to be substituted, there is necessarily a maximum limit set to the highest standard warp counts, this maximum being the constant in the equation. It follows that these equations could not predict a higher standard warp count than 57 from fibre-weight (X_3), 101 from ribbon-width (X_4), 42 from fibre-strength (X_5), and 37 from fibre-rigidity (X_7).

We now proceed to the case when all the fibre-properties are taken into consideration at the same time. When n variables, say $X_1, X_2, X_3, \ldots X_n$ are considered, the correlation between X_1 and X_2 when the remaining variables $X_3, X_4, \ldots X_n$ are kept constant (or when changes in these variables are allowed for, so far as this may be done in a linear equation) is termed the *partial correlation coefficient*, which is symbolically represented by $r_{12\cdot34\cdots n}$*.

*This is merely a shorthand method of indicating the correlation between properties 1 and 2 when all the other properties, 3, 4, ... up to n remain constant; and just as the subscript of r_{12} is read as "one, two" (page T29, footnote) so the subscript of $r_{12\cdot34\ldots\ldots n}$ is read as "one, two, point three, four, ... upto n."

As indicated on page T14, the linear equation for predicting the highest standard warp counts from any number (n) of fibre-properties considered together is given by—

$$x_1 = b_2 x_2 + b_3 x_3 + \ldots + b_n x_n \quad \ldots\ldots\ldots\ldots(3)$$

where $b_2, b_3, \ldots b_n$ are the *partial regression coefficients* (page T14), and $x_1, x_2, x_3, \ldots x_n$ are the values of the fibre-properties measured from their mean values, or, in other words, the deviations of the corresponding actual observational values $X_1, X_2, X_3, \ldots X_n$ from their respective arithmetic means. If any one of the coefficients, say b_2, has a positive value, it indicates that there is a positive correlation between X_1 and X_2 which is not affected by any correlation of X_1 and X_2 with $X_3, \ldots X_n$, as the effects of the changes in these properties are allowed for in the remaining terms of the right hand side of the equation. Moreover, the coefficient b_2 measures the mean change in X_1 for a unit change in X_2 when all the other properties remain constant; it is for this reason that b_2 is termed the partial regression coefficient of X_1 on X_2. There are various methods of determining the partial regression coefficients; as we are also interested to know the partial correlation coefficients, we have used first the method given by Yule[29] for this purpose, which entails the use of the partial correlation coefficients in the determination of the partial regression coefficients.

The regression equation can therefore be put in the form—

$$x_1 = b_{12\cdot34\ldots\ldots n}x_2 + b_{13\cdot24\ldots\ldots n}x_3 + \ldots\ldots + b_{1n\cdot23\ldots(n-1)}x_n \quad \ldots\ldots\ldots(4)$$

where $b_{12\cdot34\ldots\ldots n}$ is the partial regression of x_1 on x_2, when all the properties are considered together, with similar meanings attached to the other coefficients.

It is shown in Yule's "Statistics"[30] that, if we choose the coefficients in equation (4) so as to make it one of best fit to the data, $b_{12\cdot34\ldots\ldots n}$ is given in terms of the partial correlation coefficient and the standard errors of estimate by the following equation—

$$b_{12\cdot34\ldots\ldots n} = r_{12\cdot34\ldots\ldots n}\frac{\sigma_{1\cdot34\ldots\ldots n}}{\sigma_{2\cdot34\ldots\ldots n}} \quad \ldots\ldots\ldots\ldots(5)$$

$r_{12\cdot34\ldots\ldots n}$ is called the partial correlation coefficient of the $(n-2)$th order, since it has $(n-2)$ secondary subscripts, i.e. subscripts after the point; thus, as r_{12} has no secondary subscripts, it can be termed a partial correlation coefficient of zero order, which is thus identical with the total correlation coefficient. Relations similar to (5) hold for the coefficients of $x_3, x_4, \ldots\ldots x_n$, in equation (4).

It is also shown in Yule's "Statistics"[31] that the following equation connects partial correlation coefficients of different orders, and so enables the partial correlation coefficient of any particular order $(n-2)$, to be calculated from partial correlation coefficients of the next lower $(n-3)$th order—

$$r_{12\cdot34\ldots\ldots n} = \frac{r_{12\cdot34\ldots\ldots(n-1)} - r_{1n\cdot34\ldots\ldots(n-1)}\cdot r_{2n\cdot34\ldots\ldots(n-1)}}{(1-r^2_{1n\cdot34\ldots\ldots(n-1)})^{\frac{1}{2}}(1-r^2_{2n\cdot34\ldots\ldots(n-1)})^{\frac{1}{2}}} \quad \ldots\ldots\ldots\ldots(6)$$

The partial correlation coefficient of $(n-3)$th order may be obtained from those of $(n-4)$th order by a similar equation, and so on, so that ultimately the partial correlation coefficients of the highest $(n-2)$th order may be connected with those of the lowest, i.e. zero order.

Reference has been made above to the standard errors of estimate; these also may be calculated from the standard deviations of the original observations and from the partial correlation coefficients by means of equations of the following type[32]—

$$\sigma^2_{1\cdot23\ldots\ldots n}=\sigma^2_1(1-r^2_{12})(1-r^2_{13\cdot2})(1-r^2_{14\cdot23})\ldots(1-r^2_{1n\cdot23\ldots\ldots(n-1)}) \quad \ldots\ldots(7)$$

Hence, by using the total correlation coefficients we may calculate the partial correlation coefficients of higher order in succession, and use these as required for determining the standard errors of estimate by the application of equation (7), and finally determine the partial regression coefficients by the application of equation (5).

The application of these formulæ is illustrated by the following example giving the steps in the solution of the problem of predicting the highest standard warp counts from the seven fibre-properties of Series II, represented as before by the numerals 2, 3, 4, 5, 6, 7, 8, the highest standard warp count itself being represented by the numeral 1.

In the first place, the regression equation itself becomes, for $n=8$ in equation (4), page T31—

$$x_1=b_{12\cdot345678}x_2+b_{13\cdot245678}x_3+\ldots\ldots+b_{17\cdot234568}x_7+b_{18\cdot234567}x_8 \quad \ldots\ldots\ldots\ldots(8)$$

The partial regression coefficients are obtained from type-equation (5), page T31, as follows—

$$b_{12\cdot345678}=r_{12\cdot345678}\frac{\sigma_{1\cdot345678}}{\sigma_{2\cdot345678}} \quad \ldots\ldots\ldots\ldots(9)$$

$$b_{13\cdot245678}=r_{13\cdot245678}\frac{\sigma_{1\cdot245678}}{\sigma_{3\cdot245678}} \quad \ldots\ldots\ldots\ldots(10)$$

....

$$b_{17\cdot234568}=r_{17\cdot234568}\frac{\sigma_{1\cdot234568}}{\sigma_{7\cdot234568}} \quad \ldots\ldots\ldots\ldots(11)$$

$$b_{18\cdot234567}=r_{18\cdot234567}\frac{\sigma_{1\cdot234567}}{\sigma_{8\cdot234567}} \quad \ldots\ldots\ldots\ldots(12)$$

The partial correlation coefficients of the sixth order in equations (9) to (12) are evaluated by repeated application of the type-equations (6), thus the partial correlation coefficient of equation (9)—

$$r_{12\cdot345678}=\frac{r_{12\cdot34567}-r_{18\cdot34567}\cdot r_{28\cdot34567}}{(1-r^2_{18\cdot34567})^{\frac{1}{2}}(1-r^2_{28\cdot34567})^{\frac{1}{2}}} \quad \ldots\ldots\ldots\ldots(13)$$

and repeated application of type-equation (6) similarly enables the partial correlation coefficients of fifth order in type-equation (13) to be expressed in terms of partial correlation coefficients of fourth order, thus

$r_{12\cdot34567}$	is expressed in terms of	$r_{12\cdot3456}$, $r_{17\cdot3456}$,	and $r_{27\cdot3456}$
$r_{18\cdot34567}$	,, ,,	$r_{18\cdot3456}$, $r_{17\cdot3456}$,	and $r_{87\cdot3456}$
$r_{28\cdot34567}$	,, ,,	$r_{28\cdot3456}$, $r_{27\cdot3456}$,	and $r_{87\cdot3456}$

These fourth order partial correlation coefficients are similarly derived from third order partial correlation coefficients, the third order similarly from the second, the second order similarly from the first, and finally the first order from the zero order or total correlations. By working backwards in this way it is possible to pick out (and evaluate) just those partial correlation coefficients of each order that are ultimately necessary for the evaluation of the seven partial correlation coefficients of the sixth order appearing in equations (9) to (12).

The values of the σ's in equations (9) to (12) for the partial regression coefficients, are determined by the application of type-equation (7), page T32, from which we get

$$\sigma_{1\cdot345678} = \sigma_1(1-r^2_{13})^{\frac{1}{2}}(1-r^2_{14\cdot3})^{\frac{1}{2}}(1-r^2_{15\cdot34})^{\frac{1}{2}}(1-r^2_{16\cdot345})^{\frac{1}{2}}(1-r^2_{17\cdot3456})^{\frac{1}{2}}(1-r^2_{18\cdot34567})^{\frac{1}{2}}$$

$$\sigma_{2\cdot345678} = \sigma_2(1-r^2_{23})^{\frac{1}{2}}(1-r^2_{24\cdot3})^{\frac{1}{2}}(1-r^2_{25\cdot34})^{\frac{1}{2}}(1-r^2_{26\cdot345})^{\frac{1}{2}}(1-r^2_{27\cdot3456})^{\frac{1}{2}}(1-r^2_{28\cdot34567})^{\frac{1}{2}}$$

$$\sigma_{3\cdot245678} = \sigma_3(1-r^2_{32})^{\frac{1}{2}}(1-r^2_{34\cdot2})^{\frac{1}{2}}(1-r^2_{35\cdot24})^{\frac{1}{2}}(1-r^2_{36\cdot245})^{\frac{1}{2}}(1-r^2_{37\cdot2456})^{\frac{1}{2}}(1-r^2_{38\cdot24567})^{\frac{1}{2}}$$

....

$$\sigma_{7\cdot234568} = \sigma_7(1-r^2_{72})^{\frac{1}{2}}(1-r^2_{73\cdot2})^{\frac{1}{2}}(1-r^2_{74\cdot23})^{\frac{1}{2}}(1-r^2_{75\cdot234})^{\frac{1}{2}}(1-r^2_{76\cdot2345})^{\frac{1}{2}}(1-r^2_{78\cdot23456})^{\frac{1}{2}}$$

$$\sigma_{8\cdot234567} = \sigma_8(1-r^2_{82})^{\frac{1}{2}}(1-r^2_{83\cdot2})^{\frac{1}{2}}(1-r^2_{84\cdot23})^{\frac{1}{2}}(1-r^2_{85\cdot234})^{\frac{1}{2}}(1-r^2_{86\cdot2345})^{\frac{1}{2}}(1-r^2_{87\cdot23456})^{\frac{1}{2}}$$

The values of the different partial correlation coefficients that have been evaluated from the 45 sets of values of the fibre-properties of the Series II samples, in order to obtain the values of the seven regression coefficients of equation (8), are given in Appendix V, Table II. Similarly, Table I of Appendix V gives the values of the partial correlation coefficients evaluated from the 95 sets of values of the fibre-properties of Series I and used in obtaining the six partial regression coefficients necessary for the corresponding regression equation of this series.

The two regression equations thus obtained are, in terms of deviations from the respective means—

For Series I: $x_1 = 71{\cdot}6x_2 - 70{\cdot}8x_3 - 20{\cdot}8x_4 + 17{\cdot}9x_5 + 0{\cdot}037x_6 + 4{\cdot}4x_7$.

For Series II: $x_1 = 42{\cdot}7x_2 - 66{\cdot}4x_3 - 49{\cdot}3x_4 - 18{\cdot}7x_5 + 0{\cdot}0277x_6 + 21{\cdot}8x_7 - 26{\cdot}2x_8$

When the actual observational values (X_1, X_2, X_3, X_4,.........X_8) for the fibre-properties are used for direct substitution in the regression equations, as on page T15, these become

For Series I:

$$X_1 = 71{\cdot}6X_2 - 70{\cdot}8X_3 - 20{\cdot}8X_4 + 17{\cdot}9X_5 + 0{\cdot}037X_6 + 4{\cdot}4X_7 - 14{\cdot}1 \quad \text{.........(14)}$$

For Series II:

$$X_1 = 42{\cdot}7X_2 - 66{\cdot}4X_3 - 49{\cdot}3X_4 - 18{\cdot}7X_5 + 0{\cdot}0277X_6 + 21{\cdot}8X_7 - 26{\cdot}2X_8 + 39{\cdot}5 \quad (15)$$

Similar regression equations were calculated omitting from consideration some of the measured fibre-properties; these equations were

For counts (X_1), fibre-length (X_2), and fibre-weight per inch (X_3)—

Series I: $X_1 = 75{\cdot}4[\pm10{\cdot}8]X_2 - 79{\cdot}5[\pm14{\cdot}8]X_3 - 22{\cdot}8$ .... (16)

Series II: $X_1 = 54{\cdot}8X_2 - 110{\cdot}9X_3 + 0{\cdot}7$..(17)

For counts (X_1), fibre-length (X_2), fibre-weight per inch (X_3), and fibre-strength (X_5)—

Series I: $X_1 = 72{\cdot}5[\pm10{\cdot}7]X_2 - 93{\cdot}3[\pm17{\cdot}9]X_3 + 26{\cdot}7[\pm17{\cdot}8]X_5 - 21{\cdot}8$ (18)

For counts (X_1), fibre-length (X_2), fibre-weight per inch (X_3), and ribbon-width (X_4)—

Series I: $X_1 = 72{\cdot}2X_2 - 61{\cdot}9X_3 - 23{\cdot}9X_4 - 7{\cdot}2$ ....(19)

For counts (X_1), fibre-length (X_2), fibre-weight per inch (X_3), ribbon-width (X_4), and clinging-power (X_8)—

Series II: $X_1 = 48{\cdot}6X_2 - 58{\cdot}3X_3 - 50{\cdot}1X_4 - 35{\cdot}4X_8 + 40{\cdot}1$ ....(20)

The spinning-values predicted for the various cottons by these different formulæ are shown in Appendix IV. The extent to which the predicted values agree with the actual spinning-values has already been discussed on pages T23 and T24.

As mentioned on page T22, in order to test the statistical significance of the partial regression coefficients in the prediction formula for Series I, the standard errors of these coefficients were calculated; the standard errors of the partial regression coefficients of equation (14)—the complete equation for Series I—have already been discussed (page T22). The formula[33] for calculating the standard error of a partial regression coefficient $b_{12\cdot k}$ for a normal distribution is $\frac{\sigma_{1\cdot 2k}}{\sigma_{2\cdot k}\sqrt{n}}$*, where k denotes any collection of secondary subscripts other than 1 or 2. For example, the coefficient of X_2 in equation (4) applied to Series I is $b_{12\cdot 34567}$, so that its standard error is $\frac{\sigma_{1\cdot 234567}}{\sigma_{2\cdot 34567}\sqrt{n}}$, the value of which is obtained by applying type-equation (7).

The standard errors of the partial regression coefficients have also been calculated for the prediction equations (16) and (18) relating to the Series I samples; in these cases the standard errors are shown in brackets immediately following the partial regression coefficients to which they relate. It will be observed that in equation (16) the partial regression coefficients of fibre-length (X_2) and fibre-weight per inch (X_3) are respectively 7·0 and 5·4 times as large as their standard errors, so that both coefficients are statistically significant. The same is true for the partial regression coefficients of these properties in equation (18), but in this case the additional term for fibre-strength (X_5) has a partial regression coefficient which is only 1·5 times its standard error, and so is not statistically significant, even if we only apply our less stringent test of significance that the coefficient must be at least twice as large as its standard error (page T22).

It is interesting to note that the partial regression coefficient for fibre-strength (X_5) is positive in equation (14) Series I), and negative in equation (15) (Series II), as a consequence of the corresponding partial correlation coefficients being respectively positive and negative. Reference to Appendix V shows that the total correlation coefficients between highest standard warp counts and fibre-strength are both negative; the first order coefficients, eliminating fibre-length, are likewise both negative; but the second order coefficients, eliminating also fibre-weight per inch, are both positive; when ribbon-width and convolutions are also eliminated, the coefficients remain positive; but whereas the elimination also of fibre-rigidity leaves the fifth order coefficient still positive in Series I, it causes the coefficient in Series II to become negative, and to remain so for the sixth order coefficient with clinging-power also eliminated. At the same time it should be remarked that none of these partial correlation coefficients for fibre-strength which are of higher order than the first can be regarded as statistically significant (page T22).

In only one other case is the sign of the partial regression coefficient opposite to that of the corresponding *total* correlation coefficient, viz. for the fibre-rigidity (X_7), which, for both Series I and Series II, has negative total correlation coefficients but positive partial regression coefficients in equations

* In applying this formula n has been taken as $(n'-p-1)$, where $n'=$ the number of sets of observations and $p=$ the number of independent variables, so that for the Series I samples, where $n'=95$, $p=6$, we have $n=88$.

(14) and (15). The change occurs when the fibre-weight per inch is eliminated, resulting in the second and all higher order partial correlation coefficients being negative—the change arising partly from the strong positive correlation between fibre-rigidity and fibre-weight per inch.

It was stated on page T31 that the partial regression coefficients in equation (4) are so chosen as to make it one of best fit to the data. The method used for doing this is technically known as the "Method of Least Squares" because the test adopted of "best fit" is that the sum of the squares of the differences between the observed values of X_1 and those calculated from the right-hand side of the regression equation, shall be a minimum. Now the method already described for determining the values of the coefficients of the regression equation necessitates very heavy arithmetical work, chiefly in the calculation of the partial correlation coefficients. These partial correlation coefficients have an intrinsic interest in the present case, and have already been discussed. But shorter methods, also based on the "Method of Least Squares" but not necessitating the calculation of the partial correlation coefficients, are available for the calculation of the partial regression coefficients of the prediction formula, and these methods have therefore been employed as a check.

The first check method is that given by Kelley,[34] who gives the generalised regression equation (4) in terms of the variables themselves—as in equation (14)—instead of in terms of the deviations, as in equation (4). This generalised equation is—

$$X_1 = b_{12\cdot 34.....n}X_2 + b_{13\cdot 24.....n}X_3 + \ldots + b_{1n\cdot 23\cdots(n-1)}X_n + C \quad \ldots\ldots (21)$$

Instead of expressing the partial regression coefficients in terms of the partial correlation coefficients, Kelley has introduced a series of "beta" coefficients which are in effect defined by the following relation[35]—

$$b_{12\cdot 34.....n} = \beta_{12\cdot 34.....n}\frac{\sigma_1}{\sigma_2} \text{ etc.} \quad \ldots\ldots (22)$$

In equation (21)

$$C = M_1 - b_{12\cdot 34....n}M_2 - b_{13\cdot 24....n}M_3 - \ldots - b_{1n\cdot 23....(n-1)}M_n \quad \ldots\ldots (23)$$

where M_1, M_2, M_3, M_n are the mean-values of the several variables X_1, X_2, X_3, ...X_n. A β of any order, $\beta_{12\cdot 34....n}$, can be connected with a β of lower order by means of the relation[36]—

$$\beta_{12\cdot 34....n} = \frac{\beta_{12\cdot 4....n} - \beta_{13\cdot 4....n}\beta_{32\cdot 4....n}}{1 - \beta_{23\cdot 4....n}\beta_{32\cdot 4....n}} \quad \ldots\ldots (24)$$

the β's on the right-hand side being connected with β's of still lower order by repeated application of the same relation, until all the β's are connected with β's of the first order. The β's of the first order are calculated from the total correlation coefficients by means of the relation[37]—

$$\beta_{12\cdot 3} = \frac{r_{12} - r_{13}r_{23}}{1 - r^2_{23}} \quad \ldots\ldots (25)$$

Having obtained the values of all the β's by the application of equations (24) and (25), we obtain the values of the partial regression coefficients by the application of equation (22), and thence the value of C from equation (23). As already indicated, the arithmetical work by this method is decidedly less than by the previous method.

The second check method[38] is still less onerous in its arithmetical demands. If we take the regression equation (3) as for six fibre-properties (Series I)

$$x_1 = b_2x_2+b_3x_3+b_4x_4+b_5x_5+b_6x_6+b_7x_7 \quad \text{.........................(26)}$$

the problem is to determine the best values of the six unknown constants $b_2, b_3, \ldots b_7$. This could be done if we had six sets of values of $x_1, x_2, \ldots x_7$, for we could them form six simultaneous equations which would be just sufficient for the complete solution of the equations, i.e. for the determination of $b_2, b_3, \ldots b_7$. Actually, however, in the case of the Series I samples we have 95 sets of values of $x_1, x_2, \ldots x_7$ available, from which we could make 95 equations to find the b's; we could of course choose six sets out of these 95 sets in many different ways, and the various selections of six sets would lead to different sets of values for the b's. As there is no justification for arbitrarily taking any particular selection of six sets, what is done in practice is to apply the "Method of Least Squares" to reduce the 95 equations to six, yet using all the data provided by the 95; these six equations so obtained are called the "normal equations"; by solving these equations the best values are obtained for the constants $b_2, b_3, \ldots b_7$ of the regression equation. These normal equations are as follows—

$$\left.\begin{array}{l} b_2\Sigma x^2_2+b_3\Sigma x_2x_3+\ldots\ldots+b_7\Sigma x_2x_7=\Sigma x_1x_2 \\ b_2\Sigma x_2x_3+b_3\Sigma x^2_3+\ldots\ldots+b_7\Sigma x_3x_7=\Sigma x_1x_3 \\ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \\ b_2\Sigma x_2x_6+b_3\Sigma x_3x_6+\ldots\ldots+b_7\Sigma x_6x_7 = \Sigma x_1x_6 \\ b_2\Sigma x_2x_7+b_3\Sigma x_3x_7+\ldots\ldots+b_7\Sigma x^2_7 = \Sigma x_1x_7 \end{array}\right\} \quad \text{....................(26)}$$

The method is of course perfectly general for any number of variables. Special methods for the solution of the normal equations are given in works on "Statistics".[38]

It may be noted that when the partial regression coefficients are calculated by this method, it is possible to utilise new data by combining it with the old data without the necessity of repeating all the arithmetical work.[39]

As previously mentioned, all three methods have been applied to the data of Series I and II, and all have led to the same regression equations to be used as prediction-formulæ.

Coefficient of Multiple Correlation—The partial correlation coefficients show how the highest standard warp count is correlated with each of the different fibre-properties separately, with the effect of any correlation between the other fibre-properties eliminated. Another useful statistical measure indicates the degree to which variations in the dependent variable (highest standard warp count) are related to the combined effect of the independent variables (fibre-properties); this statistical measure is known as the *coefficient of multiple correlation*, and is defined by the equation[40]—

$$R^2_{1\cdot 23\ldots n} = 1 - \frac{\sigma^2_{1\cdot 23\ldots n}}{\sigma^2_1} \quad \text{...(27)}$$

where $R_{1\cdot 23\ldots n}$ is the multiple correlation coefficient of the dependent variable 1 and the independent variables 2, 3,...n. The σ's have the same significance as in equation (7). The coefficient of multiple correlation can be expressed by the following equation purely in terms of the partial correlation coefficients when the first method is employed for calculating the regression equation[41]—

$$1-R^2_{1\cdot 23\ldots n}=(1-r^2_{12})(1-r^2_{13\cdot 2})(1-r^2_{14\cdot 23})\ldots(1-r^2_{1n\cdot 23\ldots(n\cdot 1)})\ldots\ldots(28)$$

and by the following equation when the third method is employed[42]—

$$R^2_{1\cdot 23\ldots n}=\frac{\{b_{12\cdot 34\ldots n}(\Sigma x_1x_2)+b_{13\cdot 24\ldots n}(\Sigma x_1x_3)+\ldots+b_{1n\cdot 23\ldots(n\cdot 1)}(\Sigma x_1x_n)\}}{\Sigma(x_1{}^2)} \qquad (29)$$

In the case of the present series of tests, the coefficient of multiple correlation for the highest standard warp counts was found to be—

0·93 for Series I (six fibre-properties),
0·91 for Series II (seven fibre-properties).

As the value of R^2 is a measure of how far the independent variables account for the value of the dependent variable,[43] in the case of Series I we have $R^2=0·86$, so that 86% of the variation in spinning-value is accounted for by the six measured fibre-properties, leaving 14% to be accounted for otherwise.

APPENDIX II

A Short Method for Revising the Total Correlation Coefficients to Include Further Results Obtained in Successive Seasons

In the table on page T18 are given the total correlation coefficients between the highest standard warp counts for five successive seasons, the test-results for each successive season being included as they became available. Now where the number of pairs of observational values is comparatively large, the working out of a single total correlation coefficient necessitates a good deal of arithmetical labour in applying the simple formula—

$$r=\frac{\Sigma xy}{N\sigma_x\sigma_y}=\frac{\Sigma xy}{\sqrt{(\Sigma x^2\cdot\Sigma y^2)}} \quad\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(30)$$

where x, y are deviations of a corresponding pair of observational values X, Y from their respective means, M_x, M_y. Thus in applying this formula to all the 134 samples included up to 1931-32, we have to determine—

(i) the mean values of the 134 values of each property;
(ii) the deviation of each of the 134 observational values from its corresponding mean;
(iii) the square of each of the 134 deviations for each property;
(iv) the sum of the 134 squares of the deviations for each property;
(v) the product (xy) of the deviation of each fibre-property with the corresponding deviation of highest standard warp counts;
(vi) the algebraic sum (Σxy) of the 134 products (v) for each fibre-property;
(vii) the value of r as given by equation (30) from (iv) and (vi) for each fibre-property.

The arithmetical labour for 134 samples and seven properties is evidently considerable, especially if it all has to be done *ab initio* every season—and this at first sight would appear to be necessary because the new data every season cause changes in the values of the means and consequently in the deviations of the observational values of the preceding seasons from these means. As the heavy labour is due primarily to the changes in the values of the means, it may be avoided by adopting, once for all, at the beginning, an arbitrary mean for each property, and later making the proper corrections necessitated by this procedure.

Let A_x be the arbitrary means adopted for a fibre-property,
and A_y „ „ „ the highest standard warp counts.

Suppose that the total correlation coefficient has been obtained for m pairs of observational values ($X_1, Y_1; X_2, Y_2; \ldots\ldots X_m, Y_m$) and that it is desired to find the new total correlation coefficient when n new pairs of observational values ($X'_1, Y'_1; X'_2, Y'_2; \ldots\ldots X'_n, Y'_n$) are available, i.e. for $(m+n)$ pairs of observational values in all.

The means for the m original values are given by—

$$M_x = \frac{\Sigma X}{m} \; ; \; M_y = \frac{\Sigma Y}{m} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (31)$$

The new means, with n additional values, are written M'_x, M'_y, and are given by—

$$M'_x = \frac{\Sigma X + \Sigma X'}{m+n} \; ; \; M'_y = \frac{\Sigma Y + \Sigma Y'}{m+n} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (32)$$

As ΣX and ΣY have already been found in order to determine the original mean-values by (31), the solution of equations (32) merely necessitates finding the sum of the new values only, then adding the result to the sum of the old values, and dividing the result by $(m + n)$. Thus if we already have the sum of the values for any property of the 116 samples of 1930-31, we have only to add to it the sum of the values for the new 18 samples of 1931-32, and divide by 134, in order to get the new mean-value for the property.

The steps (ii) to (vii) which are necessary in obtaining the original values of the total correlations by equation (30) may be indicated by re-writing that equation in terms of the mean-values and the original observational values, so that—

$$r = \frac{\Sigma(X-M_x)(Y-M_y)}{\sqrt{\{\Sigma(X-M_x)^2 \cdot \Sigma(Y-M_y)^2\}}} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (33)$$

But if arbitrary means A_x and A_y are used instead of the real means in steps (ii) to (vii)—as is usually done in practice—certain corrections become necessary, and these are indicated by re-writing (33) in terms of the arbitrary means, thus—

$$r = \frac{\Sigma^m_1(X-A_x)(Y-A_y) - m(A_x-M_x)(A_y-M_y)}{\sqrt{[\{\Sigma^m_1(X-A_x)^2 - m(A_x-M_x)^2\}\{\Sigma_1^m(Y-A_y)^2 - m(A_y-M_y)^2\}]}} \qquad (34)$$

In (34) the correction terms are $m(A_x-M_x)(A_y-M_y)$ in the top line, and $m(A_x-M_x)^2$ and $m(A_y-M_y)^2$ in the bottom line, all of which are easy to calculate.

When we include the n new pairs of values, the new value of r is given by—

$$r = [\Sigma_1^m(X-A_x)(Y-A_y) + \Sigma_1^n(X'-A_x)(Y'-A_y) - (m+n)(A_x-M'_x)(A_y-M'_y)]$$
$$\div \sqrt{[\{\Sigma_1^m(X-A_x)^2 + \Sigma_1^n(X'-A_x)^2 - (m+n)(A_x-M'_x)^2\} \times}$$
$$\overline{\{\Sigma_1^m(Y-A_y)^2 + \Sigma_1^n(Y'-A_y)^2 - (m+n)(A_y-M_y')^2\}]} \qquad \ldots\ldots\ldots\ldots (35)$$

In equation (35), $\Sigma_1^m(X-A_x)(Y-A_y)$, $\Sigma_1^m(X-A_x)^2$, and $\Sigma_1^m(Y-A_y)^2$ have already been found in order to obtain the previous value of r by (34); and it is these terms that are the most troublesome to evaluate as they are concerned with a comparatively large number of values; and if there are only few additional pairs of values (i.e. n is small), the remaining terms of equation (35) are obtained comparatively quickly, as the arithmetic is practically confined to dealing with the new values only.

APPENDIX III

Table I—Fibre-Properties of Series I Samples

Cotton	Season	Highest Standard Warp Counts	Length (inch)	Weight per inch (10^{-6} oz.)	Ribbon-Width (10^{-3} in.)	Strength (oz.)	Convolutions per inch	Rigidity (oz. in.$^2 \times 10^{-6}$)
Dharwar 1	1926–27	34	0·89	0·204	0·61	0·168	67	0·109
	1927–28	32	0·89	0·202	0·65	0·152	76	0·132
	1928–29	34	0·87	0·182	0·61	0·129	81	0·128
	1929–30	30	0·87	0·209	0·71	0·162	88	0·141
Jayawant	1929–30	32	0·91	0·224	0·72	0·192	78	0·238
Gadag 1	1923–24	36	0·89	0·174	0·70	0·138	130	0·203
	1924–25	20	0·81	0·154	0·67	0·125	132	0·137
	1925–26	30	0·82	0·150	0·71	0·107	134	0·149
	1926–27	38	0·81	0·179	0·63	0·141	110	0·151
	1927–28	38	0·86	0·167	0·62	0·148	115	0·152
	1928–29	26	0·82	0·162	0·59	0·141	122	0·138
	1929–30	32	0·84	0·166	0·64	0·140	140	0·157
1027 A.L.F. ...	1926–27	32	0·97	0·200	0·73	0·171	96	0·162
	1927–28	30	0·94	0·207	0·74	0·167	73	0·132
	1928–29	32	0·96	0·204	0·71	0·165	63	0·125
	1929–30	34	0·97	0·186	0·74	0·171	45	0·157
Wagad 4	1925–26	14	0·81	0·253	0·71	0·148	61	0·223
	1926–27	16	0·85	0·257	0·68	0·179	46	0·189
	1927–28	18	0·79	0·181	0·70	0·109	47	0·101
	1928–29	16	0·84	0·216	0·77	0·138	56	0·174
Wagad 8	1925–26	12	0·79	0·258	0·71	0·142	63	0·162
	1926–27	14	0·80	0·264	0·72	0·178	45	0·221
	1927–28	15	0·77	0·189	0·72	0·124	46	0·122
	1928–29	15	0·80	0·239	0·76	0·144	58	0·135
	1929–30	12	0·75	0·208	0·77	0·133	56	0·139
P.A. 4F	1926–27	24	0·78	0·134	0·70	0·132	104	0·093
	1927–28	22	0·79	0·186	0·70	0·156	102	0·210
	1928–29	16	0·76	0·197	0·68	0·169	99	0·234
	1929–30	20	0·81	0·179	0·69	0·167	107	0·215
P.A. 285F	1923–24	34	0·92	0·123	0·67	0·131	145	0·057
	1924–25	34	0·92	0·152	0·73	0·138	140	0·094
	1925–26	28	0·93	0·155	0·69	0·149	134	0·134
	1926–27	34	0·82	0·104	0·64	0·115	100	0·059
	1927–28	34	0·89	0·133	0·59	0·131	110	0·104
	1928–29	34	0·88	0·125	0·67	0·108	90	0·099
	1929–30	42	0·92	0·158	0·65	0·162	122	0·166
P.A. 289F	1926–27	38	0·97	0·098	0·62	0·109	88	0·053
	1927–28	40	0·94	0·142	0·62	0·135	118	0·092
	1928–29	38	0·96	0·122	0·58	0·151	122	0·093
	1929–30	42	1·00	0·147	0·61	0·148	145	0·101
Mollisoni	1926–27	8	0·68	0·272	0·77	0·164	65	0·242
	1927–28	8	0·73	0·335	0·88	0·195	114	0·463
	1928–29	7	0·69	0·303	0·76	0·182	106	0·512
	1929–30	8	0·69	0·298	0·81	0·167	87	0·386
Aligarh A. 19 ...	1926–27	7	0·66	0·301	0·79	0·187	80	0·361
	1927–28	7	0·70	0·305	0·82	0·199	72	0·450
	1928–29	7	0·71	0·324	0·74	0·225	67	0·641
	1929–30	7	0·68	0·319	0·78	0·210	74	0·506
Cawnpore K. 22 ...	1926–27	12	0·73	0·240	0·71	0·178	72	0·280
	1927–28	12	0·75	0·244	0·78	0·174	70	0·376
	1928–29	14	0·78	0·225	0·68	0·166	71	0·257
	1929–30	11	0·70	0·229	0·68	0·171	78	0·392
J.N. 1	1926–27	14	0·77	0·242	0·71	0·183	65	0·216
	1927–28	14	0·74	0·226	0·71	0·199	74	0·245
	1928–29	13	0·76	0·236	0·72	0·204	85	0·280
	1929–30	12	0·75	0·237	0·71	0·185	81	0·300

APPENDIX III—*continued*

Table I—Fibre-Properties of Series I Samples

Cotton	Season	Highest Standard Warp Counts	Length (inch)	Weight per inch (10^{-6} oz.)	Ribbon-Width (10^{-3} in.)	Strength (oz.)	Convolutions per inch	Rigidity (oz. in.$^2 \times 10^{-6}$)
C.A. 9	1926–27	34	0·87	0·182	0·61	0·160	119	0·185
	1927–28	30	0·86	0·176	0·63	0·151	105	0·170
	1928–29	40	0·89	0·166	0·60	0·158	127	0·239
	1929–30	34	0·87	0·174	0·64	0·168	108	0·294
Verum Akola ...	1928–29	23	0·83	0·187	0·63	0·174	79	0·136
	1929–30	21	0·84	0·195	0·63	0·171	88	0·202
Verum Nagpur ...	1928–29	26	0·85	0·215	0·62	0·199	72	0·193
	1929–30	21	0·81	0·190	0·64	0·175	92	0·218
Umri Bani	1926–27	24	0·81	0·200	0·67	0·186	65	0·160
	1927–28	24	0·81	0·192	0·63	0·179	93	0·188
	1928–29	22	0·83	0·185	0·63	0·176	88	0·196
	1929–30	27	0·81	0·172	0·64	0·171	90	0·185
Cambodia Co. 1 ...	1923–24	32	0·91	0·171	0·69	0·134	91	0·154
	1924–25	30	0·86	0·147	0·64	0·123	91	0·093
	1925–26	32	0·91	0·156	0·63	0·114	97	0·132
	1926–27	38	0·92	0·155	0·59	0·127	91	0·124
	1927–28	34	0·93	0·164	0·60	0·138	110	0·134
	1928–29	32	0·93	0·170	0·62	0·125	126	0·179
	1929–30	34	0·89	0·175	0·70	0·143	121	0·176
Cambodia Co. 2 ...	1927–28	33	0·88	0·141	0·62	0·123	108	0·138
	1928–29	26	0·92	0·148	0·61	0·099	90	0·099
	1929–30	28	0·89	0·172	0·64	0·123	116	0·224
Nandyal 14 ...	1926–27	34	0·93	0·191	0·61	0·223	46	0·142
	1927–28	31	0·88	0·196	0·67	0·229	56	0·147
	1928–29	31	0·91	0·187	0·65	0·236	60	0·169
	1929–30	35	0·91	0·190	0·65	0·232	70	0·169
Hagari 1	1928–29	24	0·84	0·207	0·65	0·140	78	0·164
	1929–30	27	0·84	0·192	0·71	0·128	88	0·129
Hagari 25	1926–27	26	0·76	0·177	0·65	0·110	54	0·097
	1927–28	26	0·87	0·205	0·70	0·135	76	0·112
	1928–29	30	0·90	0·188	0·65	0·132	75	0·098
	1929–30	25	0·85	0·208	0·66	0·136	63	0·128
Karunganni C7 ...	1926–27	24	0·85	0·192	0·65	0·183	57	0·170
	1927–28	24	0·85	0·183	0·62	0·177	62	0·156
	1928–29	20	0·81	0·186	0·70	0·159	74	0·184
	1929–30	23	0·83	0·196	0·78	0·171	50	0·215
Mississippi	1923–24	30	0·99	0·183	0·65	0·180	142	0·138
Memphis	1925–26	40	0·95	0·181	0·62	0·154	110	0·146
Texas	1925–26	30	0·86	0·206	0·58	0·164	140	0·210
Mean ...	—	25	0·84	0·196	0·68	0·158	89	0·189

APPENDIX III—*continued*

Table II—Fibre Properties of Series II Samples

Cotton	Season	Highest Standard Warp Counts	Length (inch)	Weight per inch (10^{-6} oz.)	Ribbon Width (10^{-3} in.)	Strength (oz.)	Convolutions per inch	Rigidity (oz. in.$^2 \times 10^{-6}$)	Clinging power (oz.)
Gadag 1	†1923–24	36	0·87	0·174	0·70	0·138	130	0·203	0·269
	†1924–25	20	0·80	0·154	0·67	0·125	132	0·137	0·249
	1925–26	30	0·82	0·150	0·71	0·107	134	0·149	0·255
	1926–27	38	0·81	0·179	0·63	0·141	110	0·151	0·280
	A1927–28	38	0·86	0·167	0·62	0·148	115	0·152	0·241
	*B1927–28	24	0·81	0·182	0·65	0·163	104	0·178	0·256
	*C1927–28	32	0·83	0·164	0·68	0·134	124	0·177	0·258
	1928–29	26	0·82	0·162	0·59	0·141	122	0·138	0·306
Wagad 4	†1925–26	14	0·80	0·253	0·71	0·148	61	0·223	0·393
	1926–27	16	0·85	0·257	0·68	0·179	46	0·189	0·350
	1927–28	18	0·79	0·181	0·70	0·109	47	0·101	0·310
	1928–29	16	0·84	0·216	0·77	0·138	56	0·174	0·335
Wagad 8	†1925–26	12	0·78	0·258	0·71	0·142	63	0·162	0·419
	1926–27	14	0·80	0·264	0·72	0·178	45	0·221	0·339
	1927–28	15	0·77	0·189	0·72	0·124	46	0·122	0·284
	1928–29	15	0·80	0·239	0·76	0·144	58	0·135	0·403
P.A. 285F	†1923–24	34	0·93	0·123	0·67	0·131	145	0·057	0·260
	1924–25	34	0·92	0·152	0·73	0·138	140	0·094	0·270
	†1925–26	28	0·95	0·155	0·69	0·149	134	0·134	0·296
	1926–27	34	0·82	0·104	0·64	0·115	100	0·059	0·266
	1927–28	34	0·89	0·133	0·59	0·131	110	0·104	0·270
	1928–29	34	0·88	0·125	0·67	0·108	90	0·099	0·276
P.A. 289F	1926–27	38	0·97	0·098	0·62	0·109	88	0·053	0·217
Aligarh A. 19 ...	1926–27	7	0·66	0·301	0·79	0·187	80	0·361	0·355
C.A. 9	*1924–25	28	0·89	0·163	0·65	0·161	144	0·164	0·300
	*1925–26	28	0·87	0·147	0·65	0·148	114	0·171	0·314
	1926–27	34	0·87	0·182	0·61	0·160	119	0·185	0·266
	1927–28	30	0·86	0·176	0·63	0·151	105	0·170	0·290
	1928–29	40	0·89	0·166	0·60	0·158	127	0·239	0·279
Umri Bani	1927–28	24	0·81	0·192	0·63	0·179	93	0·188	0·271
Cambodia Co. 1 ...	†1923–24	32	0·92	0·171	0·69	0·134	91	0·154	0·234
	†1924–25	30	0·87	0·147	0·64	0·123	91	0·093	0·284
	†1925–26	32	0·93	0·156	0·63	0·114	97	0·132	0·238
	1926–27	38	0·92	0·155	0·59	0·127	91	0·124	0·309
	1927–28	34	0·93	0·164	0·60	0·138	110	0·134	0·301
	1928–29	32	0·93	0·170	0·62	0·125	126	0·179	0·291
Nandyal 14 ...	1926–27	34	0·93	0·191	0·61	0·223	46	0·142	0·290
Hagari 25	*1923–24	24	0·90	0·210	0·70	0·165	84	0·121	0·274
	*1924–25	28	0·86	0·172	0·66	0·154	91	0·108	0·313
	*1925–26	26	0·85	0·178	0·69	0·120	94	0·102	0·308
	1926–27	26	0·76	0·177	0·65	0·110	54	0·097	0·277
	1927–28	26	0·87	0·205	0·70	0·135	76	0·112	0·309
	1928–29	30	0·90	0·188	0·65	0·132	75	0·098	0·316
Karunganni C7 ...	1926–27	24	0·85	0·192	0·65	0·183	57	0·170	0·260
Memphis	1925–26	38	0·95	0·181	0·62	0·155	110	0·146	0·289
Mean ...	—	28	0·86	0·179	0·66	0·143	95	0·147	0·293

* These seven cottons are not included in Series I

† The values given in this Table for fibre-length are those obtained from the same samples as were used for the determination of clinging-power (col. 10); in the cases marked (†) there are slight differences from the corresponding values given in Appendix III, Table I, but in no case does this difference exceed 0·02 inch.

APPENDIX IV

Table I—Predictions of Highest Standard Warp Counts from Fibre-Properties for Series I Samples

Cotton	Season	Actual Highest Standard Warp Counts	Values of Highest Standard Warp Counts Predicted From									
			Length only	Weight only	Ribbon-Width only	Strength only	Convolutions only	Rigidity only	Length and Weight	Length, Strength, and Weight	Length, Weight, and Ribbon-width	All Six Properties
Dharwar 1 ...	1926–27	34	31	24	33	24	21	30	28	28	30	29
	1927–28	32	31	24	28	26	23	29	28	28	29	28
	1928–29	34	28	27	33	28	24	29	28	28	30	29
	1929–30	30	28	23	22	25	25	28	26	27	26	25
Jayawant ...	1929–30	32	33	21	21	21	23	22	28	28	27	28
Gadag 1	1923–24	36	31	29	23	27	32	24	31	30	30	31
	1924–25	20	22	32	26	29	32	28	26	26	26	27
	1925–26	30	23	33	22	30	32	28	27	27	26	27
	1926–27	38	22	29	31	27	28	27	24	24	25	25
	1927–28	38	27	30	32	26	29	27	29	29	30	30
	1928–29	26	23	31	35	26	30	28	26	26	28	29
	1929–30	32	25	30	30	27	33	27	27	27	28	29
1027 A.L.F. ...	1926–27	32	39	24	19	24	26	27	34	34	33	33
	1927–28	30	36	23	18	24	22	29	32	31	30	29
	1928–29	32	38	24	22	24	21	29	33	33	32	31
	1929–30	34	39	27	18	24	18	27	35	36	34	32
Wagad 4	1925–26	14	22	16	22	26	20	23	18	17	19	17
	1926–27	16	26	15	25	23	18	25	21	21	22	20
	1927–28	18	20	27	23	30	18	30	22	21	22	19
	1928–29	16	25	22	15	27	19	26	23	23	22	20
Wagad 8	1925–26	12	20	15	22	27	21	27	16	15	17	15
	1926–27	14	21	14	21	23	18	23	16	16	17	15
	1927–28	15	18	26	21	29	18	29	20	20	19	17
	1928–29	15	21	18	16	26	20	28	18	18	18	16
	1929–30	12	15	23	15	28	19	28	17	17	16	14
P.A. 4F	1926–27	24	19	35	23	28	27	31	25	26	24	24
	1927–28	22	20	27	23	25	27	24	22	22	22	22
	1928–29	16	16	25	25	24	27	22	19	20	19	20
	1929–30	20	22	28	24	24	28	23	24	25	24	25
P.A. 285F ...	1923–24	34	34	37	26	28	34	33	37	37	36	37
	1924–25	34	34	32	19	27	33	31	34	34	32	34
	1925–26	28	35	32	24	26	32	28	35	35	34	35
	1926–27	34	23	40	30	30	27	33	31	31	30	30
	1927–28	34	31	35	35	28	29	30	34	34	35	35
	1928–29	34	30	37	26	30	25	31	34	33	33	32
	1929–30	42	34	31	28	25	30	26	34	35	34	35
P.A. 289F ...	1926–27	38	39	41	32	30	25	34	42	42	42	41
	1927–28	40	36	34	32	28	30	31	37	37	37	37
	1928–29	38	38	37	36	26	30	31	40	40	41	42
	1929–30	42	42	33	33	26	34	31	41	41	41	43
Mollisoni	1926–27	8	8	13	15	24	21	22	7	7	7	6
	1927–28	8	13	2	3	21	29	8	6	5	4	6
	1928–29	7	9	7	16	22	28	5	5	5	6	8
	1929–30	8	9	8	10	24	25	12	6	5	5	6
Aligarh A. 19 ...	1926–27	7	6	8	13	22	23	14	3	3	3	3
	1927–28	7	10	7	9	21	22	8	6	6	5	6
	1928–29	7	11	4	18	18	21	—	5	6	6	8
	1929–30	7	8	5	14	19	22	5	3	3	3	5
Cawnpore K. 22 ...	1926–27	12	13	18	22	23	22	19	13	13	14	14
	1927–28	12	15	17	14	23	22	13	14	14	13	12
	1928–29	14	19	20	25	24	21	21	18	18	19	20
	1929–30	11	10	20	25	24	23	12	12	12	14	13

APPENDIX IV—*continued*

Table I—Predictions of Highest Standard Warp Counts from Fibre-Properties for Series I Samples

Cotton	Season	Actual Highest Standard Warp Counts	Values of Highest Standard Warp Counts Predicted From									
			Length only	Weight only	Ribbon-Width only	Strength only	Convolutions only	Rigidity only	Length and Weight	Length, Strength, and Weight	Length, Weight, and Ribbon-width	All Six Properties
J.N. 1	1926–27	14	18	17	22	22	21	23	16	16	16	16
	1927–28	14	14	20	22	21	22	21	15	16	15	16
	1928–29	13	16	18	21	20	24	19	16	17	16	17
	1929–30	12	15	18	22	22	24	18	15	15	15	16
C.A. 9	1926–27	34	28	27	33	25	30	25	28	29	30	31
	1927–28	30	27	28	31	26	28	26	28	28	29	29
	1928–29	40	31	30	34	25	31	22	31	31	32	33
	1929–30	34	28	29	30	24	28	18	29	30	30	31
Akola Verum ...	1928–29	23	24	26	31	23	23	28	25	26	26	26
	1929–30	21	25	25	31	24	25	24	25	25	26	26
Nagpur Verum ...	1928–29	26	26	22	32	21	22	25	24	25	26	26
	1929–30	21	22	26	29	23	25	23	23	24	24	25
Umri Bani ...	1926–27	24	22	24	26	22	21	27	22	23	23	22
	1927–28	24	22	26	31	23	26	25	23	24	24	25
	1928–29	22	24	27	31	23	25	24	25	26	26	26
	1929–30	27	22	29	29	24	25	25	25	25	24	26
Cambodia Co. 1 ...	1923–24	32	33	29	24	28	25	27	32	32	31	31
	1924–25	30	27	33	30	29	25	31	30	30	30	30
	1925–26	32	33	32	31	30	26	29	33	33	34	33
	1926–27	38	34	32	35	28	25	29	34	34	36	35
	1927–28	34	35	30	34	27	29	29	34	34	35	35
	1928–29	32	35	29	32	29	31	26	34	33	35	35
	1929–30	34	31	29	23	27	30	26	30	30	30	31
Cambodia Co. 2 ...	1927–28	33	30	34	32	29	28	28	32	33	33	33
	1928–29	26	34	33	33	31	25	31	35	34	35	34
	1929–30	28	31	29	30	29	29	23	31	30	31	32
Nandyal 14 ...	1926–27	34	35	26	33	18	18	27	32	34	34	33
	1927–28	31	30	25	26	18	20	28	28	30	28	28
	1928–29	31	33	27	28	17	20	26	31	33	31	32
	1929–30	35	33	26	28	17	22	26	31	33	31	32
Hagari 1	1928–29	24	25	23	28	27	23	27	24	24	25	24
	1929–30	27	25	26	22	28	25	29	25	25	25	24
Hagari 25 ...	1926–27	26	17	28	28	30	19	31	20	20	21	19
	1927–28	26	28	24	23	27	23	30	26	26	26	25
	1928–29	30	32	26	28	28	23	31	30	29	30	29
	1929–30	25	26	23	27	27	21	29	25	24	25	24
Karunganni C7 ...	1926–27	24	26	26.	28	22	20	26	26	27	27	26
	1927–28	24	26	27	32	23	21	27	27	27	28	27
	1928–29	20	22	27	23	25	22	25	23	24	23	22
	1929–30	23	24	25	14	24	19	23	24	25	22	21
Mississippi ...	1923–24	30	41	27	28	23	34	28	37	38	37	36
Memphis	1925–26	40	37	28	32	26	29	28	34	34	35	39
Texas	1925–26	30	27	19	36	24	33	24	26	26	28	30

APPENDIX IV—*continued*

Table II—Predictions of Highest Standard Warp Counts from Fibre-Properties for Series II Samples

Cotton	Season	Actual Highest Standard Warp Counts	Values of Highest Standard Warp Counts Predicted From: Length only	Weight only	Ribbon-Width only	Strength only	Convolutions only	Rigidity only	Clinging-power only	Length and Weight	Length, Weight, Ribbon-width, and Clinging-power	All Seven Fibre Properties
Gadag 1	1923–24	36	29	29	23	28	34	25	31	29	28	29
	1924–25	20	22	32	27	29	34	29	34	26	28	28
	1925–26	30	24	33	22	31	34	28	33	29	27	28
	1926–27	38	23	28	32	28	30	28	30	25	28	28
	A1927–28	38	28	30	33	28	31	28	35	29	33	32
	*B1927–28	24	23	27	29	26	29	26	33	25	27	27
	*C1927–28	32	25	30	26	29	33	26	33	28	28	29
	1928–29	26	24	31	36	28	32	28	26	28	30	30
Wagad 4	1925–26	14	22	16	22	28	22	23	15	16	15	15
	1926–27	16	27	16	26	25	20	25	21	19	20	18
	1927–28	18	21	28	23	31	20	31	26	24	21	20
	1928–29	16	26	22	15	28	22	26	22	23	18	17
Wagad 8	1925–26	12	20	15	22	28	23	27	12	15	12	12
	1926–27	14	22	14	21	25	20	23	22	15	15	14
	1927–28	15	19	26	21	29	20	29	29	22	20	18
	1928–29	15	22	18	16	28	22	29	14	18	13	12
P.A. 285F ...	1923–24	34	35	37	27	29	36	34	32	38	35	34
	1924–25	34	34	32	20	28	35	31	31	34	30	29
	1925–26	28	37	32	24	28	34	29	28	36	32	32
	1926–27	34	24	40	30	30	29	33	32	34	32	31
	1927–28	34	31	35	36	29	30	31	31	35	36	35
	1928–29	34	30	36	27	31	27	31	30	35	32	31
P.A. 279F ...	1926–27	38	39	41	33	31	27	34	38	43	43	40
Aligarh A. 19 ...	1926–27	7	9	9	12	25	26	15	20	4	3	6
C.A. 9	*1924–25	28	31	30	29	27	36	27	27	31	31	31
	*1925–26	28	29	33	29	28	31	27	25	32	30	31
	1926–27	34	29	28	34	27	32	26	32	28	32	32
	1927–28	30	28	29	32	27	30	27	28	28	30	30
	1928–29	40	31	30	35	27	33	22	30	31	34	35
Umri Bani ...	1927–28	24	23	26	32	25	28	25	31	24	27	26
Cambodia Co. 1 ...	1923–24	32	34	29	24	29	27	28	36	32	32	31
	1924–25	30	29	33	30	30	27	31	29	32	32	30
	1925–26	32	35	32	32	30	28	29	35	34	36	35
	1926–27	38	34	32	36	29	27	29	26	34	35	34
	1927–28	34	35	30	35	28	30	29	27	34	35	34
	1928–29	32	35	29	33	29	33	26	28	33	34	35
Nandyal 14 ...	1926–27	34	35	26	34	22	20	28	28	31	33	29
Hagari 25 ...	*1923–24	24	32	23	23	26	26	30	30	27	27	24
	*1924–25	28	28	29	28	27	27	30	25	29	28	26
	*1925–26	26	27	28	24	30	28	31	26	27	26	25
	1926–27	26	28	28	29	31	21	31	30	23	24	22
	1927–28	26	29	24	23	29	25	30	26	26	24	23
	1928–29	30	32	27	29	29	25	31	25	29	29	27
Karunganni ...	1926–27	24	27	26	29	25	22	26	22	26	28	26
Memphis	1925–26	38	37	28	33	27	30	28	29	33	34	33

* These seven cottons are not included in Series I

APPENDIX V

Table I—Total and Partial Correlation Coefficients for Fibre-Properties for Series I Samples

Total Correlation Coefficients		Partial Correlation Coefficients: First Order		Second Order		Third Order		Fourth Order		Fifth Order	
12	·87	12·3	·7409	12·35	·7204	12·345	·7181	12·3456	·7278	12·34567	·7033
		12·5	·8616								
13	—·80	13·2	—·5765	13·25	—·5578	13·245	—·4130	13·2456	—·3830	13·24567	—·3568
		13·5	—·7941								
14	—·69	14·2	—·4792	14·23	—·2578	14·235	—·2298	14·2356	—·2275	14·23567	—·2292
		14·3	—·3033	14·25	—·4619						
		14·5	—·6627	14·35	—·2446						
15	—·33	15·2	—·2356	15·23	·1600	15·234	·1070	15·2346	·1355	15·23467	·1030
		15·3	·2931								
16	·46	16·2	·3888	16·23	·2542	16·234	·2577	16·2345	·2703	16·23457	·2044
		16·3	·1866	16·25	·3488	16·235	·2721				
		16·5	·3963	16·35	·2191	16·245	·3149				
						16·345	·2148				
17	—·67	17·2	—·2380	17·23	·2218	17·234	·2113	17·2345	·1892	17·23456	·0574
		17·3	—·0625	17·25	—·1286	17·235	·1840	17·2346	·1052		
		17·5	—·6223	17·35	—·1347	17·245	—·0123	17·2356	·0499		
						17·345	—·1282	17·2456	—·1594		
								17·3456	—·2698		
23	—·68	23·1	·0541	23·15	·0100						
		23·5	—·6811								
24	—·57	24·1	·0849	24·15	·0816	24·135	·0843				
		24·3	—·1795	24·35	—·1198						
		24·5	—·5401								
25	—·25	25·1	·0797								
		25·3	·2555								
26	·32	26·1	—·1832	26·15	—·1712	26·135	—·1708	26·1345	—·1721		
		26·3	·0214	26·35	·0422	26·345	·0371				
		26·5	·2616								
27	—·67	27·1	—·2380	27·15	—·3262	27·135	—·3716	27·1345	—·3739	27·13456	—·3383
		27·3	—·2773	27·35	—·3522	27·345	—·3501	27·3456	—·4196		
		27·5	—·6658								
34	·70	34·1	·3408	34·12	·3382	34·125	·3846				
		34·2	·5188	34·15	·3837						
		34·5	·7011	34·25	·5408						
35	·59	35·1	·5754	35·12	·5740						
		35·2	·5916								
36	—·45	36·1	—·1539	36·12	—·1467	36·125	—·0469	36·1245	—·0523		
		36·2	—·3346	36·15	—·0478	36·245	—·1754				
		36·5	—·3414	36·25	—·2312						
37	·81	37·1	·6152	37·12	·6477	37·125	·4860	37·1245	·4448	37·12456	·5170
		37·2	·6512	37·15	·4560	37·245	·4104	37·2456	·5328		
		37·5	·7112	37·25	·4720						
45	·26	45·1	·0473	45·12	·0409	45·123	—·1988				
		45·2	·1478	45·23	—·2307						
		45·3	—·2654								
46	—·33	46·1	—·0196	46·12	—·0042	46·123	—·0488	46·1235	·0234		
		46·2	—·1897	46·15	—·0105	46·125	·0036				
		46·3	—·0235	46·23	—·0200	46·135	·0085				
		46·5	—·2698	46·25	—·1582	46·235	—·0406				
				46·35	—·0453						
47	·56	47·1	·1819	47·12	·2088	47·123	—·0144	47·1235	·0449	47·12356	·0383
		47·2	·2920	47·15	·1836	47·125	—·2231	47·2356	·0261		
		47·3	—·0167	47·23	—·0703	47·135	·0105				
		47·5	·5202	47·25	·2558	47·235	·0008				
				47·35	·0430						
56	—·32	56·1	—·2006	56·12	—·1899	56·123	—·1305	56·1234	—·1234		
		56·2	—·2616	56·23	—·0839	56·234	—·0910				
		56·3	—·0756								
57	·58	57·1	·5122	57·12	·5486	57·123	·2833	57·1234	·2862	57·12346	·3828
		57·2	·5738	57·23	·3084	57·234	·3011	57·2346	·3920		
		57·3	·2156								
67	—·13	67·1	·2704	67·12	·2374	67·123	·4410	67·1234	·4422	67·12345	·5025
		67·2	·1200	67·15	·4434	67·125	·4163	67·1235	·5030		
		67·3	·4477	67·23	·4723	67·135	·5234	67·1245	·4262		
		67·5	·0721	67·25	·3421	67·234	·4722	67·1345	·5233		
				67·35	·4765	67·235	·5260	67·2345	·5265		
						67·245	·4009				
						67·345	·4794				

APPENDIX V—*continued*

Table II—Total and Partial Correlation Coefficients for Fibre-Properties for Series II Samples

Total Correlation Coefficients		Partial Correlation Coefficients											
		First Order		Second Order		Third Order		Fourth Order		Fifth Order		Sixth Order	
12	·72	12·3	·5356	12·34	·4856	12·345	·4585	12·3456	·4698	12·34567	·5087	12·345678	·5156
13	—·78	13·2	—·6482	13·24	—·5571	13·245	—·4804	13·2456	—·3503	13·24567	—·4059	13·245678	—·2271
14	—·71	14·2	—·5825	14·23	—·4629	14·235	—·4101	14·2356	—·4467	14·23567	—·4171	14·235678	—·4368
		14·3	—·5162										
15	—·23	15·2	—·2492	15·23	·2500	15·234	·0854	15·2346	·0348	15·23467	—·0328	15·234678	—·0707
		15·3	·3809	15·24	—·3317								
				15·34	·1986								
16	·59	16·2	·4930	16·23	·2738	16·234	·3198	16·2345	·3111	16·23457	·1316	16·234578	·1603
		16·3	·2700	16·24	·4889	16·235	·2482						
				16·34	·3159	16·245	·4561						
						16·345	·2907						
17	—·40	17·2	—·1227	17·23	·4236	17·234	·3627	17·2345	·3555	17·23456	·2224	17·234568	·1600
		17·3	·3052	17·24	—·1094	17·235	·3659	17·2346	·2231				
				17·34	·2366	17·245	·1269	17·2356	·2808				
						17·345	·1934	17·2456	—·0410				
								17·3456	·0345				
18	—·67	18·2	—·5838	18·23	—·2634	18·234	—·2599	18·2345	—·2466	18·23456	—·2436	18·234567	—·1890
		18·3	—·2205	18·24	—·5174	18·235	—·2044	18·2346	—·2434	18·23457	—·1655		
				18·34	—·2163	18·245	—·4724	18·2356	—·1976	18·23467	—·1786		
						18·345	—·1710	18·2456	—·3900	18·23567	—·1259		
								18·3456	—·1650	18·24567	—·3886		
										18·34567	—·1628		
23	—·57	23·1	—·5162										
24	—·50	24·1	·0229	24·13	·0236								
		24·3	—·2593										
25	—·08	25·1	·1268	25·13	·1747	25·134	·1915						
		25·3	·3403	25·34	·2605								
26	·38	26·1	—·0800	26·13	—·0871	26·134	—·0925	26·1345	—·1197				
		26·3	·0738	26·34	·0766	26·345	·0315						
27	—·45	27·1	—·2548	27·13	—·3220	27·134	—·3212	27·1345	—·3850	27·13456	—·3850		
		27·3	—·0953	27·34	—·1579	27·345	—·2470	27·3456	—·3232				
28	—·42	28·1	·1212	28·13	·1473	28·134	·1489	28·1345	·2061	28·13456	·2082	28·134567	·0966
		28·3	·0033	28·34	·0220	28·345	·1020	28·3456	·1035	28·34567	—·0008		
34	·57	34·1	·0368	34·12	·0372								
		34·2	·4005										
35	·55	35·1	·6087	35·12	·6160	35·124	·6419						
		35·2	·6158	35·24	·6879								
36	—·58	36·1	—·2371	36·12	—·2394	36·124	—·2486	36·1245	—·2816				
		36·2	—·4782	36·24	—·4526	36·245	—·4393						
37	·69	37·1	·6592	37·12	·6767	37·124	·6778	37·1245	·4669	37·12456	·6204		
		37·2	·5907	37·24	·6203	37·245	·3448	37·2456	·5948				
38	·74	38·1	·4680	38·12	·4740	38·124	·4758	38·1245	·5279	38·12456	·5177	38·124567	·5537
		38·2	·6714	38·24	·6263	38·245	·6351	38·2456	·5833	38·24567	·6241		
45	·01	45·1	—·2238	45·12	—·2287	45·123	—·3197						
		45·2	—·0347	45·13	—·3106								
		45·3	—·4423	45·23	—·3897								
46	—·33	46·1	·1563	46·12	·1587	46·123	·1728	46·1235	·2105				
		46·2	—·1748	46·13	·1700	46·235	·0845						
		46·3	·0009	46·23	·0208								
47	·27	47·1	—·0217	47·12	—·0164	47·123	—·0565	47·1235	·0522	47·12356	—·0770		
		47·2	·0582	47·13	—·0611	47·235	—·1059	47·2356	—·1919				
		47·3	—·2073	47·23	—·2413								
48	·46	48·1	—·0300	48·12	—·0331	48·123	—·0576	48·1235	—·1496	48·12356	—·1524	48·123567	—·1780
		48·2	·3181	48·13	·0534	48·235	—·0497	48·2356	—·0454	48·23567	—·1081		
		48·3	·0691	48·23	·0725								

APPENDIX V—*continued*

Table II—Total and Partial Correlation Coefficients for Fibre-Properties for Series II Samples

Total Correlation Coefficients	Partial Correlation Coefficients					
	First Order	Second Order	Third Order	Fourth Order	Fifth Order	Sixth Order
56 −·21	56·1 −·0946	56·12 −·0855	56·123 ·0810	56·1234 ·1461		
	56·2 −·1948	56·13 ·0645	56·124 −·0512			
	56·3 ·1603	56·23 ·1441	56·134 ·1252			
		56·24 −·2042	56·234 ·1653			
		56·34 ·1792				
57 ·58	57·1 ·5473	57·12 ·6043	57·123 ·3231	57·1234 ·3224	57·12346 ·2936	
	57·2 ·6110	57·13 ·2447	57·124 ·6170	57·2346 ·2930		
	57·3 ·3317	57·23 ·3887	57·134 ·2380			
		57·24 ·6145	57·234 ·3297			
		57·34 ·2736				
58 ·25	58·1 ·1327	58·12 ·1191	58·123 −·2493	58·1234 −·2830	58·12346 −·2842	58·123467 −·2079
	58·2 ·2393	58·13 −·2169	58·124 ·1147	58·2346 −·2835	58·23467 −·1984	
	58·3 −·2796	58·23 −·2983	58·134 −·2461			
		58·24 ·2642	58·234 −·2941			
		58·34 −·2784				
67 −·06	67·1 ·2379	67·12 ·2257	67·123 ·5424	67·1234 ·5615	67·12345 ·5494	
	67·3 ·5772	67·13 ·5396	67·124 ·2312	67·1235 ·5474		
		67·23 ·5883	67·134 ·5593	67·1245 ·3344		
		67·24 ·1471	67·234 ·6113	67·1345 ·5496		
		67·34 ·5903	67·235 ·5838	67·2345 ·5980		
			67·245 ·3530			
			67·345 ·5722			
68 −·48	68·1 −·1414	68·12 −·1331	68·123 −·0230	68·1234 −·0132	68·12345 ·0297	68·123457 ·1757
	68·2 −·3817	68·13 −·0355	68·124 −·1295	68·1235 −·0029	68·23457 ·1496	
	68·3 −·0927	68·23 −·0933	68·134 −·0268	68·1245 −·1246		
		68·24 −·3493	68·234 −·0951	68·1345 ·0042		
		68·34 −·0930	68·235 −·0533	68·2345 −·0493		
			68·245 −·3129			
			68·345 −·0456			
78 ·34	78·1 ·1058	78·12 ·1424	78·123 −·2751	78·1234 −·2793	78·12345 −·2072	78·123456 −·2676
	78·2 ·1863	78·13 −·3049	78·124 ·1420	78·1235 −·2123	78·12346 −·3286	
	78·3 −·3504	78·23 −·3518	78·134 −·3093	78·1245 ·0911	78·12356 −·2518	
		78·24 ·1773	78·234 −·3453	78·1345 −·2663	78·12456 ·1420	
		78·34 −·3444	78·235 −·2682	78·2345 −·2754	78·13456 −·3215	
			78·245 ·0196	78·2346 −·3646	78·23456 −·3072	
			78·345 −·2904	78·2356 −·2924		
				78·2456 ·1464		
				78·3456 −·3226		

Note on Tables I and II of Appendix V

In each column of these Tables, the figures on the right-hand side show the value of the correlation coefficient for the fibre-properties indicated by the figures on the same line on the left-hand side, *e.g.* Table II, col. 1, line 1: ·72 is the total correlation coefficient for properties 1 and 2, the fibre-properties indicated by the numerals 1 to 8 being—

1 = highest standard warp count;
2 = fibre-length;
3 = fibre-weight per inch;
4 = fibre-width;
5 = fibre-strength;
6 = fibre-convolutions per inch;
7 = fibre-rigidity;
8 = fibre-clinging power.

Note by A. J. T.

The data on which this paper is based were obtained while I was Director of the Technological Laboratory; the delay in the completion of the paper has been occasioned by the pressure of my other work since I entered the service of the British Cotton Industry Research Association.

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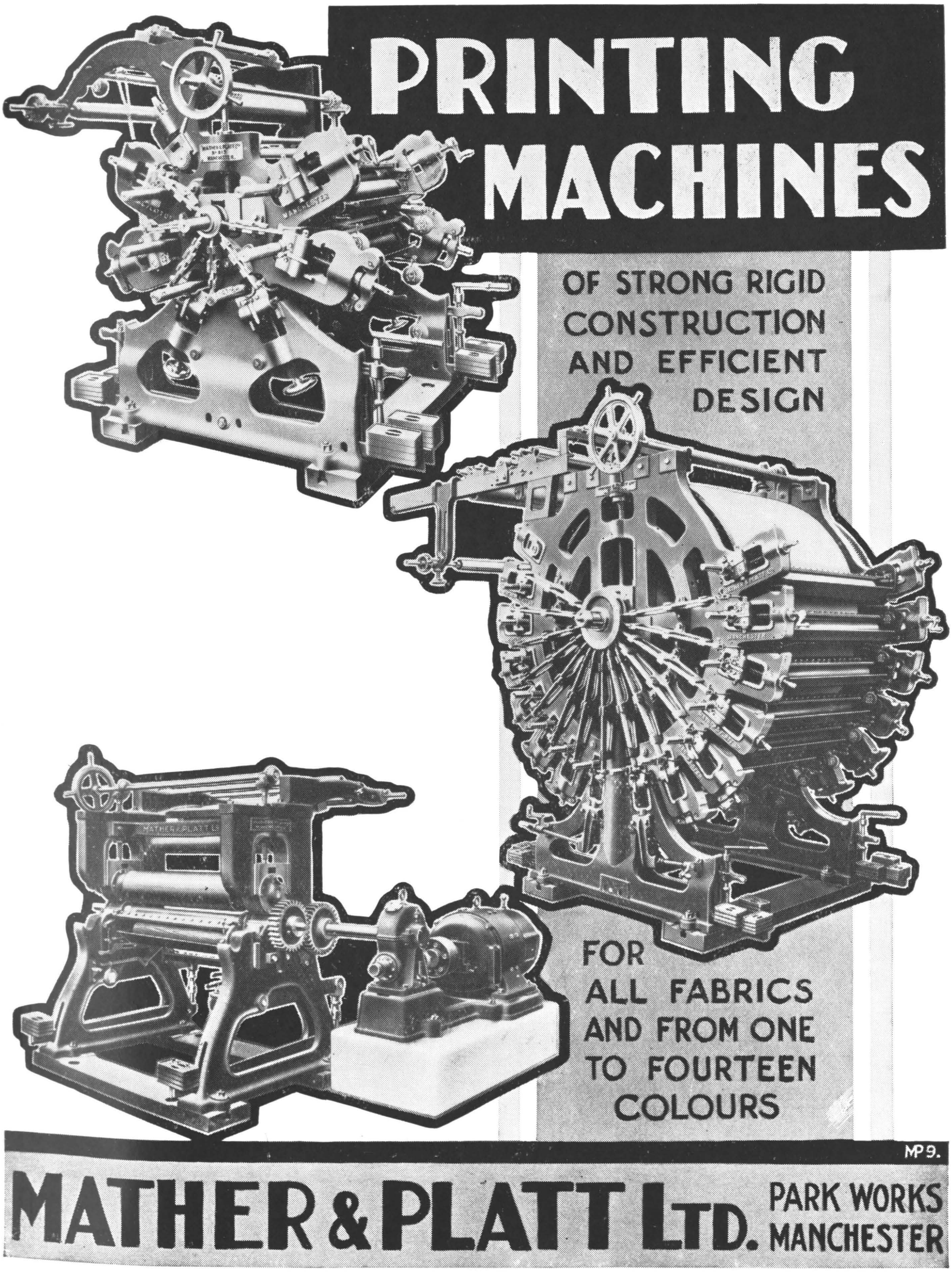
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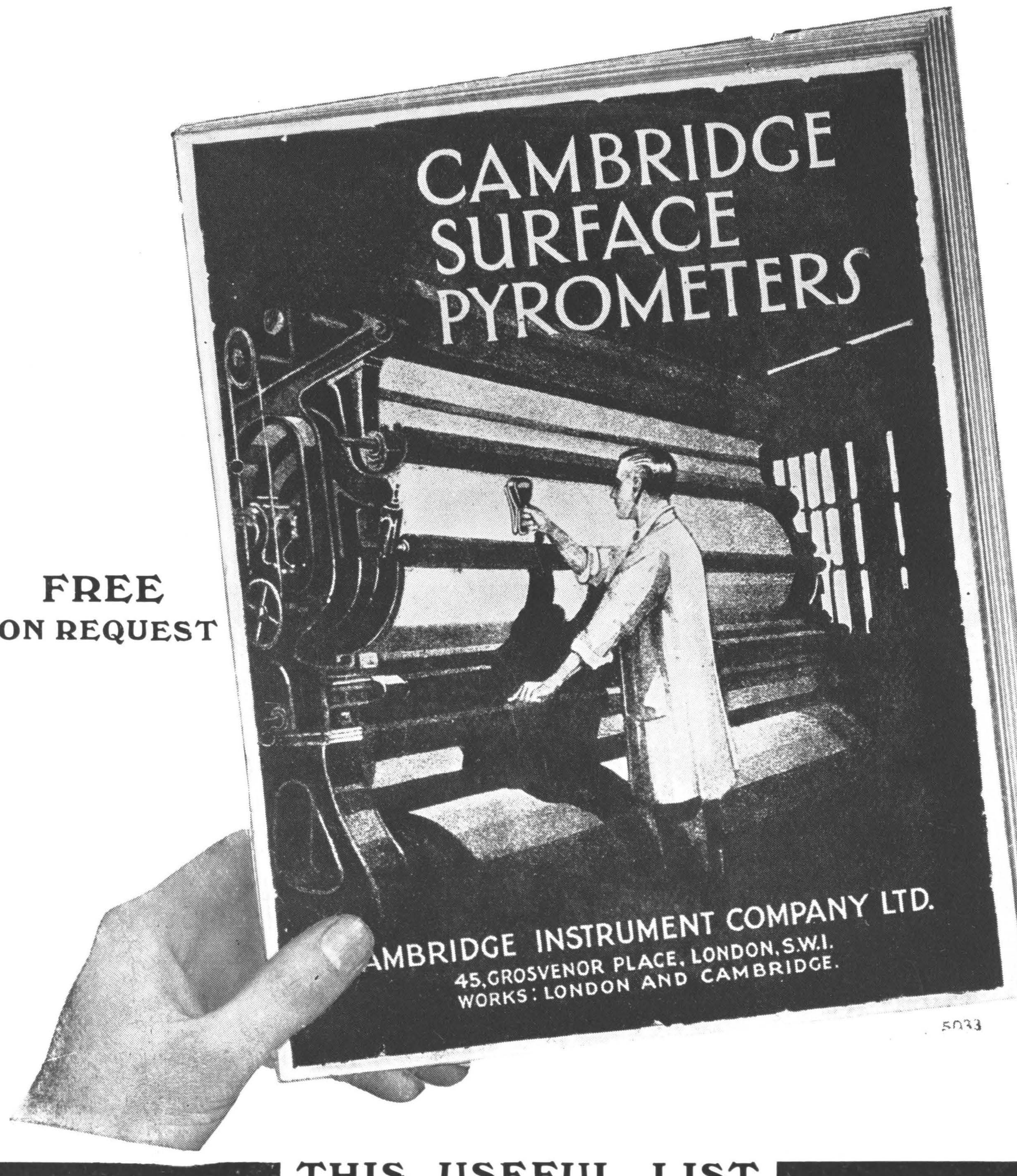

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1—FIBRES AND THEIR PRODUCTION

(B)—Animal

Silk: Swelling and Solution in Copper and Nickel Ammonium Solutions. H. Sobue and S. Manago. *J. Soc. Chem. Ind. Japan*, 1933, 36, 576B-579B.

Tables are given of the viscosities of copper and nickel ammonium solutions and their mixtures, and also of boiled-off silk sols in these solutions. The minimum swelling is obtained at 30° C. in a solution containing 123·2 parts copper to 20 of nickel. C.

Silk Fibroin: Solubility in Copper Ethylenediamine Solution. Y. Takamatsu. *J. Soc. Chem. Ind. Japan*, 1933, 36, 566B-568B.

The solution of a large quantity of silk fibroin in a solution of copper oxide in ethylenediamine solution of known copper content is described, and is shown to be analogous to the solution of colloidal substances, since the solubility increases with larger amounts of fibroin, until a maximum is reached, when further increase diminishes the solubility. A solution containing a known quantity of copper will dissolve no more fibroin than is chemically equivalent to the amount of copper in the solution. A complex fibroin-copper-ethylenediamine compound was isolated containing equivalent quantities of each substance. This ratio also expresses the least quantities of copper and amine necessary to dissolve a definite amount of fibroin. In the solid phase the ratio is two equivalents of fibroin to one each of copper and ethylenediamine. C.

Rendering of Sericin Insoluble by Action of Heat. G. Colombo and G. Baroni. *Bull. uff. R. Staz. sperim. Seta*, 1933, 3, 21-27 (through *Chem. Zentr.*, 1933, **ii**, 2477).

Data for the effect of treatment of sericin with hot air are recorded. S.

Hatching of Eggs of *Bombyx mori* out of Season. P. Malucelli. *Arch. Sci. Biol.* (Italy), 1932, 17, 224-233 (through *Chem. Abs.*, 1933, 27, 5429).

Immersion of the eggs in solutions of hydrogen chloride or thiourea, even after exposure to ether vapour to overcome any possible resistance of the serous membrane, gave no results of any moment. Reactions and materials giving mitogenetic rays, such as oxidation of oxalic acid with permanganate, or onion paste, notably increased the proportion of eggs hatched in January and February. S.

Physical Properties of Raw Silk. III—Specific Heat of Cocoon, Raw Silk, Fibroin, and Sericin. J. Kubota and S. Kozaki. *Bull. Sericult. Japan*, 1933, 6, August, 1-2 (through *Chem. Zentr.*, 1933, **ii**, 2918); see *J. Text. Inst.*, 1932, A635.

The specific heat of cocoons varies with the strain and is affected by heat treatment. Moist cocoons have a higher specific heat than dried cocoons. Difference in sex has no effect. The specific heat of raw untreated silk is 0·355 g.-cal. and that of dried raw silk 0·275 g.-cal. The specific heats of natural fibroin, dried fibroin, and sericin are 0·357, 0·279, and 0·382 g.-cal. respectively. S.

Behaviour of Aqueous Solutions of Domestic Cocoons. XIII—Velocity of Electrophoresis of Sericin Particle. XIV—Behaviour in Sericin Gel. H. Kaneko. *J. Agr. Chem. Soc., Japan*, 1933, **9**, 697-704 and 737-740 (through *Chem. Abs.*, 1933, **27**, 5545); cf. *J. Text. Inst.*, 1933, **24**, A301.

XIII—The rate of electrophoresis increases with dilution, time of heating, and rise of temperature. From observations on the rate of electrophoresis the iso-electric points of sericin A and sericin B were found to be *p*H 4·1 and 4·3, respectively. In electrical behaviour sericin resembles gelatin. XIV—If sericin gel is electrolysed with platinum electrodes, a precipitate in the form of a ring appears at the anode, possibly due to electrolysis of organic acid adsorbed from sericin A. Liesegang rings of silver salts may be obtained in sericin gel. Organic colouring matters diffuse in sericin gel more slowly than in gelatin or agar-agar. S.

The Future of Mohair. F. J. du Toit. *Farming in South Africa*, 1933, 8, 419 and 433.

A general article giving a historical survey of the development of the mohair industry, its origin in Cape Province, and the characteristics and uses of the fibres. W.

Angora Rabbit Farming. E. du Toit. *Farming in South Africa*, 1933, 8, 409-410.

An article dealing generally with Angora rabbit farming, and the single hutch and colony systems of management. A short bibliography is given of books on rabbits and rabbit farming. W.

(C)—Vegetable

American Cotton: Community Production. J. A. Shanklin, R. C. Campbell, and W. C. Jensen. *S. Carolina Sta. Circ.*, No. 48, 1933, pp. 26 (through *Exp. Sta. Rec.*, 1933, **69**, 358).

The influence of the source and care of seed on the yield and staple has been studied in various communities in S. Carolina, data being collected from 329 growers producing 5,140 bales on 8,758 acres. The yield from pure seed of improved cotton (91 growers) averaged 349·4 lb., as against 294·9 lb. for mixed seed of improved varieties (77 growers), and 263·3 lb. for run-down short staple cotton. Of the cotton from pure seed, 73·7% was 1 in. or more and none was untenderable. Of that from mixed seed of improved varieties, 76·9% was 1 in. or more and only 1·9% was untenderable. Of the run-down sorts, only 3·3% was 1 in. or more and 26·9% was untenderable. C.

American Cotton: Variety Trials, U.S.A. (Oklahoma). W. M. Osburn. *Oklahoma Sta. Bull.*, No. 209, 1933, pp. 31 (through *Exp. Sta. Rec.*, 1933, **69**, 356-357).

A review of variety, date of planting, and spacing trials during 1916-31. On the whole, medium-stapled types proved most profitable. C.

Cotton Plant: Breeding Experiments, U.S.A. *Plant Breeding Abstracts*, 1933, *Supplement*, I, 22-23.

An account is given of genetical research in the cotton Experiment Stations of various American States from 1929 to 1931. C.

Indian Cotton Plant: Relation of Size and Shape to Yield. S. N. Venkatraman and C. J. Rao. *Madras Agric. J.*, 1933, **21**, 51-58 (through *Exp. Sta. Rec.*, 1933, **69**, 358).

The relation of height, nodes, and number of monopodia to yield of cotton has been studied on 6,000 plants of 46 selections of Northerns cotton (*G. indicum*). Taller types were not necessarily good yielders but yield was strongly correlated with number of monopodia. Plants attacked by stem borer (*Earias sp.*) gave a significantly higher yield, due, apparently, to an increase in number of monopodia and productivity of each monopodium. A comparison of other strains, such as Cambodia and especially Uppam (*G. herbaceum*) where the effect of the borer was the reverse, showed that the difference could be explained by the more monopodial habit of this type. The relation of yield to monopodia was much higher in this cotton than in more sympodial types. C.

Cotton Worm Fungus: Occurrence in Egypt. R. M. Nattrass. *Min. Agric. Egypt, Tech. Sci. Serv. Bull.*, No. 120, 9 pp. (1933).

Notes on the entomogenous fungi of Egypt include an account of a species of *Empusa* parasitising the cotton worm when kept in captivity. No worms have yet been found attacked in their natural state. C.

American Cotton: Ginning. N. A. Olsen. *Cotton (M/cr)*, 1933, 39, No. 1887, 25, No. 1888, 8-9.

Cotton ginning investigations of the United States Department of Agriculture are described. Recent developments include a seed cotton drier and improved apparatus and methods for measuring conditions and quality in seed cotton. Excessive use of cleaning machinery damages the ginned lint, whilst ginning with a tight seed roller may cause more fragments of seed coat than usual to be left in the product. C.

Cotton Gametophyte and Embryo: Development. U. R. Gore. *Amer. J. Bot.*, 1932, 19, 795-807 (through *Exp. Sta. Rec.*, 1933, 69, 357).

The development of the female gametophyte and embryo have been studied in Sea Island, Pima, and Uplands cottons. The embryo sac develops from the chalazal megaspore of the tetrad, the complete structure being very long and embedded in many layers of nucellus. The antipodals degenerate early and the polars begin fusing before entrance of the male gametes to form a polar fusion nucleus. The pollen tube enters the ovule 15-20 hrs. after pollination and digests its way through the nucleus to the embryo sac. Fertilisation is completed from 24-30 hrs. after opening of the flower. A massive endosperm is formed, usually by fusion of the second male gamete with the polar fusion nucleus, but is resorbed by the growing embryo. C.

American Cotton: Cultivation in the Punjab. A. Howard. *Empire Cotton Gr. Rev.*, 1933, 10, 268-272.

American cotton is never entirely successful in the alluvial soil of the Punjab and sometimes fails altogether. The above-ground behaviour of the plants at flowering time in a year of crop failure suggests that the root hairs are working in zones in which the soil solution contains a high proportion of alkali salts. The root hairs cannot absorb an adequate supply of water from the soil solution, and the transpiration current is affected so that the development of the anthers and seeds is upset. The comparative immunity of the indigenous variety is explained by the diffuse nature of its root system and its relative independence of the upper soil layers for its moisture supply, whereas most of the root system of American cotton is superficial. C.

Cotton Bollworms: Control. C. B. Williams. *Empire Cotton Gr. Rev.*, 1933, 10, 273-281.

An account is given of the characteristics and life histories of the pink, spiny, Sudan, and American bollworms. The best method of combating pink bollworm infestation is to plant as early a cotton crop as possible and to burn all cotton sticks before the start of the next season. The American bollworm may be destroyed by winter ploughing or by dusting with calcium arsenate. Control of the spiny and Sudan bollworms has not as yet been very successful. C.

Sisal Cotton Bale Cover: Properties. American Manufacturing Co. (Brooklyn). *Cotton Oil Press*, 1933, 17, No. 6. pp. 16-17.

The authors complain against the penalities exacted on bales of cotton covered with sisal bagging, and quote a report of tests by a firm of spinners who state that no trouble has been caused by its use, and that sisal fibres are more readily removed from cotton than are those of jute. C.

Cotton Hairs: Influence of Growth Factors on Length. G. M. Armstrong and C. C. Bennett. *J. Agric. Res.*, 1933, 47, 467-474.

Small plants, growing on plots of low fertility, and clearly suffering from malnutrition, produced lint of practically the same length as that produced by vigorous plants growing on plots of high fertility, though the uniformity of distribution of the different lengths was less in the poorly nourished plants. The lint from bolls produced from blooms that were among the last to be retained was from one-sixteenth to two-sixteenths of an inch shorter than that from bolls arising a week earlier. Bolls from blooms opening on the same day but with a maturation period of 75·1 days had a larger percentage of short hairs than those with a maturation period of 58 days, though the practical lint length was the same. The variability in lint length and the distribution of the different length groups was about the same in bolls of a first crop and in those of a second crop produced on the same plants. C.

Cotton Hairs: Variability in Length. G. M. Armstrong and C. C. Bennett. *J. Agric. Res.*, 1933, 47, 447-466.

Cotton hairs from all bolls on individual plants have been arrayed by the use of

Baer and Johannsen sorters which allow an accurate separation of the different lengths into groups by weight. A difference of six-sixteenths of an inch in the practical staple length of the cotton classer has been found between the hairs of two bolls located rather close together on a plant. Very appreciable differences in the uniformity of distribution of the hairs of various lengths have also been shown. In terms of the staple length of the cotton classer, a difference of three-sixteenths of an inch in length was found between the lint from seed of one locule and the same difference between the lint from bolls developing from blooms of the same day. Five-sixteenths of an inch was the difference in length of lint from blooms of two successive days. Conditions seemed to be favourable for the production of long lint in bolls from all flowers during certain periods of time. During certain intervals, however, conditions seemed very unfavourable, as relatively short lint was produced. The position of the boll along the vertical axis or the horizontal axis does not seem to be of very great importance in determining the length of lint, though there is a distinct tendency for shorter lint to be produced near the top of the plant when grown in the field. Studies have been made of halo length, seed surface area and volume, boll volume, number of hairs per seed after 25 days of seed development, unit hair weight, and sorter distribution of hairs in bolls at approximately 4-day intervals from 25 to 50 days of age. The increase in surface area of the seed was most rapid from about 10 to 18 days of age. The relative increase in seed volume and boll volume was about the same after 10 days, when the boll cavity became filled with developing seed and lint. The halo had practically reached full length in 25 days, though not absolutely so in 30 days. There is no evidence of an increase in the number of hairs per seed after 25 days. The unit hair weight was not constant, the shorter hairs showing the greatest weight per inch. The sorter distributions of hairs from bolls at approximately 4-day intervals from 25 to 50 days of age indicate that many of the hairs continue to elongate after the boll is 25 days old. C.

(D)—Artificial

Viscose Rayon: Stretch Drying. Z. Kawata. *J. Cellulose Inst., Japan*, 1933, 9, (33).

Abolition of the preliminary drying of viscose rayon threads before desulphurising does not affect their length, but slightly diminishes lustre. Handle, strength, elongation, and dyeing capacity are somewhat improved, and manufacturing costs are reduced. C.

Alkali Cellulose: Preparation and Ripening. F. Steimmig. *RUSSA*, 1933, 8, 829-831.

Improvements are claimed for a process in which cellulose is delivered to the alkali bath as a continuous sheet from a drum, is carried through the bath on an endless revolving band, and passes to the ripening chamber containing pairs of rollers arranged horizontally and each pair connected with an endless band. The cellulose passes over these pairs of rollers and travels down the ripening chamber, passing from side to side. A much higher temperature can be used in the ripening chamber than when flakes or fragments of cellulose are used. A diagram is given. C.

Rayon: Production in Japan. Y. Nagai. *J. Soc. Chem. Ind., Japan*, 1933, 36, 533B-534B.

Japanese production of rayon shows an increase of 5,470,000 kg. over the corresponding period of last year, and Japan is now second only to the United States in rayon production, whilst Great Britain has taken fifth place. Production is still increasing month by month, and new plant is being constructed, particularly for the manufacture of staple fibre, for which a bright future is predicted. C.

Patents

Cotton Bolls: Artificial Ripening. S. N. Schatz. Russ. P.22,387 of 10/10/1929 and 27,539 of 22/12/1930 (through *Chem. Zentr.*, 1933, **ii**, 3065).

Fruits of cotton, flax, hemp, etc. are gathered before ripening and this process is hastened by exposing them to the action of ethylene at the ordinary or raised temperature. C.

Rayon Centrifugal Spinning Apparatus. International General Electric Co. Inc. (New York). E.P.397,098 of 11/11/1931.

The guide tube of centrifugal apparatus for spinning rayon is reciprocated by means driven from the driving spindle of the apparatus and comprising a cam, or a double-threaded spindle which, with the transmission gear, may be mounted in a casing carried by the casing of the driving and suspension gear. C.

Imitation Spun Rayon Yarn: Production. British Celanese Ltd. (London), M. M. Taylor and S. M. Fulton. E.P.397,138 of 5/2/1932.

In order to produce yarn from continuous filaments having the appearance of spun yarn, that is yarn made from staple fibre, a continuous filament bundle is subjected to the action of cutting means, particularly abrasive means, between which and the filaments there is relative movement to ensure severance of the filaments. The cutting operation is such that at any one point one or relatively few of the filaments are severed, and to facilitate the distribution of the points of severance the cutting may be effected by a relative movement of the cutting means transverse to the bundle. To produce a curly, wool-like effect the yarn may be subjected to a scraping action immediately before being torn. The process may be applied to any continuous filament yarn, for example to yarn of cellulose acetate or other organic derivatives of cellulose or of reconstituted cellulose, to silk, or to a mixture of such filaments. A yarn of broken filaments may be doubled with any other yarn and with one or more other broken filament yarns. The yarns may be introduced into the warp or weft or both of woven fabrics to produce the appearance of a fabric composed of staple fibre yarns, or to produce local patterns or effects and may be used as effect materials or the sole or principal constituents of knitted fabrics. C.

Rayon Stretch-spinning Tensioning Devices. British Celanese Ltd. (London) and W. I. Taylor. E.P.397,509 of 18/2/1932.

Artificial filaments are stretched continuously with production, the stretching force being prevented wholly or partly from extending back to the liquid filaments at the point of extrusion by a tensioning device or devices applied initially at points which are successively brought closer to the point of extrusion. In this manner stretching of the filaments when in a condition too weak to withstand the shock of the initial application of the tensioning means may be effected. If desired, tensioning devices more remote from the extrusion orifices may be removed after a tension device nearer to the extrusion orifices has been brought into action. The tensioning devices may be rods or freely-mounted rollers, and in the case of dry spinning, they may be disposed at intervals along the whole path of the filaments through the evaporative atmosphere or within a range where the filaments contain more than 50% of solvent. These devices may be used in dry or wet spinning processes for the production of threads of cellulose acetate, nitrate, or other cellulose ester, ethylcellulose or other cellulose ether, or regenerated cellulose threads from viscose, cuprammonium or cellulose nitrate solutions.

Cellulose Esters: Preparation. G. Jayme (Hawkesbury, Ontario, Canada). E.P.397,638 of 16/6/1932.

Wood pulp is purified and at the same time rendered active for acetylation or other esterification by treatment with a fatty acid and sulphuric acid or other catalyst as used in the esterification reaction, the liquor which carries with it the impurities being subsequently separated and the pulp washed with fatty acid. Cellulose esters of good colour are obtained by the use of the purified pulp. In the case of cellulose acetate, the acid used is acetic acid, with other esters, the acid corresponding to the esterifying radicle. C.

Benzylcellulose Films and Filaments: Production. L. Light (London). E.P. 397,773 of 16/2/1933.

Viscous chlorinated diphenyl isomerides, which function as plasticisers, are admixed with benzylcellulose together with suitable liquid media to yield films, lacquers, filaments, and plastic masses. Resinous chlorinated diphenyl isomerides may also be added to the composition. C.

Rayon Filaments: Stretching. H. Dreyfus (London). E.P.397,881 of 29/1/1932.

The stretching of artificial filaments, yarns, ribbons, etc., made from or containing cellulose acetate or other film-forming substances which are relatively resistant to penetration by water, is facilitated by stretching materials from which an additional substance has been removed before or during the application of the stretch-assisting agent. The additional substance is defined as a substance of different nature from the base of the materials and from the solvent, or other substance which is removed from the spinning solution or like composition in order to form the materials. Examples are given. The additional substance may be wholly or partly dissolved out by suitable liquids which may or may not have a solvent action on the substance of the materials. In wet spinning processes a volatile additional substance in the coagulating bath may be employed, and subsequently removed from the materials by the action of heat. If the liquid used to eliminate the additional substance from the filaments is itself a relatively strong swelling agent for the substance of the filaments, it may be unnecessary to treat again with a stretch-assisting agent, the stretching operation being, for example, continuous with the removal of the additional substance by means of a liquid having swelling properties. C.

Cellulose Carboxylates: Preparation. Kodak Ltd. (London). E.P.397,906 of 2/3/1932.

Cellulosic material is esterified with an unsubstituted aliphatic mono-carboxylic acid (including cycloparaffinic), an aromatic mono-carboxylic acid, or an aralkyl mono-carboxylic acid, in the presence of a methoxy-, ethoxy-, or propoxy-fatty acid anhydride as impeller. The starting material may be reverted cellulose, cotton, wood pulp cellulose, ethers or partially acylated cellulose, and the reaction may be carried out in the presence of solvents such as glacial acetic acid, ethylene chloride or alkoxy-fatty acids, such as methoxy-, ethoxy-, or propoxy-acetic acids, or in the presence of non-solvents, such as ligroin. The products are used in the production of artificial filaments, films, plastics, etc. C.

Rayon Cakes: Unwinding. Vereinigte Glanzstoff-Fabriken A.-G. (Elberfeld, Germany). E.P.398,126 of 18/4/1933.

To facilitate the unwinding of spun cakes of rayon a removable and rotary flange of a diameter exceeding that of the cake is mounted, preferably adjustably as regards height, above the cake. The flange is perforated to reduce its weight, and the internal support for the cake consists of a rolled strip of rubber, celluloid, presspahn, or the like. C.

Organic Borate Delustring and Weighting Agents: Application. H. Dreyfus (London). E.P.398,166 of 26/2/1932.

Artificial filaments, films, etc., of organic derivatives of cellulose, of modified properties, e.g. lustre, weight, heat resistance, etc. are obtained by incorporating therein an organic boron compound such as methyl borate, ethyl borate, or glycerine borate. The boron compound is preferably incorporated into the spinning solution but may be applied to the formed materials. The organic boron compound may be decomposed, either in the spinning solution or in the materials to produce other boron compounds, e.g. ethyl borate dissolved in alcohol may be added to a solution of cellulose acetate in aqueous acetone whereby boric acid is formed in the spinning solution, or finished materials containing the borate ester may be treated with aqueous media. C.

Yarn Liquid Treatment Apparatus. British Celanese Ltd. (London) and E. L. Greenwood. E.P.398,191 of 7/3/1932.

Liquid is applied to travelling artificial filamentary material continuously with its production by a wick through which the liquid is flowing continuously past the point of contact of the yarn with the wick. Such filamentary material includes yarns, threads, straws, etc., and the liquid may be dyes, sizes, conditioning and solvent liquids and may, if a solvent, contain a small percentage, e.g. 0·1% of the substance of which the filaments consist. The continuous flow of liquid through the wick may be created by siphon action, or the liquid may drip steadily on to the wick. C.

Cellulose Acetate: Preparation. British Celanese Ltd. (London). E.P.398,192 of 4/12/1931.

Cellulose acetates giving non-delustring products, particularly rayon, are obtained by limiting the ripening process in such a manner that although acetone solubility is reached, yet the process is not allowed to proceed so far as normal acetone solubility, that is to say, the acetyl content is reduced to only 56-60% calculated as acetic acid, preferably to 56-57%. The acetates are obtained with the aid, as catalysts, of sulphuric acid, phosphoric acid or other oxy acids or derivatives of such acids, and the ripening is carried out under conditions such that any acid present is an oxy acid. The ripening is carried out with the customary proportions of water or other ripening agent, or with reduced quantities of water, or with partial neutralisation of the acid catalyst before or during ripening, or by a two-stage process in which there is first added water or other ripening agent in quantity sufficient to destroy any excess of acetylating agent or equivalent to ½-1½ such amount, and then adding at a later stage a further quantity of water, etc. The acetylation process is carried out at a temperature below 40° C. in order to avoid degradation of the cellulose, and it may be conducted in solution or in suspension, in which case the ripening is also carried out in suspension. C.

Rayon: Delustring, Weighting, and Mordanting. H. Dreyfus (London). E.P. 398,258 of 14/3/1932.

Artificial filaments, threads, yarns, films, fabrics, etc. are delustred, weighted, mordanted, or the like by incorporating therein a wholly inorganic compound in finely divided form and treating the formed products with a reagent to convert it into its final form. Suitable inorganic compounds are the hydroxides of aluminium, zinc, and tin, barium carbonate, mono- and di-sodium phosphates, sodium silicate, carbonate, sulphate, stannate, and zincate, barium chloride, and magnesium and zinc sulphates. The yarn containing the inorganic compound is then treated with a reagent to convert the inorganic compound into its required form, e.g. yarn containing finely divided hydroxide of tin or zinc is treated with a solution of phosphoric acid or a phosphate. The inorganic compound is preferably incorporated in the spinning solution. An alternative procedure is to treat the formed filaments, preferably while in a swollen condition, with the inorganic compound. The insoluble organic compound may also be applied by padding or spraying, with or without the use of a stencil. C.

Coloured Rayon: Production. R. Dinklage (Cologne). E.P.398,279 of 12/4/1932.

Cellulose derivatives which are coloured throughout are obtained by condensing cellulose or an alkali cellulose with a reactive aromatic compound, and subsequently producing from the condensation product a coloured derivative by introducing into the aromatic radical a chromophoric group and an auxochrome. The coloured cellulose compound may be admixed in solution with viscose, for example, for the production of coloured threads. C.

Viscose Threads: Production from Films. D. M. Livsey, London (Sidac Soc. Industrielle de la Cellulose Soc. Anon., Ghent, Belgium). E.P.398,427 of 13/3/1933.

Bands of cellulose film, preferably from regenerated viscose, are loosely compressed or crushed in the direction of their width. Waste strips produced in the manufacture of cellulose films may be utilised. The resulting strands may be loosely twisted, and may be doubled with other yarns of the same or different material, including metal wires. The strands may wholly or partially surround the threads of textile material or metal. The strands may be fireproofed, e.g. by treating with a solution of borax. C.

Rayon Dry Spinnng Apparatus. British Celanese Ltd. (London) and E. Kinsella. E.P.398,478 of 12/3/1932.

In a dry spinning apparatus for the production of artificial filaments, ribbons, and like materials, and in particular of filaments of cellulose esters or ethers, there is provided, around the filter candle or other supply means immediately prior to the extrusion orifices, a readily removable attempering member. Water or other fluid may be circulated through the attempering member and preferably the construction is such that the attempering member may be removed from about the filter candle without interrupting the flow. The attempering member may be an annular jacket slidable upon the filter candle or it may be a coiled pipe surrounding the filter candle. C.

Cellulose Esters: Hydrolysis. Kodak Ltd. (London). E.P.398,626 of 18/7/1932.

The solubility characteristics of acetone-soluble mixed organic esters of cellulose are changed by treating the esters with a hydrolysing agent. Particularly useful in the production of films and filaments are the originally acetone-soluble and subsequently hydrolysed mixed esters of cellulose, the acyl content of which comprises at least 15% of fatty acid radicle higher than acetyl (calculated on the weight of the mixed ester before hydrolysis). Mixed esters specified are the acetate-propionate, acetate-propionate-butyrate, acetate-butyrate, acetate-stearate, and acetate-laurate. A dilute mineral acid is preferred as the hydrolysing agent, particularly when used in the presence of a sufficient quantity of organic acid to prevent precipitation of the cellulose ester. The hydrolysis may be carried out at about 100° F. for from 1 to 360 hours. The "precipitation value" of the hydrolysed ester, which is defined as the percentage of ester which from an acetone solution thereof, will be precipitated in a mixture of 40% of water and 60% of acetone by volume, is preferably above 85%. C.

Variable Diameter Bobbin: Use in After-treatment of Rayon. I.G. Farbenindustrie A.-G. (Frankfort). E.P.398,738 of 2/3/1933.

Rayon which has been washed free from acid and dried is twisted and wound on to a bobbin of variable diameter, and the wound package of threads, after diminishing the diameter of the bobbin, is irrigated with the after-treatment liquids. The bobbin is preferably made of elastic material and slit along its longitudinal axis. The bobbin is expanded by introducing a core of somewhat greater diameter than the normal internal diameter of the bobbin. The core may be formed of two parts one of which is introduced into each end of the bobbin thus causing the slit to be widened. The after-treatment and drying may be effected with the lap still on the bobbin of reduced circumference or after removal. To protect the threads, a permeable or non-permeable textile, felt, rubber, or other covering may be placed over the bobbin before winding on the thread. If the covering is permeable, it may be employed to protect the threads during the subsequent wet treatments and the ends may be drawn over the wound lap. It may serve to prevent the lap from being soiled by solid impurities in the liquids used. C.

Cellulose: Purification. H. Dreyfus (London). E.P.398,801 of 16/2/1932.

Cellulose in a form particularly suitable for esterification, is obtained from wood, straw, grass, or other lignified cellulose material by separating the non-cellulosic constituents therefrom by means of a liquid comprising a glycol, e.g. of ethylene, propylene, or trimethylene. An aqueous solution of the glycol containing between 30 and 80% of water may be employed at elevated temperatures, for example, from 120 to 180° C. Increased pressure, if required, may be obtained by working in an autoclave and introducing an inert gas under pressure. The cellulosic materials may be subjected to a prior or simultaneous treatment, for example, with dilute alkali or the usual liquors, to remove resins, lignins, or the like. C.

Rayon: Treatment to Minimise Electrification. H. Dreyfus (London). E.P. 398,820 of 10/3/1932.

In the manufacture of spun yarn from organic derivatives of cellulose, the material is provided, to minimise electrification difficulties, with an outer coating containing a hygroscopic substance which is cellulose or cellulose derivative material or a degraded cellulose or a derivative of a degraded cellulose or a polyvinyl alcohol or derivative thereof, before the opening, carding, drawing, or spinning operations. The coating may also contain other hygroscopic non-colloidal materials and roughening media to assist spinning. The production of the coating may be effected before or after cutting and, if desired, continuously with manufacture by dry or wet spinning. Methods of producing the coatings are described. C.

2—CONVERSION OF FIBRES INTO FINISHED YARNS

(A)—Preparatory Processes

Automatic Hopper Feeder. Coisne, Lambert, and Van Assche. *Revue Text.*, 1933, 31, 643-645.

The new automatic hopper feeder is designed to work in combination with a finisher scutcher in a single-process scutching system. The feeder has two chambers. The feed to the first chamber is controlled in the usual way with an arrangement which maintains the cotton content within certain fixed limits. In the second chamber the arrangements are such that the volume and pressure of the mass of cotton in this chamber are kept constant, the feed from the first to the second chambers being controlled by the mass of the cotton itself. C.

Carding-Doubling System. J. Gilljam and N. Voss. *Spinn. u. Web.*, 1933, **51**, No. 37, pp. 1-5; No. 38, pp. 1-6; No. 40, pp. 6-8.

The need for improvements in preliminary processes, especially for high-draft spinning with three-roller systems, is pointed out and a new system is described in which a roller card and a sliver lap machine are introduced between the opening and cleaning plant and the usual flat card. The web from the roller card is divided into four slivers; about 12 of these slivers are converted into a narrow lap by the sliver lap machine, and four of these laps are fed side by side to the flat carding engine. Great improvements in regularity of the product are claimed for this system. Details of the appartus and suitable opening and cleaning plants are discussed. The new system is compared with various other systems and its advantages are pointed out. C.

Continuous Card Stripper: Advantages. Saco-Lowell Shops. *Saco-Lowell Bulletin*, 1933, **6**, No. 4, p. 6-7.

The use of the Saco-Lowell continuous card stripper in a S. Carolina mill, with 371 cards producing a total of 439,562 lb. of sliver per week, resulted in an annual saving of $30,406, a 2% increase in stock production per card, and an improved quality of sliver. C.

Carding Engine Dust Removal Device. *Text. Weekly*, 1933, **12**, 278-279.

A device for removing dust from cardrooms consists of two endless lattices carried on boles underneath the card. These revolve towards each other and converge over an air shaft underneath the floor which leads to the common type of mixing box and to a fan controlling the air current. Dust is drawn down on to the lattices and falls through the shaft into the mixing box and is stripped from the cage into a bag. Diagrams are given. C.

Indian Cottons: Use in Lancashire. A. J. Turner. *Text. Weekly*, 1933, **12**, 372-373.

Short staple Indian cottons have some advantages such as coarseness, which gives a full rigid yarn, and economy in consumption of dye. Small diameter front rollers ($\frac{7}{8}$ in.) and high draft spinning are best for these cottons but 1in. rollers may also be used. Experiments on the growing of American cotton in the Punjab are in progress and the agricultural year in India is described. A table is given classifying the Indian cotton crops by staple lengths and spinning capacity for 24's warp counts and above. C.

The Use of Ready-made Olein Emulsions. —. Welwart. *Wollen-u. Leinen-Ind.*, 1933, **53**, 292-293.

For fibre oiling in woollen spinning, the disadvantages are stated of the use of olein emulsions which are produced by mixing olein, water and aqueous ammonia, or by using aqueous soda solution or aqueous soap solution. The use is recommended of the amides of higher molecular fatty acids, the anilides of the same and the aromatic bases, the so-called acetyl derivatives, as agents for emulsifying fatty acid such as olein. These emulsifying agents being ready-made, the wool oil is quickly prepared. A compound called "Emulgator" is a mixture of glue and aromatic compounds as above, the latter acting as a fungicide. W.

(B)—SPINNING AND DOUBLING

Boutry-Droulers Converted Mule. N. Schlumberger and Cie. *Fils et Tissus*, 1933, **21**, 439-441.

The carriage of an ordinary mule is rendered stationary and is furnished with ring rails which are given a rising and falling motion by a suitable cam. The yarn passes from the grooved delivery rollers to the point of the spindle which gives it twist, makes a few turns round the upper part of the spindle, and finally passes to the traveller which winds it on to the tube. The production of the mule is not adversely affected by this conversion, although half of the spindles are removed. Labour and power requirements are reduced. High-draft systems applicable to ordinary ring frames can be applied. For equal twists the yarn produced on the converted frame is stronger than that produced on the ordinary mule and is also superior in lustre and regularity. C.

High Draft Spinning Frame. C. Simon. *Revue Text.*, 1933, **31**, 561-565.

A machine for the direct spinning of draw-frame slivers is provided with several pairs of rollers. In the form described there are seven pairs of rollers providing five drawing fields. The drafts may be selected to give the same final result as the usual combination of speed and spinning frames. C.

Long Bobbins: Production on Spinning and Twisting Frames. A. Sarler. *Rev. Fil. et Tiss.*, 1933, **18**, 394-396.

In attempts to produce long bobbins on ordinary frames, difficulties are caused by the size of the balloon of the yarn and its variation during the formation of the bobbin. Practically uniform tension on the yarn may be obtained by means of a system in which the thread guide support rests on rods that are displaced vertically with the spindle support, following its downward motion until they come to rest against a fixed piece and then remaining stationary while the spindle support completes its required downward motion. C.

Mule Spinning Frame; Twist on——. C. Berntzwiller. *Fils et Tissus*, 1933, **21**, 387-392, 435-439.

Examples showing loss in production due to starting, and the difference between the theoretical and the actual mean speeds of the spindles on mules are given. It is shown that the twists produced in practice differ considerably from the theoretical values, and the causes of these differences are studied in detail for mules working with and without indicators. C.

Ring Spinning Frame Slubbing Motion. Platt Bros. & Co. Ltd. *Platt's Bull.*, 1933, **1**, 221-222.

The motion is constructed to cause an undrafted portion of the roving to be delivered to the front rollers at predetermined intervals. With a three-line arrangement, the back and middle lines of rollers are accelerated; if a four-line roller arrangement is in use, the acceleration is transmitted to the back, third and second lines in order to cause an undrafted portion of roving to be delivered to the front rollers. For the purpose of operating the mechanism for transmitting the intermittent motion, a peg wheel is applied and is driven from a 16T or 20T pinion mounted on the front roller. The pinion gears into a compound wheel mounted on a swing, which in turn gears into the peg wheel. The compound wheel constitutes a change place and it is possible, therefore, to vary the speed of the peg wheel and so alter the size and the spacing of the slub to the required extent. A series of case-hardened pegs are mounted in the peg wheel and are fixed in holes drilled at a definite radius. Usually there are 20 holes in this peg wheel, to allow the pegs to be spaced at intervals to meet particular requirements. These pegs operate an arm which controls the catch box, and in consequence the back roller is accelerated every time the peg lifts the arm. The amount of acceleration depends on the speed of the catch box and the length of time the catch box is in gear. The motion is applied on the outside of the framing, over which it does not project more than 8 in. or 9 in. C.

Spinning Frame Thread Guide. F. Piron. *Rev. Fil. et Tiss.*, 1933, **18**, 390-394.

A guide in the form of a bar with grooves at suitable intervals for the passage of the thread is introduced between the front line and the adjacent line of rollers. With this arrangement the short fibres that are usually lost between the two lines of rollers are pressed into the yarn and retained. It is claimed that there is a reduction of 80% in the waste produced, with the result that the rollers need cleaning less often whilst the yarn is heavier and more regular. The application of the guide on a mule is described; applications to other roller drawing systems are possible. C.

The Making of Slub Effect Yarns. Platt Bros. & Co. Ltd. *Text. Mfr.*, 1933, **59**, 399.

A description of an improved slubbing motion which can be applied to ring spinning frames. W.

Winding Machinery. L. H. Leedham. *Hosiery Tr. J.*, 1933, **40**, 46-50.

The following improvements in winding machinery are discussed—two-end bobbin mounting; riser traverse mechanism; speed control devices; starting spindle devices; building mechanism. W.

Practical Aspects of Mule Winding. R. Fletcher. *Text. Mfr.*, 1933, **59**, 428.

A method is described of adjusting copping and winding in mule spinning by using more or less of the curve of the copping rail, which is tilted to accommodate the alteration and avoid faulty copping and winding. W.

Roller Covering. A. Bland & Co. *Wool Rec.*, 1933, **44**, 315.

The covering consists of an endless ring of specially prepared composition cork made in various densities to accommodate the drafting requirements of different thicknesses and qualities of material. Before a roller is fitted its surface is knurled to anchor the covering. The nature of the covering is such that fibres do not readily adhere thereto and consequently it remains clean-faced. It is claimed that it is not affected by atmospheric conditions, and is impervious to vegetable, animal and mineral oils. W.

Influence of Worsted Processing and Spinning on the Wool Fibre. E. Hauss. *Mitt. Forsch.-Inst. Reutlingen-Stuttgart,* 1932, June (through *Text. Forsch.*, 1933, **15**, 67).

In Parts 1 and 2 the author discusses the nature and general properties of the wool fibre and the value of fibre diagrams. The correction to the fibre length for the curliness or crimp of the fibres is given as $\pi/2$. Measurements have been made of fineness, elasticity, and strength of individual fibres. In Part 3 the influence of processing on fibre properties is discussed. In Part 4 there is an analogous discussion on the influence of pressure and the effects of drying and storage. The paper concludes with data of general physical investigations on tops and yarns from different sources and of different qualities. W.

Cap Spinning: Production of Clean Yarns for White and Cream Worsted Goods. F. R. Hewitt. *Text. Mfr.*, 1933, **59**, 423 and 428.

In the cap spinning of yarns for white and cream worsted goods, the following types of stains which may occur are discussed—oil stains from machinery; rust stains from the inside of the caps; stains resulting from lack of care in handling full bobbins between the spinning, twisting, and winding operations; stains caused by discoloured oil which has percolated through the spinning and twisting bobbin barrels and which appears in the form of small spots occurring at regular intervals along the end, the distance between the marks corresponding to the circumference of the bobbin barrel. In the latter case, many efforts have been made to render wooden bobbins immune from this defect. W.

Improvements on Mule Spinning Machinery for Carded Wool. Soc. des Ateliers H. Duesberg-Bosson. *Rev. Text.*, 1933, **31**, 821-823.

A detailed description, illustrated by diagrams, of a patented device which attains the same results as the differential motion as in use on the mule for backing-off, but by less complicated methods. The rotation of the spindles for twist is produced as usual by the rim pulley of the headstock; the reversing motion, for the backing-off, is obtained by a countershaft which reduces the speed, and is mounted on the carriage and worked by a silent chain coming from the driving pulleys of the main cylinder. This headstock drives, by means of spur wheels, a gearing clutch on the tin roller shaft, as with the driving pulley, and turning in the opposite direction from the latter. The connecting of this clutch gearing with the correspinding clutch on one of the main cylinders brings about the reversing of the main cylinders and hence of the spindles. The controlling motion is composed of levers and of a special form of gearing for use as a twist counter. W.

(C)—Subsequent Processes

Gassing and Singeing Plant; Use of Coal Gas for——. T. Wiggins. *Text. Weekly*, 1933, **12**, 287.

A short general article on the uses of coal gas in the cotton industry, paying particular attention to the best use of the gas flame. In the gassing of yarn, the supply of gas should be regulated by fitting a valve of the needle type instead of the usual plug cock to give more accurate control, by using a micromanometer for setting the pressure in the flame gas pipe to a very accurate degree, and by employing a flow meter. Experiments with surface combustion blocks for cloth singeing are mentioned. C.

(D)—Yarns and Cords

Angola Yarns: Spinning. *Text. Mfr.*, 1933, **59**, 383, 386.

Angola yarns are used as warp and weft in the manufacture of cloth for cheap dress goods, shawls, flannelette, etc. The yarns are produced chiefly from cotton waste with shoddy, flocks, and extract wool added to give body to the blend and to add a degree of warmth to the resultant fabric. The blend is laid down in layers and is fed to a scribbler through an automatic hopper feed. The scribbler set used for Angola blends is similar to that used for woollens except in respect of its card clothing. This is of finer counts and a typical scribbler will include a creeper feed shaft, feed rollers and licker-in, covered with strong wire teeth. The scribbled material is carried by the travelling sheet and overhead carrier of a scotch feed to the feed sheet of a condenser carding system. The slubbing size for Angola yarns requires to be proportionately smaller or nearer to the spinning size than for woollen yarns. Roller drawing or "drag" gearing is employed on the mule so that the greater portion of the drawing is accomplished during the time that the rollers are delivering the slubbing, the speed of the carriage being in excess of the roller delivery. C.

PATENTS

Bobbin Creel. J. Laurent. F.P.742,508 (through *Revue Text.*, 1933, **31**, 585-587).

The new V-shaped creel is provided with steel tubes to which pairs of spindles are attached at suitable intervals. While yarn is unwinding from bobbins carried by the spindles directed towards the outside of the frame, full bobbins are placed on the spindles on the inside and are moved into working position when required by turning the supporting tubes. The bobbins may be arranged so that the yarn unwinds from the side or over the end. C.

High Draft System. Société Le Blan et Cie and M. A. Roth. F.P.744,351 (through *Revue Text.*, 1933, **31**, 647).

The new system has an endless band which, in contrast to the bands used on other systems, is driven independently of the rollers. The band may be given a higher speed than the rollers preceding it so that it produces a partial drawing of the material before the high draft produced by the delivery rollers. C.

Static Electricity Suppression Device. W. Platt. F.P.744,890 (through *Revue Text.*, 1933, **31**, 567).

A method of suppressing static electricity in spinning mills consists in treating the fibrous material, laps or slivers with liquid or vapour in a finely divided state. An example of the application of this method in the carding process is given, in which the liquid atomising device is placed above the doffer. C.

Mixing Machine for Wool. Société des Filatures de Carignan. F.P.747,289 of 8/3/1932 (through *Rev. Text.*, 1933, **31**, 817-821).

A horizontal distributor, rotating at a constant speed on a vertical axis, spreads on the ground different qualities of wool in such a way that they are superimposed in layers and homogeneously mixed. The apparatus is fully described and diagrams given. W.

Doubler Winder Spindles. Société des Etablissements Lemaire et Dillies. F.P. 751,626 (through *Revue Text.*, 1933, **31**, 827-829.

An improved spindle is provided with a conical piece against which the bottom of the bobbin tube rests. Above the bobbin is placed a curved plate which is pressed down firmly by means of a spring and screw head arrangement placed on the top of the spindle. The bobbins are very easily placed in position and removed from spindles of this type. Highly-skilled labour is not required and it is claimed that better running and great reductions in waste are obtained. C.

Spinning Ring. E. Scragg & Sons Ltd. and S. Scragg (Macclesfield). E.P.397,011 of 5/1/1933.

A ring and traveller comprises a flat plate having a central circular hole, the edge of which is rounded and projects slightly above and below the level of the plate, and a small and light C-shaped traveller with its tips inwards towards the faces of the plate, and outwards from the centre of the ring so that the curved yarn-engaging part of the traveller points inwards towards the spindle. The ring may be made separately from the ring plate which has ears for securing it to the rail and upturned edges to engage and grip the groove in the flange of the ring. The rim may be of substantially elliptical shape with the major axis of the ellipse inclined towards the centre of the ring and the top of the spindle, whilst the lower end of the elliptical edge forms a face substantially at right angles to the face of the plate. The plate may have holes through which oil can be passed to lubricate the tips of the traveller. C.

Bobbin Skewers. F. Hutchings and Fine Cotton Spinners' and Doublers' Association Ltd. (Manchester). E.P.397,294 of 25/7/1932.

Bobbin skewers or like bobbin supports are tipped at the lower end with a bearing surface of a known material or alloy of the self-lubricating type, such as a bronze alloy with which graphite has been incorporated. The tip is preferably formed by die-casting, oil being used in the process. The anti-friction element is preferably held in a stiffening element. C.

Ring Spinning and Twisting Frames. F. Sojka (Schaan, Liechtenstein). E.P. 397,362 of 28/12/1932.

Ring spinning and twisting frames are adapted for winding long bobbins by shortening the holder and shaping the shank of the guide in a specified manner, or by supporting the lappet in an inclined position by a stop, so that the length of the balloon is not diminished. C.

Spinning Spindles. Saco-Lowell Shops (Boston, U.S.A.). E.P.397,458 of 19/11/1931.

Hollow spindles such as are used in spinning yarn upon paper tubes comprise three parts, viz. a hollow blade, a whorl, and a bearing blade formed separately, the whorl and the hollow blade being made of steel and secured together by soldering, sweating, brazing, or welding, and the bearing blade being forced into the whorl as customary. C.

Winding Machine Supply Holder. W. J. Tennant, London (Universal Winding Co., Boston, U.S.A.). E.P.397,548 of 26/2/1932.

In yarn or like winding machines the support for the supply package is arranged so that the package extends downwardly and the yarn therefrom passes downwardly to a guide and thence upwardly to the winding spindle, so that the supply package may be located adjacent to the package being wound while maintaining the necessary length of free yarn between the packages. The holder for the supply package is provided with a retaining device for the bobbin to enable it to be operative when downwardly directed. C.

Elastic Threads: Coating and Ornamenting. Dunlop Rubber Co. Ltd. (London) and F. A. H. Heynert. E.P.397,890 of 1/3/1932.

Rubber threads produced in any known manner are coated and ornamented by a process which comprises rendering the surface of the threads adhesive and then applying a surface coating thereto. The adhesive surface may be produced by the application of rubber, celluloid, and cellulose varnishes of all types, synthetic and natural resins, linseed oil and like compounds or glues; or by treating the surface of the thread, e.g. by solvents. The coating materials are cork dust, paper, comminuted cotton linters, pulverised crumb rubber, asbestos, and the like. The coating materials may be applied while twisting or turning the thread about its longitudinal axis or subjecting it to tension. After the application of the coating the thread may be further treated by, for instance, the application of cotton, silk, etc. by winding or wrapping. The thread may be treated throughout the whole of its length or only in sections and the coating may be such as to provide a multi-coloured effect. C.

Electrically-driven Carding Engine. P. A. Fridkin (Leningrad). E.P.399,827 of 9/4/1932.

The patent relates to an electrically-driven carding engine, the rotating parts of which are designed so as to form at the same time parts of the driving electromotor. Thus the rotating drum or any other cylindrical part of the engine forms a rotor of the driving motor, the stator of which is formed as a removable segment of magnetic iron having single or multi-phase winding. C.

Cotton: Oiling and Moistening. G. Hill (Wellford, South Carolina, U.S.A.). E.P.400,308 of 7/5/1932.

A method of oiling or moistening cotton and other fibrous materials during scutching or opening comprises separating the fibres and applying liquid thereto substantially at the point of separation. By the point of separation is meant the point closely adjacent to the feed rollers where the cotton, retained by these rollers, becomes subject to the opening action of the beater arms. A machine for this purpose comprises a beater for separating the fibres and one or more nozzles for supplying liquid to the separated fibres substantially at the point of separation. C.

Rubber-coated Fibre Carding Apparatus. International Latex Processes Ltd. (St. Peter's Port, Guernsey). E.P.400,548 of 20/5/1933.

The apparatus consists of a soaking tank for the rubber coating of the fibres, a squeezing device serving for the removal of the excess liquid, a carding, i.e. opening or teasing machine effecting the loosening of the squeezed fibres and a device used for transporting the carded or teased fibres. These different devices and machines are disposed immediately adjoining each other in such a way that the carded or teased fibres are leaving the carding or teasing apparatus whilst the rubber dispersion coating them is still in the fluid state. C.

Multi-storey Twisting Machine. Barmer Maschinen-fabrik A.-G. (Wuppertal-Oberbarmen, Germany). E.P.400,867 of 5/5/1933.

A multi-storey twisting machine in which the rows of spindles of each storey are each driven by a circulating driving band, is characterised by the employment of inclined double twist twisting spindles in which the driving band is guided over conical belt guiding pulleys arranged between the rows of spindles of the individual storeys. The conical belt guiding pulleys are preferably subdivided. C.

Yarn Winding and Doubling Machines. J. Higginson and Arundel, Coulthard & Co. Ltd. (Stockport), E.P.400,945 of 26/4/1932.

The invention comprises the provision between each cop or bobbin being unwound and the cheese being wound of a bowl or roller (round which the yarn passes) which is carried by a part interconnected with and actuated by the stop motion mechanism so that when an end breaks and before the cheese comes to rest, it shortens the yarn path between each cop or bobbin and the cheese by an amount that compensates in such path for the length of yarn that the cheese takes up due to over-run before it comes to rest, and thereby minimises the extent to which the broken end is drawn towards the cheese. The invention further comprises an arrangement wherein, when knock-off occurs, the guide bowl or its equivalent which delivers the yarn to the cheese or bobbin being wound, moves the yarn clear of the path of the reciprocatory yarn guide and also shortens the yarn path for compensation purposes. In a machine having two upper and one lower guide bowls for each length of yarn being wound, means are provided for causing the upper and lower bowls to approach one another to shorten the yarn path when an end breaks. C.

Carding Engine with Fixed Concave Toothed Surfaces. J. Platt (Harrow) E.P. 400,971 of 4/2/1932.

In an improved carding machine there is provided, preferably in the position ordinarily occupied by the usual carding flats, a stationary toothed surface constituted by rigid pointed and inclined teeth of which the teeth or points provide a concave carding or working surface in close proximity to and conforming with the toothed surface constituted by the teeth points on the drum or cylinder of the carding machine. The arrangement is such that there is no enlarged entrance gap or space between the co-operating teeth points as there is between the ordinary carding flat and the drum in the usual arrangement, and in contradistinction to the usual construction wherein the carding flats are ground flat on the points, the toothed surface according to the present invention is formed or ground to produce the concavity necessary to conform with the curvature or convexity of the drum or cylinder. By means of this construction an improved carding action can be produced as all the teeth of the concave carding surface participate in the carding of the material. After the teeth have been formed or ground to the desired degree of concavity they require no further grinding or sharpening, thus allowing the teeth to be shortened considerably and decreasing the space between the adjoining rows of teeth so as to avoid the accumulation of waste. C.

Spinning and Doubling Machine Pulleys. Platt Bros. & Co. Ltd. (Oldham) and J. F. Kinchin. E.P.400,972 of 6/2/1932.

The invention relates to various improvements in pulleys for spinning and doubling machines of the kind in which discs or circular plates of sheet metal, the circumferential parts of which form the circumferential parts of the pulleys, are applied and secured on centre pieces or spindles. The improvements provide stronger, better balanced and cheaper constructions than hitherto and facilitate the provision of case-hardened or other hard central parts or spindles. C.

Card Waste Collecting Device. R. Greg & Co. Ltd. (South Reddish) and J. Knowles. E.P.401,056 of 12/7/1932.

It is proposed to collect, batch, or roll up the liberated fibre and trash slowly upon a rotary support located within the compartment of a card below the dish feed and licker-in. The rotary device is so fashioned or clothed, and so located and driven, that it picks up the floating fibre and trash or collects it, so that the fibre and trash grows or is rolled up, and a thick sleeve or wrapping is ultimately produced upon the rotary support. The support is adapted to be removed for stripping purposes. Waste fibre falling below the main cylinder and doffer may be conveyed into the compartment by an endless apron or lattice. C.

Spinning Mule Twist Indicator. C. J. Glenny (Harwick). E.P.401,385 of 1/6/1932.

A twist indicator for use in combination with spinning mules comprises in combination a driving pully mounted on a driven part of the machinery, a spindle rotatably mounted in bearings formed in a mounting member supported from the framework of the machinery, a pulley mounted on the spindle and adapted to be driven from the driving pulley, a worm formed in the length of the spindle, a worm wheel adapted to be driven from the worm, an index carrried by the worm wheel and a relatively fixed graduated disc adapted to co-operate with the index, the driving means being arranged to give a constant predetermined relationship between the degree of movement of the index, the revolutions of the spindles and the length of yarn or thread produced at each cycle of operations, whereby the index in conjunction with the graduations on the disc is enabled to record the number of twists per unit length imparted to the yarn or thread during the cycle of operations. C.

Spinning Frame Automatic Feed-interrupting Apparatus. E. Stutz-Benz (Landsberg Warthe, Germany). E.P.401,551 of 27/2/1933.

Apparatus for automatically interrupting the feed of the material for spinning, twisting, and similar machines is characterised in that upon breakage of the thread a thread feeler situated near its labile position of equilibrium draws a disengaging lever situated in or near its stable position of equilibrium into the range of a driving device. The thread feeler and the disengaging lever are so connected together, for example by a link member, that the disengaging lever is not drawn into the range of the driving device until the thread feeler has fallen through a predetermined path. The return of the disengaging gear to the spinning position can take place automatically, as well as by hand. The feeler pressure can be adjusted to suit any desired thread tension and reliable operation is obtained with a low feeler pressure. C.

3—CONVERSION OF YARNS INTO FABRICS

(A)—Preparatory Processes

"Aquaresin" Glycol Bori-borate Rayon Lubricant. C. B. Ordway. *Amer. Dyes. Rep.*, 1933, **22**, 638-640.

The desirable and undesirable properties of natural and synthetic lubricants for cotton fibres are tabulated. Glycol bori-borate gives excellent results when used on a commercial scale for vat, sulphur, and direct dyed cottons. It is manufactured by the Glycol Products Co. Inc. under the name of "Aquaresin". It can be removed by a hot water bath at 170-180° F., or by soap or milder alkalis at lower temperatures. Its use in rayon lubrication is suggested. C.

"Non-Skid" Winding Spindle. Atwood Machine Co. *Text. World*, 1933, **83**, 1830.

The head of a new spindle for rayon and silk winding is faced with a one-piece replaceable rubber tread similar to an automobile tyre. The construction of this rubber tread with the friction wheel is said to give a smooth running, positive drive, and an extremely high traction or "non-skid" operation. The tread is easily placed on the spindle; requires no cement, being held in place by its own elasticity; and may be applied to old spindles as well as new equipment. The outstanding feature of this spindle is the elimination of slippage and the consequent loss of production on high-denier rayons and heavy silk threads, particularly where cleaners are used. It is not recommended for light threads. C.

Slub Catcher. Draper Corporation. *Text. World.*, 1933, **83**, 1830.

In an improved form of the MacColl spooler guide or slub catcher, the comb is attached to the holder in a fixed position. The size of the opening for the yarn is varied by an adjusting screw which lifts or lowers the comb by swinging the holder on its hinge. A set screw locks the adjusting screw so that the opening cannot change accidentally. The adjustment is said to be more easily and quickly made by this new arrangement. C.

Weft Pirns: Cleaning. Textile Operating Executives of Georgia. *Cotton, (U.S.)*, 1933, **97**, No. 10, p. 97.

Machines for cleaning weft pirns nearly always injure the pirns to some extent, especially if they are not looked after and continually adjusted. The number of pirns cleaned per operative per minute is reported to range from 90 to 125. C.

Analysing Silk Warping. O. W. Bitzenhofer. *Text. World*, 1933, **83**, 1810-1811.

The rationalisation of silk warping is described. The speed and quality of warping are materially improved by fitting remote controls, operated by switches, for starting and stopping the warper. Higher speeds are practicable if a metal tube is slipped on the spindle, revolving freely on it, and the bobbin is slipped over this; this device serves to reduce the tension on the thread at high speeds. There is, however, a limit to the useful increase in speed, owing to increasing thread-breakages. Statistical material is reproduced. S.

(B)—Sizing

Sizes: Composition and Application. B Métais. *Revue Text*, 1933, **31**, 749-753, 831-835.

The author discusses the general methods of sizing, the cooking of size, and the importance of careful control in the drying of sized yarns, and gives formulæ of suitable sizes for cotton and woollen warps. C.

Sizing, Dyeing, and Beaming Plant. P. Custers. *Rev. Fil. et Tiss.*, 1933, **18**, 444-448.

A device for simultaneous sizing, dyeing, and finishing is arranged so that the threads pass through the sizing tank, the dyeing and finishing bath, the drying chamber, a softening mechanism, and are finally wound on to the beam. The softening mechanism consists of two knives with the edges pointing in opposite directions, over which the threads are bent and drawn so as to scrape them and render them more flexible, the degree of flexibility increasing with the acuteness of the angle of bending. Separation of the sized threads is effected by means of combs combined with two grooved cylinders, the two threads which travel over one groove in the first cylinder being separated by the comb so that they occupy separate grooves in the next cylinder and are paired with other threads. Diagrams are given. C.

Slashers: Temperature Control. Textile Operating Executives of Georgia. *Cotton* (*U.S.*), 1933, **97**, No. 10, pp. 88 and 90.

A symposium of results from American mills using temperature controls on slashers reports more even running of yarn weights and a more constant moisture content. Temperatures mentioned run from 200 to 242° F., and the moisture content aimed at was 7% and sometimes 8%. Good results are also claimed for thermostatic or automatic size-level controls in the size box. C.

Slasher with Double Size Boxes: Advantages. Textile Operating Executives of Georgia. *Cotton* (*U.S.*), 1933, **97**, No. 10, p. 95.

Better penetration is obtained from the use of double size boxes on the slashers. When a reverse twist yarn is used in the warp this yarn is dried by passing it through a separate size box. Good results have also been obtained from a "hollow" immersion roller constructed of ten small bars equally spaced around the periphery of the roller, more uniform penetration being claimed. C.

Starch: Liquefaction with Enzymes. Textile Operating Executives of Georgia. *Cotton* (*U.S.*), 1933, **97**, No. 10. pp. 90 and 92.

A discussion on the respective merits of acid-converted thin-boiling starch and ordinary pearl starch liquefied with enzymes reports excellent results from the latter. Increased weight in warp yarn, decrease in weaving room sweeps, less shedding, and better penetration by the size are obtained, and there is no processing tax on the starch content so applied. The size solution is non-congealing and the circulating pipes are not stopped up. A saving of one dollar per kettle is also obtained by the use of pearl starch. C.

Starch Pastes: Structure Viscosity. W. Seck. *Textilber.*, 1933, **14**, 546-547.

Work on the structure viscosity of starch pastes and its reduction on heating or by mechanical treatment is reviewed and its practical importance is indicated. C.

(C)—Weaving

Cotton and Rayon Warps: Effects of Extensibility on Cloth Appearance. G. Harris. *Text. Weekly*, 1933, **12**, 255.

A report of a lecture dealing with the relations between reediness and setting-on places and shedding. The view is held that the back rest need not be more than 1 in. out of normal position and is frequently raised too much. C.

Loom Back Rest: Regulation. A. Wanger. *Revue Text.*, 1933, 31, 653-657.
A general discussion of types of back rests in use, the function of the back rest, and the effects of horizontal and vertical displacements of the back rest on the tension of the warp. C.

"Mutter" Multiple Shuttle Loom. K. Mutter. *Text. Mfr.*, 1933, 59, 404.
A description is given of the multiple shuttle loom of E.P.393,580. In this loom several shuttles pass through the warp one after the other. Each shuttle travels in its own warp shed and each pick is beaten up continouusly as it is laid. Each shuttle comprises a spindle lying warp-way and mounted on a baseplate which is provided with a dovetail piece engaging in a guide slot formed in a coarse reed. Beat-up, shuttle traverse, and shedding, depend upon shafts in which discs are arranged in spiral form, and the operations take place in wave-form across the width of the warp. The loom is positive, runs almost continuously, is gentle in action, and almost noiseless, has advantages in the production of high-pick cloths and in weft mixing, and can be used for check weaving. The cut selvedges and limitations in reed and weave are disadvantages. C.

Pickers: Preparation. W. Shuttleworth. *Text. Weekly*, 1933, 12, 197-198.
Directions are given for the preparation and treatment of pickers. Drying should be extended over two months, and sperm oil is recommended for steeping, owing to its more rapid penetration. Steeping requires 12 months, and the second drying three months. The spindle holes are best bored wirh a spiral drill, the diameter of which is $\frac{1}{32}$ in. larger than the thickness of the spindle. The tip of the shuttle must be presented to the centre width of the picker. The buffer at the end of the picker spindle should be made of the most resilient leather possible. C.

Special Fabrics: Weaving. W. Wilkinson. *Text. Weekly*, 1933, 12, 259-260.
A report of a lecture. Suggestions for the avoidance of warp breakage and spreading during the manufacture of special fabrics are (*a*) Warp in stretch should be as short as is practicable. (*b*) The warp line should be regulated by the structure; for half sheet distribution or warp-faced fabrics woven face up, the warp line should be 1 in. to 2 in. above the point where the healds cross. (*c*) Greater consideration should be given to leasing. (*d*) Shedding for the warp should be on the split-shed principle. The importance of uniform extensibility in the weft of crêpe yarns is discussed and the various factors connected with the shuttle traverse are enumerated. C.

Trapezoidal Shuttles: Application. A. Cohen. *Text. Lloyd*, 1933, 7, No. 20, pp. 21-24.
The usual types of shuttles and bobbins do not make the maximum use of the shed and the space inside the shuttle. The quantity of yarn in the shuttle can be increased if the size and shape of the shuttle are made to approximate more closely to those of the shed and flattened bobbins are used. A rectangular shuttle carrying a bobbin of elliptical cross-section may be employed, but greater advantages are obtained by the use of trapezoidal shuttles carrying bobbins of ovoid cross-section. Such flattened bobbins may be obtained by placing ordinary circular bobbins on elliptical shuttle pegs. The shuttle pegs may consist of two or more sections of which the relative positions can be changed after introduction into the usual paper tube carrying the yarn in such a way that the bobbin is forced to assume an elliptical or ovoid cross-section. C.

Tyre Fabric Automatic Loom. British Northrop Loom Co. Ltd. *Text. Merc.*, 1933, 89, 385.
The warp yarn is carried on large double-headed bobbins carried in an all-steel creel placed behind the loom. The ends are drawn through special thread guides in the creel and down to a large thread guide used for spacing the ends which are then led to the warp-tensioning arrangement at the back of the loom. This arrangement consists of three rollers, one being placed on the top of the other two. The top roller is covered with rubber; the back roller is covered with a special quality of felt, and the front roller is just plain wood. These different materials are used to ensure that the yarn is gripped securely and a uniform tension maintained on the yarn. The arrangement is positively driven and gear wheels of different size can be used according to the number of picks required per inch in the fabric. The let-off and the take-up are positively controlled in this way. As a rule the picks per inch vary from 1½ to 6 or 7, and the let-off and take-up have change wheels to cover this range. The shedding motion is of the ordinary roller

type for weaving plain cloth, the tappets being placed on the tappet shaft. The loom is usually driven through a core friction clutch and is applicable for either lineshaft or individual loom motor drive. The weft is automatically replenished in the shuttle with a standard Northrop battery, and the bobbins used are usually approximately 8½ in. in length, having a maximum yarn diameter of 1½ in. or 1⅝ in., according to the counts. The loom is equipped with an automatic weft feeler motion and special thread cutters for controlling the weft yarn. The automatic warp stop motion is of the standard mechanical type usually with four bars for four rows of drop wires. A special take-up motion is fitted to the loom with a cloth wind-up motion on an auxiliary stand behind the weaver's platform capable of accommodating rolls up to 36 in. diameter. The cloth take-up motion always works in advance of the let-off motion, so as to maintain the cloth in correct tension, but at the same time there is an automatic friction arrangement which allows the wind-up to slip, thus compensating for the greater speed in the taking up of the cloth. As there is no warp beam, the ends are spliced in the creel and the loom can be kept running continuously. C.

Automatic Loom Shuttles: Standard Dimensions. *Textilber.*, 1933, 14, 536-537.
The dimensions of 10 standard sizes of TEX 4668 shuttles for automatic looms are given. C.

Jacquard Card and Harness: Impregnation Standardisation. F. Kreindl. *Textilber.*, 1933, 14, 538-539.
Warping and deterioration of jacquard cards under varying atmospheric conditions are discussed and it is pointed out that there is a need for a standard high-quality pasteboard for these cards. With changes in atmospheric conditions some harness cords show a tendency to twist. A standard method of impregnating cords is required. C.

Starch Products: Use in Textile Industry. *See* Section 5D.

(D)—Knitting

Cleaning Cloths: Knitting. W. Davis. *Text. Mfr.*, 1933, 59, 394.
Cloths suitable for various cleaning purposes may be made on multi-feed circular knitting machines. The yarns used for this purpose are usually single, but whilst having a low twist multiplier to yield a soft handle, the yarn should be compact and not readily shed its fibres when in use. An open mesh structure is required. Metal yarns may be introduced. One type of cleaning cloth is made on a kind of warp knitting machine in which the threads are not given a side-to-side action but work always on the same needle moving round it at each course to lay the thread. Cotton warp threads are used. Between the knitting courses are inserted weft threads consisting of jute cores with two metal threads twisted round in opposite directions. This type of fabric may be strengthened by the inclusion of fine copper wires alternately with the cotton warp threads. C.

(F)—Subsequent Processes

Gassing and Singeing Plant; Use of Coal Gas for——. *See* Section 2C.

(G)—Fabrics

Double Cloths: Weaving. R. A. C. Scott. *Text. World*, 1933, 83, 1808-1809.
A discussion of the structural characteristics and the methods of weaving double cloths or cloths composed of two series of weft and two series of warp threads. C.

Double Piqué Fabric: Weaving. U. Schirdewan. *Leipz. Monats. Text. Ind.*, 1933, 48, 207-209.
A discussion of the structure and weaving of figured double piqués. C.

Jacquard Designs: Enlarging. E. Gräbner. *Spinn. u. Web.*, 1933, 51, No. 39, pp. 38-46; No. 40, pp. 1-6; No. 41, pp. 1-5.
The author shows that it is possible to enlarge designs in Jacquard weaving by means of the harness arrangements. The preparation of additional cards is unnecessary and large designs can be produced on comparatively small Jacquard machines. Examples of the application of the method in the weaving of tapestries, brocades, and silk damasks are described in detail. C.

Rayon Crêpe Fabrics: Manufacture. *Deutsche Färber-Ztg.*, 1933, 69, 467-468.
A short discussion of some of the precautions necessary in the preparatory, weaving and finishing processes involved in the production of rayon crêpe fabrics. C.

Thick Fabrics: Weaving. P. Body. *Revue Text.*, 1933, 31, 847-849.
Thick fabrics suitable for the manufacture of slippers and similar articles comprise a surface layer of fine, good-quality yarns and a number of lower layers composed of material of poorer quality. The different layers are united by connecting yarns. Various constructions are shown in diagrams. C.

Leather Cloths: Manufacture. A. Jones. *Synth. Appl. Finishes*, 1933, 4, 208-211.
Patent literature is reviewed and a general account is given of the methods of manufacture. C.

Fabrics: Selection of Trade Names. B. Teufer. *Textilber.*, 1933, 14, 548-549.
The names given to textile materials are frequently misleading. For example, such names as "Markoline" and "Duroline", which are given to certain cotton goods treated to resemble linen, may lead purchasers to believe that the goods are actually linen goods. The author suggests various rules which should be observed in the selection of trade names and in statements relating to quality. Referring to the Sanforising process, he points out that the need for processes of this type can be eliminated by careful control of tension in weaving and finishing processes. C.

Satins and Sateens: Designing. J. H. Strong. *Text. Weekly*, 1933, 12, 364-365.
An arrangement for satin or sateen weaves may be constructed on an arithmatical basis by the following rule. Divide the number of ends on which the satin or sateen is to be made into two unequal parts so that one shall not be a measure of the other and not divisible by a common number. A table of intervals for satins and sateens is given. If a patternless cloth is desired, then the binding dots should be as far as possible from each other. C.

"Lutex" Elastic Web. Luke Turner & Co. Ltd. *Text. Rec.*, 1933, 51, No. 608, p. 40.
A new elastic web known as "Lutex" is made by covering a rubber thread exuded from the liquid latex with fine quality rayon. For certain uses a special threader is provided. W.

PATENTS

Shuttle Yarn-protecting Plate. Bélissant Frères. F.P.744,761 (through *Revue Text*, 1933, 31, 669).
With the ordinary type of shuttle, the weft yarn passes out from the interior and along a groove in the face of the shuttle where it is exposed to possible mechanical damage and to staining by oil in the shuttle box. The yarn may be protected by fixing a small metal plate over the groove. C.

Automatic Cop-changing Device. J. L. R. and Mlle. S. Cherpin. F.P.744,841 (through *Revue Text.*, 1933, 31, 587-589).
An automatic cop-changing mechanism for looms is described and shown in diagrams. C.

Weft Feeler Mechanism. Ateliers Diederichs. F.P.747,125 (through *Revue Text.*, 1933, 31, 671).
A bent spring is attached by one end to the pirn tube and its other end is pressed against the tube by the layers of yarn. When the weft is exhausted the spring projects from the shuttle and presses against another spring in the shuttle box. This second spring is displaced in such a way that it completes an electric circuit. The current may be used to operate a stop motion or a weft replenishing mechanism. C.

Uncut Double Velvet: Weaving on Ordinary Looms. C. Labriffe. F.P.748,742 (through *Revue Text.*, 1933, 31, 849-851).
A method of weaving uncut double velvet on ordinary looms involves the introduction of shafts of healds behind the harness for the formation of the ground fabrics, and of a special shaft carrying blades or strips which regulate the distance between the two pieces and the length of the pile. C.

Cereal Protein Sizing Agent. B. N. Lougovoy (for Ellis-Foster Co.). U.S.P. 1,884,015 of 18/1/1928 (through *Brit. Chem. Abstr.*, 1933, *B*, 781).
Proteins of the gliadin-zein type that are soluble in aqueous alcohol are used in (*a*) the preparation of hair fixatives, etc., (*b*) as stiffening and sizing agents for fabrics, and (*c*) as adhesives for laminated paper products. C.

Milk Filter Cloth. Robinson & Sons Ltd. (Chesterfield), V. O. Robinson, and J. J. Blow. E.P.393,592 of 4/12/1931.

A filter medium especially suitable for filtering milk and similar liquids comprises a backing of textile material, e.g. gauze, and a facing of cotton wool, preferably in layers, which is caused to adhere to the textile material by locally applied mechanical pressure, e.g. by impressing a pattern on the facing, leaving substantial areas of the cotton wool undisturbed. When the gauze and cotton wool layers are united by this method, the tactile sticking properties of the cotton wool are overcome and thus it is possible to stack a pile of the filter media without any interleaving and when stacked a single medium can readily be detached from the pile. It is possible to use such a filter medium more than once, since washing (e.g. by steeping in hot water) does not destroy the adherence between the cotton wool and the gauze. C.

Straight-bar Knitting Machine. Wildman Manufacturing Co. (Norristown, Pensylvania, U.S.A.). E.P.396,280 of 23/12/1932.

A full-fashioned knitting machine is provided with a picot bar movable either to idle position away from the needles or into working position. The bar is operable longitudinally by one of the narrowing point carriers. While narrowing is performed the picot bar is in its upper position. The movement of the narrowing point carrier is reduced when the picot bar is in operation. The adjusting means for yarn carrier stops is thrown out of operation while picot is being formed. C.

Non-barry Stockings: Knitting. C. A. Kaufman (New York). E.P.396,346 of 19/4/1933.

Full-fashioned stockings, parts thereof, or blanks therefor, devoid of horizontal bands, streaks of light and heavy shadings are obtained by forming successive series of courses in which each course is composed of a different thread from the threads forming the other courses of that series. A series preferably comprises an odd number of courses. C.

Latch Needle. R. K. Mills (Sherwood, Nottingham). E.P.396,705 of 5/2/1932.

The latch of a hosiery machine needle is somewhat cranked near the pivot to reduce the tendency to cut the yarn. When the latch is fully closed the point of the needle hook is completely guarded by a spoon. An additional latch may be provided. C.

Jacquard Card Cutting Machines. P. P. Fielding and Devoge & Co. Ltd. (Manchester). E.P.396,922 of 4/7/1932.

In piano jacquard card cutting machines having self-centring card guides comprising two adjustable jaws movable to and from a permanent centre line, one jaw is fixed to one or more sliding bars and the other jaw is loosely mounted on the bars and acted on by springs. The cards to be punched are then placed in succession between the jaws, the one jaw yielding as each card is introduced, but being returned by the springs and centring the inserted card. C.

Loom Warp Stop Motions. R. Scheffel (Greiz, Germany). E.P.397,078 of 4/5/1933.

The serrated bar which is movable in the upper U-shaped heald stave and stops the loom when its movement is blocked owing to warp breakage and consequent falling of a heald, is operated directly by a normally stationary vertical stop surface on a bearing on a lever which is pivoted on a slider and is normally raised by a spring. C.

Pile-fabric Looms. T. W. Head, H. & M. Southwell Ltd., and Platt Bros. & Co. Ltd. E.P.397,226 of 18/3/1932.

In looms for weaving Royal Axminster, moquette, and like tufted pile fabrics, the rear knife of the pile-cutting mechanism is primarily moved into alignment with a row of tufts, by means of a cam, and then held rigidly against abutment stops, during the shearing movement of the co-operating front knife, by a cam-actuated locking device. The knife-supporting levers are connected to a pair of rearwardly extending arms the forked extremities of which are slidably mounted on a shaft that can be rocked by means of cams on the tappet shaft. When one of the cams engages a bowl on a pivoted lever, locking levers, fixed to the shaft and provided with cam-faced shoulders, are lowered into engagement with projections on the rearwardly extending arms so as to lock the rear knife in its advanced position. With the continued rotation of the tappet shaft, the other cam comes into operation to raise the locking levers and permit withdrawal of the rear knife after the cutting operation. W.

Loom Dobbies. F. Fielden (Stockport). E.P.397,255 of 7/5/1932.

The cast metal catch grates of a dobby are provided with sheet-metal plates having holes punched therein to accommodate needles, the lower plate also having guiding slots for the peg levers. The plates are secured to the underside of their respective grates by means of screws. C.

Pattern Card Foil Coating: Application. R. V. Neher A.-G. (Kreuzlingen, Switzerland). E.P.397,378 of 23/1/1933.

A Verdol paper, band, or the like is coated on one or both sides with metal foil, such as aluminium foil, whereby changes due to the variations in the moisture of the air are reduced. C.

Knitting Machine Yarn Positioning Device. H. H. Holmes and Wildt & Co. Ltd. (Leicester). E.P.397,478 of 22/2/1932.

A device for positioning the yarn of a feeder moving into operative position so that it can be readily taken by the needles comprises a pivoted member having a portion which, when the device is in operative position, lies close to and in a direction crosswise of the needles. As applied to a cylinder and dial rib machine, the device is so arranged that this portion lies beneath and radially below the heads of projected dial needles, and is preferably of such length that it extends beyond the trapper and the feeders. C.

Patterned Rib Fabric: Knitting. H. Brinton Co. (Frankford, Philadelphia, U.S.A.). E.P.397,498 of 23/2/1932.

A rib knitted fabric, hose or half hose has patterned portions comprising tuck stitches or openwork combined with warp or wale yarns. As applied to rib knitted hose, the openwork may be produced by the cylinder needles only, and a welt patterned by warp yarns may be provided. C.

Warp Beam Flange-securing Means. British Aluminium Co. Ltd. (London), J. R. Whitelegg, and J. H. Proctor. E.P.397,613 of 6/5/1932.

The flanges of a warp beam are adjustably secured by mounting them on split sleeves each of which is formed with a tapered outer surface and a screwed portion, the application of a nut causing the internally-tapered flange to be forced against the sleeve and the latter to be clamped to the beam. All parts, including the beam, are preferably made of aluminium, or an alloy thereof, but, if desired, the flanges and their securing means may be mounted on a wooden beam having a thin metal sleeve at each end. C.

Shuttle Peg. U. Sayler (Stuttgart, Germany). E.P.398,153 of 1/12/1931.

The cop tube is made with an extension having transverse slots and is provided with a flange serving as an abutment for the yarn and for limiting the entrance of the tube into the socket. The socket has a tubular body, a base, and the usual ribs, and is furnished with a cup flanged over the body and having the diameter of its interior equal to that of the extension of the tube. A spring is housed in the rim of the cup and its ends pass through slots in the cup. In use the socket is pushed on to the extension so that the spring ends snap into the slots, the correct position for inserting the tube being indicated by notches. C.

Vinyl and Polyvinyl Sizing Compounds: Preparation. H. Dreyfus (London). E.P.398,173 of 1/2/1932.

Vinyl compounds containing hydrophile groups are manufactured by reacting a vinyl halide with a compound containing a replaceable hydrogen atom and at least one hydrophile group. The invention includes the production of compounds substituted in the vinyl group from correspondingly substituted vinyl halides. The products may be polymerised alone, or in admixture with one another or with other vinyl compounds, by the action of heat or light or both in the presence or absence of diluents, and in the presence or absence of substances facilitating the reaction. In an example, vinyl chloride is heated to 80-100° C. in an autoclave with sodium glycol to produce glycol monovinyl ether, the product may be polymerised by warming under a reflux condenser in the presence of benzoyl peroxide and under the influence of radiation from a quartz mercury vapour lamp; the polymerised product may be dissolved in water and used directly for sizing purposes. C.

Jacquard Cards: Punching. L. Koch (trading as Koch & Te Koch), Oelsnitz, Germany. E.P.398,183 of 3/3/1932.

The patent relates to means for punching cards for jacquards for controlling the weft supply in looms for weaving chenille fabrics, etc. wherein card saving motions are used, each card, in addition to colour determining perforations, being punched with shot counting perforations controlling the number of times this card is repeated in the machine. According to the invention, the card band to be punched is fed forwardly intermittently one step at a time through the punching machine, but the paper strip pegging plan viewed through one of two windows provided with observation marks comprising graduated scales is, after a punching operation, fed forwards at once a distance corresponding to the number of times the colour is observed to be repeated. When the direction of traverse of the pegging plan is reversed, a different observation mark is utilised, by moving the left-hand window to an angular position and bringing the right-hand window into position directly in front of the pegging plan. Means are described whereby each time the pegging plan is reversed stampings may be marked on the card band. C.

Cellulose Ester Rayons: Lubricating and Sizing. British Celanese Ltd. (London), H. M. Hibbert, and R. P. Roberts. E.P.398,243 of 11/3/1932.

Textile materials are lubricated or sized with an oil or fat obtained by completely or partly hydrogenating an oil or fat of the coconut oil group, such as coconut oil or palm-kernel oil. The treatment may be effected at atmospheric or raised temperature and may be applied to filaments, etc. of cellulose acetate and other organic derivatives of cellulose, a number of which are mentioned. The oil or fat may be applied as such or as a solution or emulsion, and with or without other treating agents such as plasticisers, swelling agents, and hygroscopic solids. Various methods of applying the oil or fat are indicated. C.

Variable Speed Take-up Mechanism. British Celanese Ltd. (London), W. H. Kimpton, and S. M. Fulton. E.P.399,808 of 1/4/1932.

In an improved take-up mechanism for winding webs of materials such as yarns, warps, fabrics, films, etc. the drive is transmitted to a winding device through a differential mechanism whose planetary gears are carried by a housing provided with a braking surface. The drive is applied to one of the sun wheels of the differential mechanism, and transmitted to the winding device through the other sun wheel. The differential mechanism can be used to provide for large degrees of slip between the driving means and the winding device, as for example, in the winding of webs of material into large rolls or beams, such slip being provided by varying the braking effort applied to the housing carrying the planetary gears. Thus the mechanism can be used to maintain substantially uniform tension in warps undergoing sizing, nothwithstanding the increasing diameter of the beam of sized yarn, the slip occasioned being provided by the rotation of the braked member against the braking effort. Cooling means may be employed to dissipate the heat produced at the braking surface. If fire control of the degree of braking is required, a lubricant may be applied to the braking surface. The braking means may comprise a brake band adapted to contact with the braking surface of the rotatable housing of the differential, and means for applying tension to the band. C.

Shuttle Checking Mechanism. N. Catterall (Dunscar, near Bolton). E.P.399,810 of 5/4/1932.

In an improved form of the mechanism described in E.P.239,343 the spring that is arranged to press upon the end of the swell lever is mounted so that it is fixed upon and moves with the swell lever, as well as having its free end clear of the same from time to time, so that the actions of the spring may be more easily adjusted, in order to enable the mechanism to be used in a fast reed loom as well as in the ordinary and usual loose reed loom of the type where swell levers are also used. C.

Polyvinyl Alcohol Sizes: Application. I.G. Farbenindustrie A.-G. (Frankfort). E.P.399,905 of 6/5/1932.

A particularly favourable sizing effect is obtained by using a mixture of at least two polyvinyl alcohols, the viscosity (determined in the aqueous solution) of one of which differs materially from that of another, for instance, by using the combination of a polyvinyl alcohol of high viscosity with a polyvinyl alcohol of low viscosity. A similar effect is produced when for one or more components of the mixture there is substituted a water-soluble derivative of a polyvinyl alcohol, the viscosity of one component being materially different from that of another. A product of the reaction of an alkylene oxide on a polyvinyl alcohol may be used as the water-soluble derivative. Examples are given. C.

Slay Actuating Mechanism. F. J. Marx and O. Wittmers (Cologne). E.P. 400,136 of 12/6/1933.

The double lever, pivoted to each of the slay swords, is arranged as a bell-crank lever with the obtuse angle between the arms facing the crankshaft and with the arms of different length. With this arrangement it is possible for the forward pause in the travel of the slay to be shortened until it disappears completely, whereas the rear pause can be lengthened or the angular distance to be traversed by the crankshaft during this pause without the slay being moved, can be determined as required. C.

Change Box Looms. Blackburn Loom and Weaving Machinery Making Co. Ltd. and W. Wilkinson. (Blackburn). E.P.400,638 of 29/3/1932.

The object of the invention is to adapt an over or under picking motion of the ordinary type (picking alternately from side to side) as applied to fast running Lancashire looms to the weaving of fabrics containing single picks and involving the use of from two to seven shuttles. This enables the manufacturer to adapt his looms for weaving either the standard fabrics, or those patterns requiring single picks for which the complicated pick-at-will looms have previously been used. According to this invention the dobby pattern barrel, or jacquard cylinder actuating mechanism and the weft fork mechanism for stopping the loom are all put out of action at predetermined times to enable the loom to work on one pick without shuttle. For this purpose two levers actuated by cam gearing from the bottom shaft of the loom are utilised, one to control a weft fork device and the other to control a dobby pattern barrel or jacquard cylinder actuating mechanism. C.

Yarn Sizing and Finishing Machine. G. Hill (Wellford, South Carolina, U.S.A.). E.P.401,327 of 7/5/1932.

A machine for sizing and finishing yarns comprises a tubular member through which the yarn is passed and a nozzle positioned substantially adjacent the end of the tubular member, the nozzle being directed to deliver liquid against the yarn in a direction substantially opposite to the direction of travel of the yarn. C.

Loom Let-off Motion Control Means. Beaumont & Smith Ltd. (Pudsey), F. Richardson, and A. Sutherland. E.P.401,470 of 12/9/1932.

The object of the invention is to provide means which can be applied to various classes of looms to obviate the hand adjustment of the loom after picking back whereby a more perfectly woven cloth is produced free from the usual uneven weaving that frequently occurs when re-starting the loom after having taken out several picks of weft. This is achieved by the combination with the teller lever or levers forming part of the warp let-off motion, of means connected to the usual reversing rod and serving as a control device for arresting the intermittent motion of the teller lever or levers and warp beam operating means, whereby the warp beam stops simultaneously with the reversal of the piece beam irrespective of the warp tension. C.

Loom Framework. Tefag Textil-Finanz A.-G. (Zurich, Switzerland). E.P. 401,605 of 23/5/1933.

A longitudinal frame element connects together the lateral frame members of the loom and carries a driving shaft and such mechanisms driven thereby as are directly associated with the shedding, beating-up, and shuttle movements. Preferably two or more similar sets of mechanism are provided each comprising the means for operating the parts directly associated with the shedding and beating-up movements, all of these mechanism sets being driven from the driving shaft through couplings which can be readily disconnected. Preferably the longitudinal frame element, which extends across the loom, is V-shaped in cross-section so that the let-off and take-up beams can be arranged within the limits of the lateral members of the frame. If desired an oil bath may be incorporated in the longitudinal frame element, the supply of lubricant to the moving parts of the loom being effected, for example, by means of one or more circulation pumps. C.

4—CHEMICAL AND FINISHING PROCESSES

(A)—Preparatory Processes

Sulphonated Oils: Properties. L. W. Davis. *Amer. Dyes. Rep.*, 1933, **22**, 634-637.

The preparation and properties of sulphonated oils are discussed. The formation of insoluble calcium or magnesium soaps in hard water may be prevented by keeping the percentage of combined alkali as low as possible, and by increasing the -SO_3 content. The carboxyl group may also be "blocked" by substituting various groups for the hydroxyl group. Since the sulphonated oil only acts as a dispersing agent for the neutral oil, which has the lubricating and softening properties, an over-sulphonated oil will not give a soft finish because too little neutral oil is present. A discussion is appended. C.

Wetting Agents: Chemical Constitution. W. Kritchevsky. *Amer. Dyes. Rep.*, 1933, **22**, 630-634.

The author discusses the work of Harkins, Feldman, Langmuir, and others on the wetting and spreading actions of various organic liquids. Hydrophil and lipophil substances are defined and discussed, and an analogy is drawn between the relation of colour of dye to chemical constitution and that of wetting action to chemical constitution. Witt's theory is applied to wetting agents, and groups are classified as lipophores, hydrophores, and auxohydrophores, the latter corresponding to auxochromes in dyes. A discussion is appended. C.

Decamine—A Stripping Agent: Application. L. G. Lawrie. *J. Soc. Dyers and Col.*, 1933, **49**, 309-312.

Decamine A is a soluble alkylamine stripping agent marketed by Imperial Chemical Industries Ltd. Seven different methods for applying it are described. A discussion is reported in which the following photo-effect was mentioned. A fabric dyed with Caledon Yellow GS was exposed to light, padded in Decamine A and caustic soda solution, then dried, steamed, and washed. Instead of this fixing the colour, it was stripped almost to white, whereas there was scarcely any stripping with a piece treated similarly, but not exposed. C.

(B)—Boiling, Scouring, Degumming, and Washing

Gardinol and Avirol Scouring Agents: Properties. S. Lenher. *Amer. Dyes. Rept.*, 1933, **22**, 663-667.

The respective merits of Gardinols WA and CA in scouring wool are discussed, and the uses of the Brilliant Avirols are reviewed. Tables and graphs are given showing the solubilities of the calcium alkyl sulphates in water and also in solutions of Gardinol WA. The presence of Gardinol increases the solubility, so that curds are not formed as with ordinary calcium soaps. C.

Percolloid B: Application in Scouring. *Textilber.*, 1933, **14**, 550-552.

Attempts to improve scouring by the addition of soaps, oils, and various solvents to the alkali bath have not been wholly satisfactory but good results have been obtained with Percolloid B, which has a high emulsifying power. The fat, ash, and nitrogen contents of goods after scouring in baths containing Percolloid B are over 40% less than those of similar goods scoured without the addition of this compound whilst the goods are of higher white content and higher strength and capillarity. The higher strength is attributed to the fact that such baths retain their reducing properties and protect the fibre from attack by atmospheric oxygen. C.

Use of Soap in Degumming Silk Hosiery. W. W. Bray. *Text. World*, 1933, **83**, 1816-1817.

Formulæ are given. S.

Influence of Alkali in Degumming of Silk. V, VI. I. Toyoda. *J. Soc. Chem. Ind. Japan* (Suppl.), 1933, **36**, 368B-370B (through *Chem. Zentr.*, 1933, **ii**, 2918).

Silk may be degummed without injury by boiling 0·001 *N*-sodium hydroxide or 0·007 *N*-sodium carbonate, a colloid preferably being added. In soap degumming continuous control of the alkali content is essential. S.

Colour Bleeding in Scouring. F. C. Pratt. *Text. Col.*, 1933, **55**, 679 and 704.

In scouring after dyeing, colour bleeding is more likely to occur in woollens than in worsteds. Better results are obtained if a saponifiable oil is used during spinning, this making unnecessary the addition of external soap in scouring.

Details are given of the strength and temperature of the soda ash used. In the case of very low quality woollens which have been oiled with unsaponifiable matter, it is beneficial to add a saponifiable oil, e.g. olein, in place of soap. W.

(D)—MILLING

Cloth Milling with Acids. A. Yewdall. *J. Text. Inst.*, 1933, **24**, P173-P177.

Fulling and Milling Machinery. E. Kilburn Scott. *J. Text. Inst.*, 1933, **24**, P247-P263.

(E)—DRYING AND CONDITIONING

Air Drying Machines. *Chemical Age*, 1933, **29**, 437-438.

Three Kestner gas or air drying plants are described. The first is a continuously operating unit consisting of two silica gel absorbers which work alternately, one being regenerated while the other absorbs. The plant is electrically operated. Another unit with two absorbers is designed for cupboards and storage spaces, and the necessity for regeneration is shown by a colour change in the absorbent material. The third has two absorbers for continuous operation and is designed for the drying of compressed gases. C.

Drying Apparatus. C. G. Haubold A.-G. *Textilber.*, 1933, **14**, 557-558.

The drying apparatus is divided into several sections through which the cloth is carried in a horizontal path by an endless travelling belt. A current of air passes through the apparatus in the opposite direction to the cloth. Fans are arranged at each side of the apparatus in such a way that the air is blown into the top half of each section and sucked from the lower half so that the current of air has a kind of alternating horizontal and vertical zig-zag motion. Heating devices are placed between the drying sections and the temperature of the air increases as it approaches the end where the cloth enters the machine. Between the drying sections are free spaces in which the cloth can contract in length and width. C.

Hank Drying Machine: Process Analysis. M. Scholtz. *Textilber.*, 1933, **14**, 539-542.

By an example it is shown that a continuous yarn drying machine which gives a high production with hanks of a particular type and size will not have the same output with a different size of hank unless the air supply or rate of transport of the goods is suitably adjusted. The drying process in a drying chamber in which the goods remain stationary is analysed and the method of calculating air requirements, time required for drying, etc. is indicated. C.

(G)—BLEACHING

Absorbent Cotton: Preparation. W. Fehre. *TIBA*, 1933, **11**, 737-739.

Boiling in caustic soda containing suitable wetting agents followed by hydrogen peroxide bleaching is recommended. Details of procedures for the treatment of ordinary clean cotton and dirty raw cotton are given. C.

(H)—MERCERISING

Wetting Agents: Application in Mercerisation. A. J. Hall. *Amer. Dyes. Rep.*, 1933, **22**, 623-628.

A review of recent patents for wetting-out agents, some recipes being given. The Mercerols receive special notice and Shirlacrol is mentioned briefly C.

(I)—DYEING

Azo Dyes: Colour and Constitution. J. S. P. Blumberger. *Chem. Weekblad*, 1933, **30**, 538-547 (through *Brit. Chem. Abstr.*, 1933, *A*, 946).

The powerful bathochromic effect of the co-ordinated *o*-hydroxyazo group is termed "chromophoric inversion". Usually, a *p*-hydroxymono-azo dye shows a bathochromic colour change with hydroxyl ions, but with *o*-hydroxymono-azo dyes the colour change may be absent or hypsochromic (54 examples are quoted). Parallel effects are observed with amino-azo dyes and hydrogen ions (40 examples) the influence of substituents being similar in the two cases. The colour changes are explained on the electronic conception. The NHNa group is suggested as a new auxochrome. It is unnecessary to assume a quinonoid structure for either type of dye. The azo chromophore is considered to be mainly responsible for absorption in the visible range of the spectrum, the ethylenic linking having little influence. Absorption curves are reproduced for a large number of mono-azo dyes. C.

Caledon Dyes: Application to Cotton and Rayon. W. M. Todd. *J. Soc. Dyers and Col.*, 1933, 49, 312-316.

Previous work on the vat dyeing of rayon is reviewed, and a table is given showing the dyeing rates of various Caledon colours on cotton. Tests on regenerated cellulose rayons show that, although the rates of exhaustion vary with the type and quality of the rayon, the relative rates of dyeing of the different dyes correspond approximately with the results obtained on cotton. The failure of certain vat dyes to dye in combination is probably due to differences in the exhausting properties. In dyeing viscose rayon—cotton mixtures, cotton is coloured more deeply than viscose rayon at the lower temperatures, and the reverse is true at high temperatures. Variation of the caustic soda content does not affect dye distribution, whilst this is improved by the addition of Glauber's salt or of a retarding agent such as Perminal W. The tendering of rayon during vat dyeing may be produced by bleaching in neutral solution, by sunlight, by finishing agents, and by deposition of sulphur compounds if the goods are acidified before they are cleared from hydrosulphite solution. Chemical constitution may also have an effect on tendering. A discussion is appended. C.

Cellulose Materials: Direct Dyeing. S. M. Neale and L. H. Griffiths. *Amer. Dyes. Rept.*, 1933, **22**, 651-654.

A general review of recent work on direct dyes and cellulose. A classification of the direct dyes is given and their nature and behaviour are discussed. Some recent theories of dyeing and the structure of cellulose are reviewed. C.

Cellulose Materials: Dyeing. R. E. Rose. *Ind. Eng. Chem.*, 1933, **25**, 1265-1268.

A general review. The dyeing characteristics of viscose rayon and sheet, acetate rayon, paper, and linen are described, and dyeing conditions and the particle size of different dyes are discussed. Under the heading of causes of variation in cotton dyeing, the author states that sledded cotton gives different results from hand-picked cotton. C.

Textiles: Dyeing and Printing. G. Martin. *Bull. Soc. Chim.*, 1933, **53**, 1001-1015.

A lecture delivered to the French Chemical Society on recent developments in the chemistry of dyeing and printing. C.

Turkey Red Oil: Preparation. —. Welwart. *Seifensieder Z.*, 1933, **60**, 707-708. (through *Chem. Zentr.*, 1933, **ii**, 3211).

The author discusses errors in the production of Turkey Red oil and other sulphonated oils. The hydrolytic effect of atmospheric moisture and especially that of the water formed in the reaction should be countered by using closed vessels and adding a substance like acetic anhydride. The end-point of the sulphonation is recognised by the fact that a 2-3% emulsion is clear. Most errors arise in the treatment subsequent to sulphonation. The processes should be carried through as rapidly as possible. The product is first washed two or three times with Glauber salt solution and the sulphonated oil should separate quickly. Litmus paper should not be trusted in the neutralisation of the product; the *p*H should be determined and adjusted to 6·5-7. C.

Acid Browns and Chrome Browns on All-wool Piece Goods. A. E. Douglas. *Text. Rec.*, 1933, **51**, No. 608, pp. 45-47.

An article dealing with the respective merits and applications of acid browns and chrome browns on all-wool piece goods. W.

Hosiery Dyeing. *Wollen-u. Leinen-Ind.*, 1933, **53**, 277-278, 291-292 and 319-321.

An article dealing in general with the dyeing and finishing, including the water- and rainproofing of cotton, silk, artificial silk, and wool-artificial silk hosiery, with details of faults likely to arise in these processes. W.

Fast Dyes for Khaki. N. A. Suikhra. *Anilinokrasochnaya Prom.*, 1932, **2**, Nos. 5-6, pp. 23-20 (through *Chem. Abs.*, 1933, **27**, 5543).

The various forms of fastness of khaki dyeings of sports and military garments are discussed. The results obtained by laboratory tests and in practical wear are thus summed up—After-treating with Cu salts increases the fastness to light and washing without impairing the strength of cloth. Skein dyed fabrics give faster khaki dyeing than piece dyed. The character of interlacing of threads in weaving influences the fastness of dyeing to friction and washing. Khaki dyes from anthracene and hydroxyazobenzene have the highest fastness to light, while khaki dyeings in the skein with indanthrene dyes will last the life of the garment. W.

After-treatment Methods in Hosiery Dyeing. R. O. Framlington. *Dyer,* 1933, 69, 605-606.

Fastness to light and washing are increased by the use of direct dyes. Diazotising, although it involves a drastic change of shade under conditions of uncertainty, is applicable to several of the direct cotton colours, and increases the fastness to washing of certain yellows, browns, blues and blacks. The diazo reaction and process are discussed. The process is carried out in the cold and in the presence of an excess of nitrous acid and of mineral acid. After diazotising, the goods are developed immediately, details being given of the preparation of developing solutions. After-treatments may be generally carried out by baths of salts which form copper and chromium salts with the dyed dyestuffs, which then, in many cases, have greatly increased fastness. In general, the fastness to light is increased by after-treatment with a copper salt and the fastness to washing heightened by combination with a chromium salt. These salts can sometimes be combined, with a consequent increase in light and washing fastness. W.

Sizing, Dyeing, and Beaming Plant. *See* Section 3B.

(J)—PRINTING

Non-creasing Rayon Yarns and Fabrics: Production. H. Roche. *Silk J.*, 1933, 10, No. 112, pp. 22-23; No. 113, pp. 23-24.

Methods of determining resistance to creasing, the importance of cloth structure and unsatisfactory weaves are briefly discussed, and methods of increasing the resistance of rayon to creasing based on incorporation of rubber compounds, surface application of rubber or the use of synthetic resins are described. It is pointed out that resistance to creasing depends on the arrangement of the micelles. The influence of the mode of manufacture and the effects of finishing processes on resistance to creasing are considered. C.

Naphthol Red; Production of Coloured Reserves under——. V. D'Olona, O. Caudiani, A. Pozzi, and A. Fumagalli. *TIBA*, 1933, 11, 743-745.

Cloth padded with Naphthol AS is printed with a reserve containing potassium sulphite, an Indigosol, and zinc oxide. After drying it is padded in a diazo bath and the Indigosol is developed by passing through an acid oxidising bath, rinsing, and soaping. Details are given and it is shown that this method is much more economical than the usual method which involves the use of vat dyes. C.

Textiles: Dyeing and Printing. *See* Section 4I.

(K)—FINISHING

"Pearl Essence": Manufacture. *Synth. Appl. Finishes,* 1933, 4, 229.

The characteristic glistening effect of fish scales is due to a very fine crystalline substance, guanine, now the most widely used ingredient of the best qualities of mother-of-pearl lacquer finishes. Early processes for isolating guanine from fish scales consisted in prolonged extraction with water. Proteins from the scales pass into solution and act as peptisers for the guanine crystals, enveloping them with a protective film which permits of their ready transmission to a colloidal suspension. Other high molecular bodies, such as nitrocellulose and rubber act as peptising agents, facilitating the separation of guanine from fish scales to a surprising extent when using an organic liquid as the suspension medium in place of water. Digestion of 100 g. fish scales with amyl acetate alone only effected separation of 0·16 g. guanine crystals; addition of 1% nitrocellulose increased the yield to 0·9 g. Finely-divided nitrocellulose is capable of rapidly adsorbing guanine from aqueous suspensions and cellulose acetate adsorbs it from benzole suspensions; after removal of the liquid by filtration or centrifuging, the solid may be worked into a paste for lacquer or plastic purposes. C.

Filter-press Cloth: Conservation. M. O. Charmandarian and L. I. Sivoplias. *Ukrain. Chem. J.*, 1933 8, 125-126 (through *Brit. Chem. Abstr.*, 1933, *B*, 943).

Filter press canvas is immersed for 1½ hr. in boiling 4% soda ash and then in ammoniacal copper carbonate solution for 2 hrs. C.

Wood and Cotton: Impregnation with Mercuric Chloride. W. Kinbey and K. Eisner. *Chem. Zeit.*, 1933, 57, 561-562, 582-584 (through *Chem. Zentr.*, 1933, **ii**, 1945).

Experiments with pinewood shavings, cotton cellulose and lignin show that cellulose only adsorbs mercuric chloride to a slight extent whilst powdered lignin, which has a larger surface, adsorbs three times the amount. Even more is adsorbed by animal charcoal. The difficulty of washing out the adsorbed mercuric chloride from charcoal is attributed to reduction to mercurous chloride and partial formation of mercuric oxide. Wood also reduces mercuric chloride, but to a smaller extent than charcoal, but the mercury salt that cannot be washed out with water always contains more than 50% of mercurous chloride. Cakes of sawdust containing 4·7 mg. of mercuric chloride per gm. are resistant to *Coniophora cerebella*. Mercurous chloride and mercuric oxide are also antiseptic. *Coniophora* will overgrow pine lignin, but affects pure cellulose very slightly. Pine wood extracted with water is as rapidly attacked as raw wood. C.

Cellulose Mono-acetate: Preparation and Properties. A. Rheiner. *TIBA*, 1933, 11, 567-577, 643-651, 723-729.

A general account is given of the preparation and properties of cellulose fibres of low degree of acetylation corresponding to the mono-acetate. Threads of this type may be prepared from unmercerised or mercerised cotton and are known commercially as passive and crystallised yarns, respectively. They are not dyed by direct cotton dyes but show an affinity for cellulose acetate dyes. The use of these yarns in combination with cotton and rayon for the production of various effects in dyeing is discussed. C.

Carpet Cropping and Shearing. Robert Hall & Sons (Bury) Ltd. *Text. Mfr.*, 1933, 59, 321.

An improved three-cylinder cropping machine for carpets is illustrated and described in detail. W.

Blanket Raising. Tomlinson's (Rochdale) Ltd. *Text. Mfr.*, 1933, 59, 234 and 238.

A catch box has been added in the pile roller drive of a double-action blanket raising machine, this allowing an enhanced raising effect, and giving a further drawing out and final laying of the nap. W.

Automatic Intermittent Press for Finishing Wool, Rayon, and other Fabrics. H. Berry & Co. Ltd. *Text. Mfr.*, 1933, 59, 152.

A description of improved constructional details on the flat automatic hydraulic press, on which pressing is intermittent, but the process is continuous, giving 1,000 yards per hour and a squeeze up to 600 tons. W.

The Structure of the Wool Fibre and its Relation to Finishing. J. B. Speakman. *J. Text. Inst.*, 1933, **24**, P166-P172.

Recent Developments in Textile Finishing. L. G. Lawrie. *J. Text. Inst.*, 1933, **24**, P226-P230.

Some Examples of Modern Finishing Machinery Development. W. J. Norton. *J. Text. Inst.*, 1933, **24**, P231-P246.

(L)—PROOFING

Rubberised Fabrics: Production. *Wool Rec.*, 1933, **44**, 1354-1356.

The preparation of concentrated latex is described and its use in the production of artificial velvet and of carpets of various types, and in the doubling of fabrics. W.

Jacquard Card and Harness: Impregnation Standardisation. *See* Section 3C.

PATENTS

Dyeing Wool, Silk, or Cellulose. Imperial Chemical Industries Ltd. F.P.748,510 of 5/7/1933 (through *Chem. Abs.*, 1933, **27**, 5551).

The fastness of dyeings is increased by treating the textile materials of natural or regenerated cellulose, wool or silk, before or after dyeing, with a dilute aqueous solution of a salt of an organic derivative of NH_3, in which one of the radicals joined to the *N* atom is composed of a chain containing not less than 12 C atoms. Examples are given of the use of octadecylpyridinium and octadecyl-α-picolinium bromide. W.

Impregnating Textile Fibres. L. S. M. Lejeune and J. E. C. Bongrand. F.P. 748,618 of 6/7/1933 (through *Chem. Abs.*, 1933, **27**, 5552).

The penetration of latex into textile fibres, etc. is favoured and premature coagulation prevented by adjusting the *p*H of the fibres and of the latex to the same value before impregnation. W.

Asbestos and Rayon Insulator Material: Application. Siemens-Schuckert Werke A.-G. D.R.P.581,446 of 19/8/1930 (through *Chem. Zentr.*, 1933, **ii**, 1907).

A process for applying asbestos insulation to wires consists in the prior addition to the asbestos of fibres, such as rayon, that are soluble in or softened by organic solvents. The insulating material, after application, is soaked in a sticking or impregnating lacquer-like substance diluted with liquids to soften or dissolve the rayon. The insulation is wound on the wire as a roving or a web, the soluble or softened fibres acting as carriers. This ensures thorough cementing of the asbestos, the soft fibrous matter, and the wire. This covering will not crack under the bending strains imposed during wear. C.

Cloth Opening System. L. P. H. Hemmer. D.R.P.581,649 (through *Deutsche Färber-Ztg.*, 1933, 69, 468-469).

In apparatus for washing cloth in rope form, the cloth passes out of the liquid over a guiding rack, then between a pair of squeeze rollers and over another roller back into the liquid. In an improved system an arrangement for opening out and rearranging the cloth is inserted between the squeeze rollers and the guide roller. The opening arrangement may consist of two adjustable opening racks with sliding bars. C.

Organic Phosphate Impregnated Fibrous Insulating Material: Application. Siemens-Schuckert Werke A.-G. D.R.P.581,761 of 17/8/1929 (through *Chem. Zentr.*, 1933, **ii**, 1907).

Fibrous material, such as asbestos, linen, or cotton, is impregnated with an organic phosphate of low electrical conductivity (such as tricresyl, methyl, ethyl, phenyl, or naphthyl phosphates) so that the conductivity of the fibrous matter is reduced to that of a "semi-conductor". These inorganic fibrous layers are prepared by freeing them from volatile matter by heating in air and then impregnating them with a liquid phosphate. Impregnation with phosphate leaves asbestos with a small conductivity throughout the whole range of temperatures to which electrical apparatus is subjected in practice. No gaps will occur in the coils of insulating material. C.

Mercerised Wool-like Cotton Fabric. F. Thies. U.S.P.1,885,019 of 5/5/1930 (Germany 16/7/1928) (through *Brit. Chem. Abstr.*, 1933, *B*, 781, and *Chem. Abstr.*, 1933, 27, 1210).

A fabric, such as cotton gabardine, is woven with a more open warp and weft than those of the final product, and then mercerised to effect shrinkage to the desired thread density. For example, the weaving specification is adjusted to allow of not less than 5% shrinkage in the warp and 8% in the weft. A fabric of wool-like handle is obtained. C.

Tarnish-proof Silverware Container Fabric: Production. G. E. Herring. U.S.P. 1,916,050 of 27/6/1933 (through *Chem. Abstr.*, 1933, 27, 4692).

Lead acetate solution is sprayed on a napped fabric while in the stretched condition with the nap standing out, and the fabric is rolled up without drying. (Apparatus is described in the full specification.) C.

Thymol-Aluminium Soap Rot-proofing Composition: Application. S. J. Hayes (for Ludlow Manufacturing Associates). U.S.P.1,917,937/8 of 11/7/1933 (through *Chem. Abstr.*, 1933, 27, 4692 and 4691).

(1) Gill netting is preserved by the incorporation of thymol and an aluminium soap. (2) Flax thread is rendered rot-proof by the application of a soluble soap and thymol followed by treatment with a precipitating agent such as aluminium acetate. C.

Mothproofing Composition for Garments. A. Markowsky. U.S.P.1,924,507 of 29/8/1933 (through *Chem. Abs.*, 1933, 27, 5554).

p-Dichlorobenzene is used, in admixture with at least 20% of *p*-nitrochlorobenzene to form a mixture which will not soften, to smear garments at temperatures of summer heat up to 38°. W.

Composition for Use in Washing Cloth. O. Mitchell and E. M. Flood (to Sterling Borax Co.). U.S.P.1,925,843 of 5/9/1933 (through *Chem. Abs.*, 1933, 27, 5555).

A bluing agent comprising an aniline dye is used with a souring agent comprising boric acid in sufficient proportion for neutralising the residual alkali and soap and for tinting articles after washing. W.

Dyeing Semi-woollen Goods with "Gallophenin." N. A. Suikhra and K. Ya. Udalov. Russ.P.30,260 of 31/7/1933 (through *Chem. Abs.*, 1933, 27, 5551).

In dyeing with "Gallophenin", a mordant composed of a solution of Cr acetate and nitrite is used. W.

Imitation Wool Fabric: Coating with Wool Fibre. H. Baltzersen (Fredrikstad, Norway). E.P.396,591 of 14/11/1932.

In a method of coating paper or fabric with wool fibre to obtain an imitation of woollen fabric, the paper or fabric is drawn from a reel and adhesive is spread over it by a doctor. The web then passes into a closed chamber in which it passes over a shaking device actuated by cams, wool fibres being sprinkled on to the web from a rotating sieve. Near the exit from the chamber is located a nozzle from which a blast of air is directed upon the web to distribute the fibres evenly and arrange them in the same direction. C.

Cloth Measuring Machine. V. Mazzucchelli (Milan). E.P.396,642 of 17/2/1933.

Two methods of locking the toothed rings described in E.P.353,142 are shown. C.

Imitation Embroidered Fabrics: Production. E. Cadgene (New York). E.P. 396,675 of 4/11/1931.

Fabrics simulating eyelet embroidery are produced by depositing a decorative substance contiguous to portions of the fabric from which some or all the threads have been removed. The threads may be removed by perforation or chemical reagents. In some cases the fabric is composed of two different fabrics united together by adhesive, a chemical reagent being employed to remove in parts one of the fabrics leaving the other visible at such parts around which the decorative composition is applied C.

Cloth Measuring Machine. R. H. Walter (London) and N. L. Russell (West Wickham). E.P.396,777 and 396,812, of 6/2/1932.

(1) In a cloth measuring machine wherein one indicating device intermittently drives a second indicating device, the zeroising mechanism is so arranged that one indicating device is released before the other.

(2) Details are given of a measuring device in which a drum frictionally rotated by the cloth is permanently connected with the primary indicating device, the latter being returned to zero by the shortest path when the drum is freed. C.

Waxed Fabrics: Coating. C. A. Chester and Raymakers Syndicate Ltd. (Edinburgh). E.P.396,810 of 13/2/1932.

A process for the manufacture of waxed paper or sheet material, such as textile material, consists in depositing wax in a liquid film upon the surface of a flotation medium at such a temperature as will ensure the maintenance of the wax film in liquid form, and applying the paper or other sheet to the surface of the flotation medium in such manner as to remove the wax film therefrom. The wax, e.g. white wax, may be dissolved in solvent such as petrol, and used at normal temperature, or the process may be carried out at higher temperatures, e.g. 90° F. when using paraffin wax dissolved in petrol. Single sheets may be waxed by hand, but the process is preferably applied to continuous lengths of material by using known apparatus for creating a floating film and transferring it to a web. C.

Sheet Material: Bias Cutting. Dunlop Rubber Co. Ltd. (London), H. Willshaw, and T. Morcross. E.P.397,233 of 24/3/1932.

To obviate the waste at the ends of rolls of sheet material that are subsequently to be cut into bias strips, the sheet material, as it comes from the calender where it has been coated or similarly treated, is cut on the bias at positions corresponding to the two ends. The invention is concerned more particularly with the rolls of coated fabric for the production of bias strips for the carcasses of tyres. C.

Coated Fabrics. Dunlop Rubber Co. Ltd. (London), and Anode Rubber Co. Ltd. St. Peter's Port, Guernsey). E.P.397,270 of 28/5/1932.

(1) A coating composition for producing a smooth matt finish on fabric or rubber surfaces consists of a flocculent precipitate of rubber obtained from an aqueous dispersion thereof, admixed with starch. The flocculent precipitate may be obtained by known means, such as the use of coagulants on dilute dispersions, and may be made before or after the addition of the starch. *See also* E.P.397,277, *J. Text Inst.*, 1933, 24, A638. C.

Cellulose Ester Rayons: Discharge Printing. British Celanese Ltd. (London) and G. H. Ellis. E.P.397,470 of 10/2/1932.

In the production of discharge effects on materials made of or containing cellulose esters, the materials are saponified after colouration with a ground colour but prior to discharge thereof. It is desirable to saponify so that there is a loss in weight of at least 5%. The discharge of the ground colour may be effected with the aid of any suitable discharging agent. Coloured pattern effects may be produced by incorporating in the compositions dyes resistant to the discharging agent but having an affinity for or capable of being fixed on the saponified fibre or dye components, or leuco compounds which may subsequently be developed or oxidised on the fibre. The process is applicable to material of any cellulose ester capable of saponification, alone or in admixture with other textile fibres. C.

Cellulose Ester and Ether Rayons: Dyeing. British Celanese Ltd. (London), H. C. Olpin, and G. H. Ellis. E.P.397,534 of 17/2/1932.

Materials made of or containing cellulose esters and ethers are coloured by applying to and retaining in the materials a compound containing two aryl radicles or aromatic residues united directly by a single linkage, which compound contains a single amino group and a single nitro group in ortho relationship to each other The amino group and also the nuclei may be further substituted. The dyes may be applied in the form of dispersions. C.

Polyvinyl Resin Finishing Agents: Application. British Celanese Ltd. (London) E.P.397,711 of 7/11/1932.

Water-insoluble polymerised vinyl compounds are incorporated in relatively small amounts in textile fabrics in order to improve their resistance to wear, to reduce their tendency to slip or ladder, and to render them more waterproof. Fabrics thus treated may be used for making tops of fancy shoes. When fabrics so treated are calendered between heated rollers, a glossy finish is produced with great adhesion between warp and weft. The fabric may be woven, knitted, or netted fabric containing yarns, filaments, straw or bristles, and may be of any textile material. The polymerised vinyl compound may be obtained by polymerising vinyl esters such as vinyl acetate, propionate, or phthalate, the compound formed by treating a vinyl halide with zinc dust, or compounds such as styrene. C.

Artificial Leather: Manufacture. J. Vottelar's Nachfolger Ges. (Reutlingen, Germany). E.P.397,741 of 16/12/1932.

Artificial leather is made from fibrous materials such as fabrics, cotton, wool, and wood or straw pulp, by introducing the material into an impregnating medium such as rubber latex, viscose, glue, starch, celluloid solution or a solution of rubber in benzine, between two strainer surfaces, squeezing between the strainers after removal from the impregnating medium by passing between rollers, removing the strainers, treating the impregnated material in a coagulant, for example aluminium acetate, again squeezing and drying. A suitable latex contains a wetting agent, an aqueous paraffin emulsion, and finely powdered cumaron resin. Sulphur and accelerators may be added so that vulcanisation takes place during drying. C.

Rubber-coated Fabrics: Production. Dunlop Rubber Co. Ltd. (London), Anode Rubber Co. Ltd. (St. Peter's Port, Guernsey), E. A. Murphy, and D. N. Simmons. E.P.397,997 of 21/6/1932.

Fabrics are coated by spreading, brushing or spraying with flocculent precipitates of rubber, obtained by coagulating largely diluted rubber dispersions by means of acids such as acetic acid, salts such as zinc or magnesium sulphates, and metallic salts produced *in situ*, in presence or absence of substances having a restraining effect on the coagulation such as caustic potash, casein, sodium aluminate, glue and gum acacia. The precipitate may be filtered, for example by ceramic material, cotton fabric, or wire gauze. Vulcanising and compounding agents may be added to the dispersion or to the precipitate. The coated fabrics may be given a smooth matt finish by subsequent treatment with a mixture of a flocculent rubber participate and starch powder. C.

Filter for Non-greasy Liquids. J. De La Torre and L. R. De La Torre (trading as J. De La Torre & Son), Mexico. E.P.398,055 of 18/11/1932.

A filter for filtering non-greasy liquids comprises a plane body of textile fabric, each individual thread of which is thoroughly degreased so as to possess readily permeable, filtering, and absorbent characteristics. The degreasing may be effected on the woven cloth prior to its use or, more advantageously, the threads may be thoroughly degreased prior to weaving. Various sorts of fabric can be used but a thick sheet of cotton, such as duck or canvas, has proved to be particularly suitable for the purpose. With this type of filter the filtering operation is accelerated and rendered more efficient and cheaper. The effect depends to a great extent upon the capillary forces in the thoroughly degreased individual threads rather than on the interstices between them. C.

Terpineol Sulphonic Acid Wetting Agents. Society of Chemical Industry in Basle. E.P.398,086 of 20/1/1933.

Water-soluble derivatives of terpineol are obtained by treating it with a sulphonating agent at a comparatively low temperature. According to examples, terpineol is treated whilst cooling with chlorosulphonic acid and with fuming sulphuric acid of 30% strength. The products may be employed as wetting, emulsifying, and washing agents in the preparation of lubricants, dressings, and sizes for textiles. C.

Vat Dyed Cotton: Stripping. Society of Chemical Industry in Basle. E.P.398,150 of 30/11/1931.

Fibres dyed with vat dyes are stripped by treating with hot alkali hydrosulphite in the presence of a quaternary ammonium compound having an alkylating action. The fibres should be dyed with vat dyes of which the leuco-compounds have little or no affinity for the fibre when treated with alkylating agents. Such vat dyes include indigoid vat dyes and anthraquinone vat dyes, such as the benzoylated aminoanthraquinones, etc. C.

Azo Dyes: Production. Imperial Chemical Industries Ltd. (London). M. Mendoza, and W. A Sexton. E.P.398,163 of 29/1/1932.

Azo dyes are made on the fibre by coupling an arylamide of 2:3-oxynaphthoic acid with the tetrazo-compound of a diamine obtained by condensing an *o*-alkyloxyaniline or a derivative thereof (2 mols.) and an aromatic aldehyde (1 mol.) the components being devoid of water-solubilising and nitro groups. Claret shades fast to kier boiling and chlorine are obtained. C.

Dyed Textiles: Treatment to Improve Fastness. Imperial Chemical Industries Ltd. (London), C. H. Barlow, and L. G. Lawrie. E.P.398,175 of 31/12/1931.

The fastness of dyeings on textile materials composed of cellulose (natural or regenerated), wool, silk, or mixtures thereof, is increased by treating the materials before or after the dyeing operation with a dilute aqueous solution of a heterocyclic ammonium salt in which the ammonium nitrogen atom is a member of the heterocyclic ring and carries a long-chain aliphatic residue of at least 12 carbon atoms, acyl, hydroxyalkyl, and hydroxycycloalkyl groups being absent. C.

Silk and Rayon: Weighting. W. Zanker (Barmen, Germany). E.P.398,323 of 25/7/1932.

Silk or rayons, or mixed materials containing them are loaded by treatment first in a bath containing one or more tin salts and then in one or more baths containing no tin but containing one or more salts of another loading metal, at least one of the baths containing a magnesium salt. Specified additional loading metals are lead, aluminium, iron, chromium, manganese, cerium, and zirconium. C.

Cellulose Ester Rayons: Delustring. British Celanese Ltd. (London). E.P. 398,371 of 1/12/1932.

Yarns or fabrics made of cellulose acetate or other organic derivatives of cellulose are delustred by first treating with a higher fatty acid, particularly oleic acid, and then with hot aqueous liquid or moist steam. The pre-treatment with higher fatty acid obviates uneven delustring especially with materials which have been lubricated or otherwise treated with olive oil, etc. The higher fatty acid may be applied as such, in solution or as an aqueous dispersion; it may be applied at the spinning cabinet or at some later stage in manufacture, or it may be incorporated in the size to be applied to the warps. When applied to sized fabrics, the size is first removed by padding, and the higher fatty acid may be contained as an emulsion in the desizing liquid; after application of the higher fatty acid, the material is preferably allowed to stand before delustring. C.

Azo Dyes: Production. A. Carpmael, London (I.G. Farbenindustrie A.-G., Frankfort). E.P.398,516 of 15/3/1932.

Azo dyes insoluble in water are made in substance, on a substratum or on the fibre by coupling a 2-hydroxy-5:6- or 7:8-benzocarbazole-3-carboxylic acid arylamide with a diazo compound. In examples, cotton is impregnated with the *p*-chloranilide of the 5:6-derivative or the *p*-aniside of the 7:8 derivative and developed with diazotised 4-chloro-2-toluidine or *o*-chloraniline, respectively, giving yellowish-brown shades. A table is given showing the shades obtained by using various additional components. C.

Direct Dyes: Diazotising and Coupling on the Fibre. Bleachers' Association Ltd. (Manchester), C. L. Wall, and F Farrington. E.P.398,532 of 14/3/1932.

Dyeings with direct dyes containing one or more free amino groups are diazotised on the fibre and coupled with an arylide of an aryl hydroxycarboxylic acid containing at least three rings or with a bi-nuclear arylide of a β-keto-carboxylic acid. Coupling components specified are hydroxycarbazole carboxylic arylides, hydroxynaphthoic arylides, hydroxydiphenylamine-carboxylic acid arylides, bisacetoacetic-*o*-tolidide and analogous compounds in which the amino and carboxy groups are interchanged between the nuclei. The following dyes and developers are specified. Diazo Fast Yellow 2G, Diazo Sky Blue 3GL, Diazo Brilliant Green 3G, Diazo Fast Blue 2RW and Diazo Indigo Blue 4GL; Naphthol AS/G, AS/LT, AS/GR, AS/LB, AS/SG, and AS/SW. C.

Dyeing Machine. Smith, Drum & Co. (Philadelphia, U.S.A.). E.P.398,710 of 23/1/1933.

A dyeing machine comprises a plurality of tanks connected in series, means for circulating liquid through the series, and means operable in each tank for causing a separate circulation of the liquid, whereby a uniform mixing of the liquid takes place. C.

Detergent, Dispersing, and Frothing Agents: Preparation. Imperial Chemical Industries Ltd. (London), A. W. Baldwin, and H. M. Bunbury. E.P.398,818 of 9/2/1932.

Detergents are obtained by sulphonating mono alkyl esters of glycerol, in which the alkyl group contains 16, 17, or 18 carbon atoms. Preferably the starting materials are those obtained by the saponification of the liver oils of elasmobranch fish. Besides having detergent properties the products are stated to be dispersing and emulsifying agents which may be used in impregnating, tanning, and in the manufacture of pigments, pastes, insecticides and fungicides. C.

Cellulose Ester and Ether Rayons: Dyeing. British Celanese Ltd. (London) and G. H. Ellis. E.P.398,842 of 12/3/1932.

Materials made of or containing cellulose esters or ethers are coloured by the application in substance of disazo dyes, free from carboxylic or sulphonic groups of the type $R_1N{:}NR_2N{:}NR_3OH$, in which R_1, R_2, and R_3 are residues of the benzene series each containing a single benzene nucleus. The residues R_1, R_2, and R_3 may be substituted, e.g. by alkyl, alkoxy, or halogen groups. The dyes are obtainable by diazotising the appropriate aminoazo compounds and coupling with phenols. C.

Azo Dyes: Production. W. W. Groves, London (I.G. Farbenindustrie A.-G., Frankfort). E.P.398,846 of 17/3/1932.

Insoluble azo dyes are made on the fibre by applying a mixture which contains an alkali salt of a hydrazine sulphonic acid of a specified general formula, and an alkali salt of a hydroxylated coupling component which combines in the adjacent position to the hydroxy group, and then steaming. The free coupling component together with the equivalent amount of alkali may also be used and dyeing or printing assistants may be added. C.

Azo Dyes: Production. A. Carpmael, London (I.G. Farbenindustrie A.-G., Frankfort). E.P.398,854 of 22/3/1933.

Insoluble azo dyes are made by coupling a 2-hydroxy-5:6-dihydro-7:8-benzocarbazole-3-carboxylic acid arylamide with a diazo compound in substance, on the fibre or on a substratum. In an example, cotton is impregnated with the *p*-anisidide and developed with diazotised 2:5-dichloraniline. A table showing the shades produced using various arylides and diazo components is given. C.

Dyeing Apparatus. G. E. Burgess, Burgess, Ledward & Co. Ltd. (Manchester), and Brown & Adam Ltd. (Glasgow). E.P.398,887 of 24/3/1932.

Fabrics of linen, cotton, silk, rayon, wool, or worsted are dyed by loosely roping and packing them in an annular space between two concentric perforated cylinders through which the dye liquor is circulated. The fabrics are packed either wet or dry, preferably in eccentric coils. A cover is pressed down on to the fabric to any desired extent by rotation of a wheel. The dye liquor enters and leaves by pipes and is circulated by any suitable means such as a pump. C.

Scouring and Mercerising Baths Containing Protein Decomposition Products. M. Freiberger (Berlin). E.P.398,958 of 21/5/1932.

Protein decomposition products, such as the moderately highly-decomposed products which give the biuret reaction obtained by heating a protein in a caustic alkali solution, are added to alkaline liquors used for the scouring and mercerisation of cellulosic materials. Suitable proteins are albumen, casein, glue, skin, flesh parts, hair, fruits, seeds, and gluten and they may be decomposed by means of alkalis, acids, oxidising agents, pectases, and steam. C.

Degreasing Wool, etc.: Cleansing Compositions. A. Golwig. E.P.399,338 of 30/11/1932.

Animal fibres, e.g. hair and wool, are degreased and cleaned by treatment below 0° C. with organic solvents of fat. Treatment at minus 10-15° C. with hydrocarbons, hydrogenated hydrocarbons, halogenated hydrocarbons, or mixtures, thereof is suitable. Ethylene trichloride, to which may be added 10% of ethane tetrachloride or carbon tetrachloride, is specially referred to. The treatment may be in stages, different solvents or/and temperatures being used at each stage. The pressure is preferably normal or reduced. W.

Partially Esterified Rot-proof Cellulose Fibres and Fabrics. A. C. Thaysen (Poole). E.P.399,952 of 23/7/1932.

By partial acetylation, cellulosic materials may be rendered immune to deterioration by destructive organisms without any substantial interference with the normal textile properties such as tensile strength of the material. The acetylation is conducted so as to secure uniformity of acetylation, and is arrested before the increase in weight is more than 18%. The acetylating mixture consists of up to 0·25% of perchloric acid or a salt thereof, such as aniline perchlorate, 5 to 10% of acetic anhydride, and the residue of a diluent organic liquid. Not more than 1-5 parts of acetic anhydride are present per part of dry cellulose. The diluent organic liquid may be an organic acid such as glacial acetic acid or a hydrocarbon such as benzene or an organic base such as pyridine. The materials may be subjected to a preliminary treatment in boiling water or alkali, to steeping in acetic acid, or to treatment with acetone for the purpose of removing water. C.

Quaternary Ammonium Salt Stripping Agents. Imperial Chemical Industries Ltd. (London). J. G. Evans and L. G. Lawrie. E.P.400,239 of 19/3/1932.

A technically advantageous, economical process of stripping, particularly adapted to the entire removal of solid shades produced by azoic colours, consists in treating the dyed material in a chemically reducing liquor (which may be acid, alkaline, or neutral) containing an amine or amine salt, preferably a quaternary ammonium salt, one radicle in which comprises a straight or branched carbon chain of not less than 10 carbon atoms. Suitable amines and quaternary ammonium salts are specified, and examples of the method are given. C.

Rayon: Delustring. Imperial Chemical Industries Ltd. (London), L. G. Lawrie, and H. D. Mudford. E.P.400,244 of 18/4/1932.

Rayon is treated with an aqueous medium to which has been added a sulphonated alkylated polynuclear hydrocarbon, or a sulphonated alkylated petroleum fraction. The material, after rinsing and drying, has a pleasing, soft, subdued lustre and an attractive handle. The method is applicable to the delustring of both regenerated cellulose and cellulose ester and ether rayons. C.

Singeing Machine Static Electrification Device. Bleachers' Association Ltd. (Manchester), C. S. Parker, and C. L. Wall. E.P.400,671 of 2/5/1932.

In the singeing of yarns and fabrics the fibres which it is desired to remove are caused to become electrically charged and are subjected to a singeing operation while they are displaced or in a substantially erect position with reference to the body of the material. Thus the whole material may be electrically charged and then brought into close proximity with a body of opposite electric charge or at earth potential so that the fibres or hairs are thereby caused to assume a substantially erect position with reference to the surface of the material and are immediately thereafter subjected to a singeing operation. The yarns or fabrics to be singed should be as dry as possible. C.

Yarn and Cloth Length-altering Apparatus. J. H. Wrigley (Worthington), A. Melville (Standish), and A. B. Henshilwood (Bradford). E.P.400,950 of 2/2/1932.

A method of altering the length of fabrics or yarns consists in pressing together a relatively soft elastic or resilient body and a relatively hard and rigid body, in causing relative motion between these bodies by moving them in the same superficial direction but at different surface speeds, and in passing the fabrics or yarns between the bodies at a place where the surface of the relatively soft body is changing between the distorted and undistorted conditions. Several forms of apparatus are described. C.

Combined Chlorine and Peroxide Bleaching Process. H. T. Böhme A.-G. (Chemnitz, Germany). E.P.401,199 of 2/5/1933.

The goods to be bleached are impregnated with a chlorine bleaching liquor and are then directly treated with a liquor containing a peroxide without an intermediate bath. When the goods are previously wetted with a sulphonated oil and treated with the chlorine liquor for only so short a time that the fibres become completely saturated, the active chlorine of the impregnating bath is almost entirely used up for chlorinating the albuminous substances in the fibres and the peroxide bath contains practically no active chlorine. Albumin-chloramines are presumably formed and are more readily decomposed and dissolved out by the alkali of the peroxide bath than the original albuminous substances. Goods bleached by this method show a pleasing full white, a soft feel, and exceptional absorptive capacity. C.

Insulating Varnish: Application. International General Electric Co. Inc. (New York). E.P.401,500 of 2/12/1932.

A method of coating or impregnating with electrically insulating varnish comprises applying styrol in a pre-polymerised state or a solution of polystyrol in monomeric styrol without a volatile solvent and subsequently hardening by a heat treatment. The heat treatment may be carried out under pressure, and catalysts and/or non-volatile softening materials may be added to the impregnating liquid. C.

Crêpe Fabrics; Production of Pattern Effects on——. Bleachers' Association Ltd. (Manchester) and G. D. Sutton. E.P.401,504 of 13/12/1932.

A process for the production of pattern effects upon textile fabrics composed wholly or in part of crêpe yarns consists in subjecting the fabric to heat and heavy compression in selected areas while the crêpe yarns are in an extended condition as compared with their condition in the finished fabric. The treatment may be applied before ar after the crêping operation. The process may be applied to cotton, rayon, silk, and other fabrics. When applied to delustred cellulose acetate rayon the lustre is restored in the selected areas to which the heat and compression are applied. C.

Cloth Shrinking Machine. Cluett, Peabody & Co. Inc. (Troy, New York, U.S.A.). E.P.401,617 of 26/6/1933.

A cloth shrinking apparatus comprises in combination a pair of spaced travelling endless bands, guide members defining diverging paths of travel for the bands, with the bands and guide members arranged for the bands to press the margins of a web of cloth against the guide members during travel of the bands, and means for feeding a cloth web between the members and bands in a lengthwise slack state. A subordinate feature consists in the use of transverse serrations in the bands to accommodate the lengthwise slack in the web. C.

5—ANALYSIS, TESTING, GRADING, AND DEFECTS

(A)—Fibres

Animal Hairs: "Setting". H. J. Woods. *Nature*, 1933, **131**, 709-710.

Relaxation of animal hairs when held stretched for some time exposed to hydrolytic action is caused by the rupture of the side chains of the keratin molecule, and "set" is due to re-combination of these broken chains in new unstressed configurations. When the side chains have been broken down by steam or hot water, but have not had time to recombine, the main chains may, under the contractile influence of steam, fold into shorter lengths than the normal fibre, so that "super-contraction" occurs. The super-contraction of wool fibres depends on the relaxation time and reaches a limit of 48% of the original length after 10 mins. relaxation. Setting is delayed by treatment with potassium dichromate, owing to reaction being with the basic $-NH_2$ group. Curves of super-contraction or "set" against relaxation time are given. C.

Cotton Boll: Internal Pressure and Hair Abnormalities. W. K. Farr. *Amer. J. Bot.*, 1932, **19**, 839 (through *Exp. Sta. Rec.*, 1933, **69**, 357).

Pima, Super Seven, and Acala cottons show hair abnormalities in the ratio 15:90:170. Very few abnormalities occur before the 20th day from fertilisation. Measurements indicate that pressure during development is relatively small in Pima, moderate in Super Seven, and large in Acala, and that it increases from the 20th day until near dehiscence. This suggests that boll pressure may be an important fact in the formation of hair abnormalities. C.

Cotton Hair: Spiral Structure. W. Seifriz. *Science*, 1933, **77**, 50-51 and **78**, 361-363.

The author discusses instances of spiral growth and structure in the animal and vegetable kingdoms and on a large and small scale, from trees to cotton fibres. He concludes that it is a fundamental heritable protoplasmic quality and not caused by external mechanical forces. C.

Cotton Sorter. E. H. Pressley. *J. Amer Soc. Agron.*, 1933, **25**, No. 2, pp. 89-98 (through *Exp. Sta. Rec.*, 1933, **69**, 286).

A new device upon which combed samples of unginned cotton may be sorted, developed at the University of Arizona, is described and illustrated with remarks on the preparation of samples for sorting, some of the results obtained with the sorter, and its advantages. C.

Egyptian Cotton Spinning Research Station. W. L. Balls. *M/cr. Guard. Comml.*, 1933, **27**, 385.

A short account is given of the construction and aims of the proposed spinning test station at Giza. A special building, designed as a hygrostat and thermostat, has windows on the north side only and can be used for the spinning of high quality fine yarns on an experimental scale.

Improved Gaorani Indian Cottons: Selection. R. D. Mehra. *Text. Weekly*, 1933, **12**, 195-196.

Hyderabad Gaorani or Bani cotton has a staple length of $\frac{7}{8}$ in. and the fibre is both fine and strong. It is, however, a low yielder, with a ginning out-turn of only 26-28%. Trials on other types of cotton indicated that none would be a suitable substitute for Gaorani. Selection trials of this cotton have produced Gaorani 4, which is jassid-resistant, very little susceptible to dry-rot, a high yielder and is suitable for 28's warp counts. Its ginning outturn is also an improvement on the parent variety. Other good strains are Gaorani 6 and 44, which are fit for 38's and 39's warp counts, respectively. C.

Regain Balance. *Chem. Fabrik*, 1933, **6**, 415.

The moisture content of wood and other raw materials may be determined by weighing on a rapid balance, the scale of which ranges from 0 to 25 gms. and registers to one-fifth of a gram, heating in a small electric drying oven (current consumption 40 watts) which can be connected to an electric light plug, and then weighing again. Since the balance operates without weights by means of a pointer, and overheating in the oven is impossible, the determination can be carried out rapidly and efficiently by unskilled labour. C.

Planimeter: Application in the Textile Industry. J. Walther. *Leipz. Monats. Text. Ind.*, 1933, **48**, 141-143, 161-162, 182, 202-203.

Various methods of measuring surfaces are outlined and the advantages of the planimeter method are pointed out. Examples illustrating the use of the planimeter for the determination of the area of cross-sections of fibres and in the evaluation of staple diagrams and the records obtained on yarn testing devices are given. C.

Spun Fibrin: Crystal Structure. J. R. Katz and A. de Rooy. *Naturwiss.*, 1933, **21**, 559 (through *Brit. Chem. Abstr.*, 1933, *A*, 1004).

Fibrin spun into threads gives an X-ray diagram with identity period along the thread axis of 6·7 Å. There are two amino-acid residues in this direction in the elementary cell. The polypeptide cell is almost straight, with slight crumpling and twisting. Fibrin agrees almost completely with stretched keratin although they are constructed from different amino-acids. C.

Fibres: X-ray Structure. W. T. Astbury. *Science Progress*, 1933, **28**, 210-228.

The reason for the production of X-ray diagrams of fibres and other microcrystalline bodies is explained, and textile fibres are shown to consist of bundles of parallel molecular chains, examples of which are given. The author also discusses the stretching and "setting" of hair, and the supercontraction of wool from the standpoint of molecular structure. Sample photomicrographs are given. C.

Indian Cottons: Testing. N. Ahmad. *Indian Centr. Cotton Cttee. Techn. Bull.*, Ser. A, No. 25, September 1933, 20 pp.

The methods employed at the Technological Laboratory of the Indian Central Cotton Committee for the determination of the fibre properties and spinning value of Indian cottons are described in detail. C.

"Miscibility" of Raw Silk. C. W. Meyers. *Amer. Dyestuff Rep.*, 1933, **22**, 644-645.

To test whether two samples of raw silk may be used in, say, different parts of a silk stocking, without the difference being apparent after dyeing, the amount of a dye, preferably an acid dye, taken up from solution by specimens of the two raw silks is determined by nesslerisation of the solutions at equilibrium. Blue or yellow dyes are the easiest to use for this test. If the two raw silks have the same absorptive power and are of the same denier they may safely be mixed. Silks differing considerably in colour in the raw state, however, should not be mixed. S.

Differentiation of Silk of *Bombyx mori* from Tussah and Yamamai Silk with the aid of Micro-dry Distillation. E. Beutel and E. Grünsteidl (with E. Ullmann). *Kunststoffe*, 1933, **23**, 157-158 (through *Chem. Zentr.*, 1933, **ii**, 2479).

On micro-dry distillation mulberry silk exhibits isolated, minute, pearly bubbles, yamamai lateral bubbles and groups of bubbles, and tussah tubular structures with innumerable coarse bubbles in one or more rows. S.

A Merino Wool Score Card. L. L. Roux. *Farming in South Africa*, 1933, **8**, 421-422.

A score card is reproduced for judging Merino wool at shows, and details given for its use. W.

Cotton Hairs: Variability in Length. *See* Section 1C.

(B)—Yarns

Autographic Load-Extension Recorder. H. S. Cliff. *J. Text. Inst.*, 1933, **24**, T351-T360.

Celta Rayon: Faults due to Stretching. J. Roussin. *Fils et Tissus*, 1933, **21**, 450-453.

In early deliveries of Celta yarn for knitting, irregularities in lustre were frequently observed on the bottle bobbins, and the hosiery knitted from them were often uneven in length and showed striped or barred effects after dyeing. These faults were due to the fact that certain sections of the yarn had been stretched beyond the elastic limit in the preliminary processes. The influence of such overstretching on the lustre, strength, elasticity, and dyeing properties is explained by a brief study of the structure of this hollow-filament rayon. By improvements in methods of production and a careful control of the tension in all winding processes the manufacturers of Celta rayon have now practically eliminated such faults. To avoid irregularities in tension in winding it has been found advantageous to put only one hank on the reel at a time. The use of Celta yarn wound into the form of cones is recommended. C.

Gassed and Mercerised Yarn: Effect of Processing on Count. A. Kindermann. *Spinn. u. Web.*, 1933, 51, No. 41, pp. 7-10.

Tests on typical doubled yarns are reported that show that gassing produces a loss in weight of 6·5% which is accompanied by a loss in yarn of 0·5% due to breaks. Mercerisation produces a further loss in weight of 4%. A shrinkage of about 2% in length occurs on mercerising. The resulting change in counts can be calculated from these figures. German regulations permit a 3% variation in counts and it is possible to choose the original counts so that this limit is not exceeded. C.

Delustred Rayon: Microscopic Examination. R. Lassé. *Textilber.*, 1933, 14, 185-187, 309-311, 358-359, 414-416, 461-463, 508-510, 553-554.

Methods of delustring rayon are discussed and examinations of various samples under the microscope are described in detail. Numerous photo-micrographs of delustred fibres and ash structures obtained from them are reproduced and discussed. C.

Silk: Electrical Conductivity. R. Tsunokaye and G. Enomoto. *Bull. Agric. Chem. Soc., Japan*, 1933, 9, 26-28 (through *Chem. Zentr.*, 1933, **ii**, 3214-3215). See also *J. Soc. Dyers and Col.*, 1933, 49, 377-379.

Raw silk is almost a non-conductor between 5 and 30° and 40 and 90% R.H. The conductivity increases on degumming, more when soap is used than when enzymes like pancreatin are employed, and still more when degumming is effected by water at above 121°. If degummed silk is treated with caustic soda, the conductivity increases with the alkali concentration. The enhanced conductivity is observed even with *N*/400 alkali, which is not strong enough to affect the tensile properties. Adsorption of alkali by fibroin is postulated. C.

(C)—Fabrics

Doped Fabric: Tautness Tests. G. M. Kline. *Amer. Paint and Varnish Mfrs. Assoc., Circ.* No. 443, 1933, pp. 266-273 (through *Chem. Abstr.*, 1933, 27, 4697)

The relative tautnesses of doped fabrics were judged by the sound test and measured with the McGowan tautness meter, the Sward hardness rocker, and a sclerometer. The McGowan test agrees best with the sound test. According to the suggested specifications, the deflection should not exceed 0·13 in. under a load of 15 oz., and when the load is removed the fabric should return to within 0·003 in. of its original position. C.

Dyed Fabrics: Fading behind Glass. H. Rein. *Glastechn. Ber.*, 1933, 11, 193-195 (through *Physikal. Ber.*, 1933, 14, 1674).

The author points out that the fact that a glass does or does not transmit ultra-violet is of little moment in the fading of the majority of dyes. Only in years of unusual ultra-violet activity, and for a few dyes, would exposure behind glass that transmits ultra-violet lead to increased fading. Much more important influences are humidity and the oxygen content of the atmosphere, especially the former. C.

Photo-electric Reflectometer. R. Joscheck. *Siemens Z.*, 1933, 13, 110-112 (through *Sci. Abs.*, **B**, 1933, 36, 576).

A portable instrument contains a lamp that illuminates the test surface at 45° and a photo-electric cell. The current from this is indicated by a separate micro-ammeter. The instrument is placed over a standard white matt surface and by means of a potentiometer device is made to read 100. The reading given when the instrument is transferred to the test surface is the reflection factor expressed as a percentage of that of the standard. The use of the instrument for comparing coloured surfaces, and for measuring gloss, transmission, and absorption is also described. C.

Sugar Filter Cloths: Endurance. L. Steiner. *Centr. Zuckerind.*, 1932, 40, 476-477 (through *Chem. Abs.*, 1933, 27, 4712).

Filter cloths are most subject to deterioration due to lime during the sweetening-out process, when the protective action of sugar is being diminished. A further cause of deterioration is the action of cuprammonium compounds arising from condensates from the copper tubes of the evaporators. C.

Cotton Cloth: Effect of Weave on Strength and Permeability. H. F. Schiefer, R. S. Cleveland, J. W. Porter, and J. Miller. *Bur. Standards J. Res.*, 1933, 11, 441-451.

The effect of weave on the strength, elongation, take-up, tear resistance, fabric "assistance" (relation between strength of ends unwoven and supported by the interlacing ends in the cloth), and air permeability of cloth is discussed. The work has been done in connection with the choice of fabrics for air-ships. In general, a cloth that is closely woven, firm, and has a large number of threads interlacing per unit area, and short floats, has a greater strength, elongation, and take-up, and has a lower tear resistance and air permeability than a cloth of the same weight that is loosely woven, sleazy, and has a small number of thread interlacings per unit area and long floats. The strength and elongation decrease as the tear resistance is increased. The factors contributing to strength are (1) the strength of the yarn, (2) the manner of interlacing of warp and weft, and (3) the twist of the yarn. Tear resistance is affected by (1) the strength of the yarn perpendicular to the direction of the tear, and (2) the freedom of movement of these yarns in the direction of the tear. Rubberising and doping cloth increase the strength and decrease the tear resistance and permeability. C.

Influence of Light and Weather on Woollen Cloth. S. S. Rakhlina. *Sherstianoe Delo*, 1933, **12**, No. 4-5, pp. 35-37.

Dyed and undyed specimens of various cloths were exposed to light and weather for 3·5 months of hot dry weather and the effect on their strength and extensibility determined. The destructive action of the light and weather was most marked on the undyed fabric, but samples dyed with Wool Black AT4B in an acid bath had suffered almost as severely. Chrome dyeing had a marked protective action, which was most pronounced with the monochrome process. Samples dyed with a substantive dye, Wool Brown AT, were almost as resistant as specimens which had been subjected to chroming or after-chroming. The aqueous extract of the undyed cloth gave a strong biuret reaction, and the fibres swelled considerably in weak alkali. For the first 1·5 months the cloth increased in weight. The need for care in interpreting the results of exposure experiments with fabrics having a raised surface is emphasised. S.

Testing of Wool, Cotton, Linen and Hemp Fabrics for the French Army. L. P. *Rev. Text.*, 1933, 31, 579-583, 663-667, 755-757, 843-845, and 927-929.

Details are given of the testing methods used, and the organisation and regulations of the Commission responsible for the testing of French army cloths. W.

Apparatus for Determining the Air Permeability of Leather and other Materials. N. S. Fedorov. *Ovladenie Tekhnikoi*; *Kozhobuvnoe Proizvodstvo*, 1932, No. 4, pp. 49-51 (through *Chem. Abs.*, 1933, **27**, 5582).

The apparatus consists of two parts. Part (1) is circular; in the top is placed a leather sample 55 mm. in diameter acting as a membrane. It is fastened tight with flanges. The bottom of (1) is connected by means of rubber tubing (with a pinch cock) to a graduated cylinder (2) placed on a higher level. The tubing is inserted through the bottom of (2) and is bent over the end, being 10 cm. from another tube also inserted through the bottom and terminating with a piece of rubber tubing and a pinch cock outside of the cylinder. This arrangement permits maintenance of a constant water pressure independent of the column of water in the cylinder. Operation of the apparatus is described. W.

Some General Sources of Faults in Textile Materials. L. L. Lloyd. *J. Text. Inst.*, 1933, **24**, P161-P165.

Some Faults in Finished Fabrics. P. Bean. *J. Text. Inst.*, 1933, **24**, P194-P203.

(D)—Other Materials

Flour: Colour Determination. J. C. Baker, H. K. Parker, and F. B. Freese. *Cereal Chem.*, 1933, **10**, 437-446.

The percentage of red, yellow, black, and white in flour colour is determined by matching a rotating sample of flour against a Maxwell disc rotating at the same speed. Results for various wheat flours are shown in graphs and tables, and it appears that (*a*) there is no correlation of yellow or white with the ash of flour; (*b*) there is some correlation of red and black with flour ash; (*c*) with bleaching and extraction the correlation between red and flour ash becomes better, whilst in the case of black it becomes less satisfactory. C.

Hygrometric Moisture Regain Determination Apparatus: Application. L. Scriba. *Messtechn.*, 1933, 9, 107-110 (through *Physikal. Ber.*, 1933, 14, 1510).

Various forms of hygrometer of the "poker" type are described and curves are given that connect the moisture content of flour and wood samples with the relative humidity of the surrounding atmosphere. C.

Pulp and Paper: Properties and Testing. E. Richter. *Zellstoff u. Papier*, 1933, 13, 431-434, 476-480.

Pulp, Paper, and Rayon: Moisture Relations. S. Oguri. *J. Soc. Chem. Ind. Japan*, 1933, 36, 504-506.

Calf Leather; Effect of Humidity on——. W. D. Evans and C. L. Critchfield. *Bur. Standards J. Res.*, 1933, 11, 147-162.

The regain and tensile properties of chrome-tanned and vegetable-tanned calfskin have been determined at a series of humidities ranging from 9% to 97%, obtained by means of saturated solutions of appropriate salts. The chrome-tanned skin was divided into two, and half was tested in the degreased state. The analyses of the leathers and the experimental results are fully recorded. Curves connecting humidity with regain, tensile strength, and change in dimensions are sigmoid and show that the effect of humidity is more pronounced for chrome-tanned than for vegetable-tanned leather. This difference is attributed to the difference in protein content between the leathers. Speculations as to the mechanism of the effect of adsorbed water on the strength of leather are advanced. C.

Starch Products: Use in Textile Industry. H. A. Crown. *Amer. Dyes. Rept.*, 1933, 22, 668-672.

The author describes the various methods for converting starch into its different products, such as dextrins, sugars, gums, and canary dextrins. The determination of the fluidity of ordinary and thin-boiling starches is described. C.

Oleines: Fire Hazard. E. J. Better. *Fettchem. Umschau*, 1933, 40, 159-161 (through *Chem. Zentr.*, 1933, **ii**, 3065).

The "peroxide number" is determined as a measure of the fire hazard of oleines. One g. oleine and 1 g. of powdered potassium iodide are dissolved in 16 c.c. of a mixture of glacial acetic acid and chloroform (2:1). The mixture is heated during 1½ min. and the iodine liberated is titrated. The number of c.c. of $N/100$ thiosulphate $\times 5 =$ the "peroxide number". Samples are exposed in shallow basins to the light of a 100-watt daylight lamp and the peroxide number determined from day to day and plotted on a curve. The sample with the greatest fire risk is that with the steepest curve. C.

Servo-Schopper Wetting Power Tester. J. F. Stöcker. *Textilber.*, 1933, 14, 544.

The wetting power of a liquid depends on its air-displacing power and its power of rise. The Servo-Schopper apparatus described by Rozenbroek measures swelling power, which is probably identical with air-displacing power, but neglects power of rise. The results give a satisfactory indication of the value of liquids used in finishing processes in which the goods are held below the surface of the liquid. The influence of air-displacing power and power of rise in processes involving the sinking of loose material, such as raw cotton, when placed on the surface of liquids is briefly discussed. C.

Determination of Nitrogen in Sericin. G. Baroni. *Boll. uff. R. Staz. sperim. Seta*, 1933, 3, 28-29 (through *Chem. Zentr.*, 1933, **ii**, 2478).

The determination of the nitrogen content of sericin by analysis of the dry residue remaining after extraction of the raw silk with hot water and evaporation of the extract yields results not differing materially from those obtained by an indirect method consisting in determination of the nitrogen content of the raw silk by the Kjeldahl method, determination of the fibroin content, extraction of the raw silk with benzene to determine the fat and hydrocarbon content, and determination of the ash content of the raw silk. Determination of the nitrogen in fibroin precipitated from the aqueous extract with ether, however, gives somewhat lower results. S.

Improved Centrifugal Method for the Evaluation of Textile Penetration Assistants. S. Lenher and J. E. Smith. *Ind. and Eng. Chem.* (Anal. Edit.), 1933, 5, 376-381.

The advantages of this method as compared with the sinking-time method for the quantitative evaluation of wetting-out agents for cotton, wool and silk are pointed out. It is shown that the surface tension of a solution toward air is no criterion of its penetrating ability toward textile fibres. Measurements of the efficiency of a variety of textile assistants as penetrating agents over a range of concentrations and temperatures are given. W.

Dry-cleaning Soaps: Testing. *See* Section 7A.

6—DESIGN

Patent

Patterns on Felt Hats. F. Fischel and S. R. Carrington & Sons Ltd. E.P.394,938 of 10/4/1933 (through *J. Soc. Dyers and Col.*, 1933, **49**, 399).

Pieces of yarn or fabric are superimposed on a partially prepared felt, which is then felted, planked, and hardened in the usual manner. W.

7—LAUNDERING, AND DRY-CLEANING

(A)—Cleaning

Cotton and Linen Fabrics: Shrinkage in Laundering. G. H. Johnson. *Amer Dyes. Rept.*, 1933, **22**, 561-564, 584, 591-592, 619-621.

Tables of shrinkage data show that the amount of shrinkage obtained varies with the material, depending upon the treatment that a given fabric receives during mill processing. Moisture is necessary for shrinkage, although soaking causes less shrinkage than actual laundering, particularly for heavily starched materials. An increase in washing temperature does not increase shrinkage. The presence or absence of washing supplies does not affect the rates of shrinkage. The greatest amount of contraction occurs during the first laundering, and within a few minutes of immersion. Unsized materials shrink very rapidly, and the warp shrinkage is generally in excess of the weft shrinkage. Pressing with a hand iron tends to stretch fabrics slightly, but will never overcome excessive warp or weft shrinkages. The use of pre-shrunk materials for the manufacture of tailored and fitting garments is advocated. C.

Dry-cleaning Soaps: Testing. C. L. Bird. *J. Soc. Dyers and Col.*, 1933, **49**, 316-319.

Small scale dry-cleaning experiments have been carried out with artificially soiled wool patterns. In the case of a potash soap with 7·9% unsaponified oleic acid, Brown's observation that inferior cleaning is obtained with solutions in white spirit, above a soap concentration of 0·5%, was confirmed. With other soaps, a continuous improvement was obtained with increase in the soap concentration. The inferior cleaning resulting from drying artificially soiled patterns before cleaning appears to be due to excessive removal of water from the dry-cleaning soap solution by the dry wool. The detergent effect of a dry-cleaning machine is usually more important than that of the dry-cleaning soap. The soap described above, when below a concentration of 1% in white spirit, precipitates when tumbled; these solutions possess the power of lathering. The surface tension of white spirit is not affected by the soaps. The solutions form stable suspensions of carbon black, capable of passing through filter paper. C.

Methylene Chloride: Properties and Uses. *Synth. Appl. Finishes*, 1933, **4**, 221-222.

Methylene chloride, technical CH_2Cl_2, is coming into use as a solvent for fats and resins, and replacing trichloro-ethylene for many purposes. The technically pure product has b.p. 38-41° C. and *D* 1·32. Other grades may contain fractions boiling above 60° C. A continental purchasing specification is reproduced. C.

Alkaline Salt Solutions: Detergency. F. D. Snell. *Ind. Eng. Chem.*, 1933, **25**, 1240-1246.

The detergent effect of various soap builders is studied by experimental washing tests, using as soiling medium a mixture of carbon black, mineral oil, and cotton-seed oil dissolved in carbon tetrachloride. The order of decreasing value of detergents of the builders studied is sodium orthosilicate, sodium metasilicate, a mixture of sodium metasilicate and soda ash, sodium hydroxide, modified soda, and soda ash. The acidity of dirt increases the ease with which it is removed. It is desirable that the hydroxyl-ion concentration of the builder solution be relatively large and the sodium-ion concentration relatively small. The theory is advanced that the efficiency of the different builders with soap is some positive power of the number of units of brightness regained in washing, between the second and the third powers. The major factors in detergency are mechanical action, wetting power, deflocculating power, and emulsifying power. A list is given of desirable properties for alkaline detergent solutions. C.

PATENT

Washing Powder: Preparation. Electric Smelting and Aluminium Co. (Cleveland, Ohio). D.R.P.577,701 of 24/10/1929 (through *Chem. Zentr.*, 1933, **ii**, 3066).

A dry washing powder for laundering, scouring cotton, etc. is made by melting together kaolin, sand and soda in such proportions that the product has the formula Al_2O_3, x SiO_2, x-1 Na_2O, where x is more than 7. The ground product is preferably incorporated with alkali salts of weak acids, and sulphonated dispersing or wetting agents. C.

8—BUILDINGS, AND ENGINEERING

(A)—CONSTRUCTION OF BUILDINGS

Metals: Electrolytic Cleaning. S. Wernick. *Ind. Chemist*, 1933, 9, 345-348.

A general review of the process of electrolytic cleaning. The author recommends the use of nickel instead of iron for the anodes, and urges that the bath be kept as free as possible from grease and other impurities, and only used for final chemical cleaning. Operation conditions and rinsing arrangements are discussed. C.

Metals: Electrolytic Cleaning. B. Kabanow. *Kolloid Z.*, 1933, 65, 101-105.

Electrolytic degreasing can be used to free metals from unsaponifiable as well as saponifiable greases, owing to increased wettability of the metallic surface by water caused by polarisation of the metal. The process is studied photographically for vaseline oil on mercury, iron, and platinum, and the gradual detachment of the oil in droplets is observed. With strong cathodic polarisation, small bubbles of hydrogen are formed, which settle on the oil drops and grow by addition of new bubbles both from within the drop and from the surrounding solution, till they finally lift the oil drop from the metal surface. The problem of wetting hysteresis is discussed. When iron sheet is coated with a solid grease and cathodically polarised, the layer of grease is first lifted at the edges (owing to increased wettability of the metal by water) and finally is lifted off bodily by bubbles of hydrogen which have collected below it. Photographs are reproduced. C.

Liquid-Solid Agitating Machines: Performance. A. W. Hixson and G. A. Wilkens. *Ind. Eng. Chem.*, 1933, 25, 1196-1203.

Intensities of agitation were compared by the Hixson-Crowell cube root law velocity constants for the liquid-solid dissolution system, using benzoic acid tablets in water and several oils. Experiments were conducted in a series of cylindrical vessels ranging in volume from 0·73 to 353 gallons fitted with propeller stirrers. In free rotational agitation the effects of stirrer speed, size of equipment, and fluid viscosity are very great. The introduction of from one to four baffles reduces the rate of solution, further addition of baffles has no effect. A general relation for the rate of solution in terms of composite variables is given. More effective agitation is found in a shallow vessel than in a deep one at the same stirrer speeds. The freely rotating turbine is found to be more effective than the propeller under the same conditions. The power consumption per unit volume of liquid undergoing agitation increases rapidly with the size of the system and with the modification of flow by baffles. C.

Corrosion and Protection of Metals. U. R. Evans. *Chem. Age*, 1933 29, 433-434.

Wet corrosion and electrochemical corrosion are discussed, and details given of resistant materials, metallic coats, and paint coats. W.

(B)—FIRE PREVENTION

Cotton Rubber-lined Fire Hose. H. R. Mauersberger. *Melliand Text. Monthly*, 1933, 5, 157-159, 207-209.

The manufacture of cotton rubber-lined fire hose consists of the following steps—(*a*) spinning the yarn, (*b*) weaving the jacket, (*c*) mending, mildew proofing and inspection of the hose, (*d*) making the rubber lining, (*e*) the insertion of the lining into the jacket, (*f*) curing the lining in the jacket, (*g*) attaching the coupling to the hose. Each step is briefly described and the tests and specifications set up by the National Board of Fire Underwriters are given together with suggestions for the care of fire hose. C.

Fireproof Theatre Curtains: Testing. N. D. Mitchell. *Bur. Standards J. Res.*, 1933, 11, 491-513.

Two types of steel curtains, four asbestos cloth curtains, and several kinds of asbestos cloth were subjected to fire tests. The single-ply wire-reinforced curtain of heavy asbestos cloth and other 2-ply curtain of plain asbestos cloth permitted the passage of smoke and flame during the test and glowed on the unexposed surface. Curtains made of two plies of wire-reinforced asbestos cloth separated by a steel frame afforded protection for about 15 minutes against a severe test fire. The steel curtains were tested for half an hour and gave indication of affording protection for somewhat longer periods. A table of strength and stretch tests of asbestos cloth is given. C.

Oleines: Fire Hazard. *See* Section 5D.

(D)—POWER TRANSMISSION

Ball and Roller Bearings: Application in the Textile Industry. L. Lautour. *Fils et Tissus*, 1933, **21**, 472-479.

The reductions in power consumption and other advantages derived from the application of ball and roller bearings are discussed. Applications to machines used in the various branches of the textile industry are described and the advantages of the patent S.K.F. spindles with roller bearings are pointed out. C.

Blowing and Card Room Machinery Individual Electric Driving Motors. R. H. Friend. *Text. Weekly*, 1933, **12**, 252-255, 308-309, 338-339.

The application of the individual electric drive is discussed for bale openers, hopper feeders, horizontal openers, Crighton openers, scutchers, carding engines, drawing frames, and speed frames. Photographs are given. C.

Eccentrics; Theory of——. V. Schirdewan. *Leipz. Monats. Text. Ind.*, 1933, **48**, 31, 51, 78, 103-104, 126-127, and 151.

A study of the theory of certain types of eccentrics used on textile machinery. C.

Worm Drive; Mechanics of——. W. Vogel. *Pamphlet*, "Eingriffsgesetze und analytische Berechnungsgrundlagen des zylindrischen Schneckentrieben mit geradflankigem Schnecken-Achsenschnitt", 1933, 62 pp., 52 figs. (through *Zbl. Mech.*, 1933, **1**, 242).

The author develops mathematically the various laws of the worm drive, with a view to the establishment of standard forms. C.

Petroleum Greases: Lubricating Properties. F. H. Rhodes and H. D. Allen. *Ind. Eng. Chem.*, 1933, **25**, 1275-1280.

The lubricating power of some soda-base greases is measured from the angle through which a horizontal plane surface lubricated with the grease must be tilted to cause slipping of a triangular rider placed upon it. The feet of the rider rest on brass lugs screwed into the plate, which can easily be removed and repolished. The first slipping of the rider closes a relay circuit and shuts off the motor that actuates the tilting device. The soap present in soda-base greases plays an important part in the formation of the lubricating film. The glycerol present aids in stabilising the structure of the grease and increases the lubricating power. Greases containing an amount of glycerol equal to two or three times the quantity equivalent to the sodium soap present are better lubricants than those with the amount equivalent to the soap. With larger quantities of glycerol the lubricating value again decreases. C.

(G)—HEATING, VENTILATION, AND HUMIDIFICATION

Humidistat. Texair Instrument Co. *Instruments*, 1933, 6, 194.

The new humidistat, which is sensitive enough to cut-in and cut-out within a 1% difference in relative humidity, was developed for operating humidifying and de-humidifying apparatus as a 2-wire or a 3-wire controller. The ribbon type sensitive element has no tendency to drift and is unaffected by temperature changes up to 200° F. The range is 20% to 100% relative humidity. The rating is 10 watts at 110 volts with a 100% reserve. The contact arms are equipped with platinum-iridium oversize points. C.

Calcium Chloride Air Conditioning Solution: Application. G. T. Condron. *Heating and Ventilating*, 1933, **30**, No. 8, pp. 11-13 (through *Chem. Abstr.*, 1933, **27**, 5128).

Diagrams of temperature and humidity relations reveal advantages of calcium chloride brine in comparison with water. C.

Ionised Air: Physiological Effects. C. P. Yaglou and others. *Heating, Piping, and Air Conditioning*, 1931, **3**, 865-869; 1933, **5**, 420-430 (through *Chem. Abstr.*, 1932, **26**, 3593; 1933, **27**, 5112).

These papers describe the effects of large and small ions on the well-being of the occupants of rooms. The main conclusions are reproduced in another paper recently abstracted. C.

Thermal Insulation. E. Griffiths. *J. Roy. Soc. Arts*, 1933, **81**, 911-926, 930-943, and 945-961.

A general review of thermal conductivity and its measurement, with details of its application to practical problems. W.

Humidification in the Worsted Industry. M. C. Marsh. *Text. Mfr.*, 1933, **59**, 427.

Abstract of a lecture to the Keighley Textile Society, 30th October 1933, outlining recognised methods of measuring humidity, and various humidifiers and control instruments. W.

Glass Silk for Heat Insulation. "Mechania." *Bradford Chem. Comm. J.*, 1933, **14**, 190-192.

Glass silk, which is spun glass, is used for thermal insulation. The advantages of "Versil", a particular variety of the material, are stated. Its coefficient of conductivity is lower than that of any of the usual insulating materials, and it is unaffected by temperatures of 1,000° F. It is available in various forms for different engineering purposes. W.

Paper Regain Hygrometer. J. Grant. *Nature*, 1933, **132**, 677.

The author suggests that thin filter paper or a good ashless cigarette paper would give a much more rapid response than writing paper when used as a regain hygrometer, equilibrium being attained in under five minutes. The relation between water content and change in length is not linear between values of the latter, which vary according to the paper from 5-10% and it seems that there is here a critical point at which there is a sudden loss of power of expansion. The curves obtained on plotting the water content against the expansion on wetting and the contraction on drying do not always coincide, the rate of shrinkage being always less for a given water content. This indicates that paper may lose its powers of response to humidity changes. C.

(I)—Waste Disposal

Effects of Trade Effluents on Sewage Purification. C. C. Beedham. *Surveyor*, 1933, **84**, 41-42 (through *Bull. Hyg.*, 1933, **8**, 821).

Describes the conditions prevailing at Bradford where trade effluents mostly from wool washing operations complicate the problem of sewage disposal very considerably. The author has carried out numerous experiments with a view to improving the methods employed for the preliminary recovery of grease from wool washing wastes before these are admitted to the sewers and has shown how much the efficiency of the process depends upon temperature and *p*H values. In spite of the partial recovery of grease at individual mills the Bradford sewage still contains a very large amount of grease and the method of sewage treatment adopted necessitates the removal of this grease by acid precipitation and sedimentation. The acid character of the tank contents inhibits septic action in the tanks, so that the works are usually free from hydrogen sulphide smells. The acid character of the tank effluent inhibits the activity of Psychoda fly larvæ. These advantages must be set against the fact that an acid liquor is not very amenable to biological filtration, exerts a corroding action on the iron of the filter equipment and gives rise to a rapid growth of fungi. The sludge disposal problem at Bradfrod is perhaps one of the most interesting in the world. The sludge is heated in contact with sulphuric acid and then steamed in presses. The liquid effluent from the presses is a mixture of grease and water and the author deals with the many interesting aspects associated with the treatment of the Bradford sludge, such as the effect of the *p*H value and addition of detritus on the time and consequent cost of pressing. H.

PATENTS

Circulating Liquid Flow Control Device. Rosser & Russell Ltd. and E. J. Naylor (London). E.P.400,199 of 5/4/1932.

The invention relates to installations in which a liquid is circulated by a pump in a closed circuit for the purpose of warming or cooling or for air conditioning or humidifying or like purposes. The liquid may be contained in one or more storage reservoirs at the same or different temperatures. The method of control consists in thermostatically controlling an auxiliary flow of liquid, which in turn regulates the flow of one or more continuous streams of heating or cooling medium supplying the working circuit. A suitable device for carrying this method into effect comprises a valve controlling the flow of heating or cooling liquid through one or more circuits and a temperature controlled valve affected by the temperature of the liquid in the circuit or by the temperature of the atmosphere influenced by the temperature of the circuit and opening with rising or with falling temperature so as to cause an auxiliary stream of liquid subjected to the suction or pressure of the circulating pump to act on the flow controlling valve and vary the controlling action of the latter. Different modifications are described. C.

Heating, Ventilating, and Humidifying System. Textile Illuminating and Engineering Co. Ltd. and R. Sutcliffe (Whitefield). E.P.400,749 of 22/8/1932.

The invention comprises the combination with a radiator and a fan delivering air through such a radiator, of liquid atomisers at the air outlet side of the radiator, the atomisers delivering water spray in the same direction as the air from the radiator so that the extent of projection of the atomised liquid is increased, the radiator being, when required, supplied with a heating medium which can drain to a system feeding the atomisers in which a constant level is maintained by automatic means, the said system supplying the radiator with cool liquid when a heating medium is not required. C.

9—PURE SCIENCE

Sol-Electrolyte Mixtures: Viscosity. S. G. K. Murty. *Kolloid Z.*, 1933, 64, 319-320.

The viscosity of some sols decreases on addition of a small quantity of electrolyte and increases on addition of a larger quantity. The author's explanation of this is that at first the diminution of the stiffness factor is greater than the increase caused by the growth of particle diameter, since the disperse phase at the beginning consists of very small particles. When more electrolyte is added coagulation becomes more pronounced and the probability of collision between an amicron and a micron is greater. The diameter of the particles also increases with coagulation. The rise in viscosity due to increased particle diameter will, therefore, more than compensate the decrease due to diminished stiffness, and a U-shaped curve, showing a minimum, will result. This explanation agrees with observations on the change of refractive index and the increased volume of sols on coagulation. C.

"Suspended Level" Viscometer: Application. L. Ubbelohde. *J. Inst. Petrol. Tech.*, 1933, 19, 376-420.

The paper describes capillary viscometers in which the hydrostatic head is defined in relation to the "suspended level" of the liquid. The lower end of the capillary is attached to a wider tube and is of such form and dimensions that the liquid emerging from the capillary flows in a layer over the end, and down the wall of the wide tube. The horizontal liquid surface underneath the end of the capillary tube (the suspended surface) is so flattened that it is without influence on the pressure head. The thickness of the suspended layer is small and is independent of the kinematic viscosity and so has the same value for all liquids. The position of its lower surface (the "suspended level") is thus accurately defineable. With high rates of flow the flat surface is deformed, but the suspended level remains unaffected, and the Hagenbach kinetic energy correction is still applicable. The device can be incorporated into instruments for measuring static and dynamic surface tension, etc. and these are briefly described. C.

Nitrocellulose: Lowering of Viscosity. H. Schulz. *Kolloid Z.*, 1933, 64, 252-256.

A review of patents for lowering the viscosity of nitrocellulose. C.

Nitrocellulose: Viscosity. G. S. Barsukov. *J. Appl. Chem. Russ.*, 1933, 6, 99-102 (through *Brit. Chem. Abs. A*, 1933, 779).

On the addition of ammonia-ethyl alcohol the specific viscosity of nitrocellulose in ethyl alcohol rises to an extent which is proportional to the ammonia content during the first 5 hours; subsequently it falls continuously. The nitrogen content and specific viscosity fall continuously with duration of immersion in boiling xylene or aqueous ammonia. C.

Illumination Intensity Measuring Device. H. R. Rosen and W. M. Roberds. *Science*, 1933, 78, 241-242.

A field apparatus for measuring intensity of illumination consists of a Weston photronic cell, a Weston galvanometer, a three-way toggle switch and small lengths of copper wire for shunts and connections. The cell is connected directly across the galvanometer, which may be shunted to give the desired range. The three-way switch connects a shunt for each position, and each position may be calibrated in terms of foot candles by means of ordinary electric lamps of known candle-power at measured distances. When the galvanometer is shunted with the proper resistance and used with the photronic cell, intensities of illumination from 10 to 15,000 foot candles may be measured accurately and the deflection is strictly proportional to the illumination over these ranges. C.

Laboratory Tachometer: Construction. W. A. Sperry. *Ind. Eng. Chem., Anal. Ed.*, 1933, 5, 288.

A tachometer may be prepared from an old magnetic automobile speedometer with the mileage counter removed. An ordinary agitator-drive is inverted and the speedometer shaft is connected to the clutch end with a short piece of rubber tubing. The instrument is then operated by a belt and a properly selected set of pulleys. The scale reading may be correlated to the angular velocity of the driving shaft by means of a variable speed motor. Measurements of the angular velocity of the motor shaft may be taken with a revolution counter, at the same time noting the tachometer reading at different spots, and the data so obtained are plotted. The velocity of the drive shaft may then be picked from the curve at corresponding tachometer readings. C.

Statistical Data: Periodogram Analysis. D. Alter. *Proc. Nat. Acad. Sci.*, 1933, 19, 335-339 (through *Sci. Abs. A*, 1933, 36, 680).

Given n data, in the form of departures from the mean of all; add all the pairs separated by a time interval l and sum the absolute values of all such sums; this sum divided by the number of pairs is denoted by M; and the periodogram is the graph of M against the various trial values of l. M will clearly be increased by any degree of repetition in the data. Its relation to the correlation coefficient is derived. The method is adapted to computing machines. C.

Statistical Data: Theory. M. S. Bartlett. *Proc. Roy. Soc.*, 1933, A141, 518-534.

Frequency laws in statistics mean "laws of chance". The distinction between these chances and probabilities on other data is emphasised, and an attempt is made to show why exact arguments about chance are more fundamental as a mathematical basis for statistical theory and inference than the formula of inverse probability. Examples of arguments about chances are Fisher's methods of maximum likelihood and fiducial probability. Such arguments do not pretend to abolish the judgment and common sense necessary when general theory is used to make, from a particular sample, an inference about the "population." C.

***Aspergillus*: Chromosome Number.** K. Wakayama. *Cytologia*, 1931, 2, 291-301 (through *Bot. Centr.*, 1933, 165, 427).

Cytological proof is given of the asexual formation of conidiospores in *Aspergillus*. The conidiospore nucleus develops in the mono-nucleur sterigma through a quite abnormal division. All the 13 species studies had the chromosome number 2. C

***Aspergillus Niger*: Culture Experiments.** M. L. Mann. *Bull. Torrey Bot. Club*, 1932, 59, 443-490 (through *Bot. Centr.*, 1933, 165, 333).

Magnesium is essential for the growth of *Aspergillus* and *Penicillium*, the minimum concentration being 0·1 mg. per litre. If calcium is essential, the minimum is of the same low order as the concentration of B, Zn, Mn, Fe, and Cu necessary to higher plants. Calcium chloride does not overcome the toxic effect of higher concentrations of magnesium, but depresses the stimulating effect of zinc sulphate.

Mycelial development is greater when the Pfeffer nutrient is made up with rather more magnesium sulphate and less ammonium nitrate than the normal formula. C.

Aspergillus Niger: **Effect of Zinc Sulphate on——.** K. B. Stehle. *Bull. Torrey Bot. Club,* 1932, **59**, 191-217 (through *Bot. Centr.*, 1933, **165**, 333).

Culture experiments are described that show that the stimulation of *A. niger* mycelium by zinc sulphate is overcome by the presence of starch, inulin, or agar in the medium. C.

Aspergillus Niger **Enzymes: Activity.** H. Dyckerhoff and R. Armbruster. *Z. physiol. Chem.*, 1933, **219**, 38-56.

The authors describe the extraction from the mycelium of *A. niger* of two enzymes, an esterase capable of hydrolysing phenyl acetate and destroyed by warming at *p*H 8·9 at 40°, and a tannase that is resistant to such treatment. The latter catalyses the hydrolysis of methyl gallate and decomposes the acid component of esters that fulfil the following conditions—(1) Two phenolic groups are present, and (2) the esterified carboxyl is attached directly to the oxidised benzene ring, but not *ortho* to a hydroxyl group. Thus the enzyme has no action on salicylic acid. D.

Aspergillus Niger **Spore Pigment: Properties and Constitution.** A Quilico (with A. di Capua). (1) *Atti. R. Accad. Lincei,* 1933 [VI], **17**, 93-98; (2) *ibid.*, 177-182; (3) *Gazz. Chim. Ital.*, 1933, **63**, 400-410 (through *Brit. Chem. Abs.*, 1933, *A*, 536, 751, 1054).

The isolation of "aspergillin", the black pigment of *A. niger*, is described. It forms alkyl derivatives, evolves carbon dioxide on heating at 150-250°, yields mellitic acid on oxidation with hydrogen peroxide, and both mellitic and oxalic acids on oxidation with nitric acid. It is regarded as a humic acid in pure form. C.

Mould Fungi: Effects of Humidity and Carbon Dioxide. O. Skovholt and C. H. Bailey. *Cereal Chem.*, 1933, **10**, 446-451.

Relative humidities of approximately 90% or more in the enveloping air are required to permit appreciable mould development on bread crust within the usual interval of time between production and consumption. Bread crumb is more hygroscopic than bread crust. Carbon dioxide concentrations of 17% will retard, and 50% will prevent mould growth on bread, but only while maintained in such atmospheres. Subsequent removal of bread so treated into a normal atmosphere results in as abundant and luxurious a mould growth as though the treatment had not been applied. C.

Flour: Protein, Moisture, and Ash Analysis; Errors———. A. E. Treloar. *Cereal Chem.*, 1933, **10**, 477-487.

Data are presented showing the systematic and random errors for protein, moisture, and ash analyses for 38 collaborators, as well as histograms for the distribution of systematic errors in percentages of protein, moisture, and ash. Systematic errors appear to be widespread. C.

Formic and Acetic Aldehydes: Determination. M. V. Ionescu and H. Slusanschi. *Bull. Soc. Chem.*, 1933, **53**, 909-918.

Formic and acetic aldehydes give white crystalline precipitates with "dimedone" (dimethyldihydroresorcinol) A method is described for the differentiation and quantitative determination of these aldehydes based on the time necessary for the appearance of the precipitate. Time-concentration curves are plotted for both formic and acetic aldehydes, the time for appearance being greater in the latter case, and increasing with the proportion of acetaldehyde present when the two aldehydes are mixed. By means of the curves it is possible (*a*) to determine formaldehyde in solutions containing at least 0·0018 gm. formaldehyde per 100 c.c. water, (*b*) to determine acetaldehyde in solutions containing at least 0·05-0·07 gm. per 100 c.c., (*c*) to differentiate and determine mixtures of the two in solutions containing at least 0·0018 gm. formaldehyde per 100 c.c. water when present to the extent of at least 2% of the total amount of aldehyde. C.

Pulps: Analysis. V. Hottenroth. *Papierfabrikant* (V.Z.I. Section), 1933, **43**, 557-579.

Details are given of methods of pulp analysis approved by the Faserstoff-Analysenkommission, particular attention being given to lignin content and degree of hardness. C.

Benzylcellulose: Production. N. I. Nikitin and M. A. Avidon. *J. Appl. Chem. Russ.*, 1933, 6, 711-715 (through *Brit. Chem. Abstr.*, 1933, *B*, 959).

Cotton wool is soaked in 25% caustic soda for 18-24 hrs., squeezed until three times its original weight and heated with 2·6 parts of benzyl chloride at 100° for 3 hrs. Two parts of caustic soda are added and heating is continued for 4 hrs. The product is almost completely soluble in a mixture of benzene and alcohol and contains more than 2 $O·CH_2Ph$ per $C_6H_{10}O_5$ unit. C.

Cellulose: Ethylation. N. I. Nikitin and T. I. Rudneva. *J. Appl. Chem. Russ.*, 1933, 6, 716-720 (through *Brit. Chem. Abstr.*, 1933, *B*, 958).

The facility of ethylation increases in the order EtCl<EtBr<Et I, a maximum of 2·75 Et per $C_6H_{10}O_5$ unit being obtained by heating cellulose in 40% caustic soda with ethyl iodide at 120° for 8 hrs. Benzyl groups can be introduced into ethylcelluloses. The product containing $2\frac{3}{4}$ OEt and $\frac{1}{16}$ $O·CH_2Ph$ per $C_6H_{10}O_5$ gives highly transparent and elastic films. C.

Cellulose: X-ray Structure. K. Atsuki and M. Ishiwara. *J. Soc. Chem. Ind., Japan*, 1933, 36, 517-525 B.

Tables are given interpreting the X-ray patterns of hemp and cotton fibres, viscose rayon filaments, and Cellophane sheet. The cellulose unit crystal is assigned to the monoclinic system, and it is suggested that the axes in hemp are arranged parallel to the fibre axis, whilst those in cotton are arranged round the fibre axis, and inclined to it. A fibrous structure parallel to the direction of spinning may exist in some parts of viscose rayon, whilst other portions may be irregular. Most of the semi-crystalline particles will be arranged parallel to the common axis. Cellophane probably has a reticulate structure, and no parallelism exists between the semi-crystalline particles. The common axis of the rayon is taken as [001], and its inclination to the direction of spinning is 0°~(20~25°). The glucose chains in the natural fibres are probably connected laterally. Photographs of X-ray patterns are given. C.

Cellulose Ethyl Ether: Fractionation. I. Okamura. *Cellulosechem.*, 1933, **14**, 135-138.

Tables of the physical and other properties of five ethyl cellulose fractions precipitated from solution in glacial acetic acid by the addition of water show that the iodine number and the osmotic pressure increase from the higher to the lower fractions, while the quantity of hexane necessary to produce precipitation from 1% benzene solution, the specific viscosity, and the molecular weight decrease. Fairly good agreement is found for the molecular weights determined from osmotic pressure, viscosity, and iodine number. C.

Cellulose Film Crystal Structure Model. G. Glockler. *Rev. Sci. Instr.*, 1933, 4, 529.

A new collapsible crystal structure model has the various parallel planes made of "cellophane" on which the black and white dots representing atoms or ions are displayed, thus eliminating the obstruction of the view by wires. A photograph is given. C.

Cellulose Hydrates, Soda-Celluloses, and Cellulose-Phosphoric Acid: Formation. G. Champetier. *Ann. de Chim.*, 1933 [X], **20**, 5-96 (through *Brit. Chem. Abstr.*, 1933, *A*, 1038).

Compounds in which the ratio of $C_6H_{10}O_5$ to NaOH is 2:1, 1:1, 3:2, and 4:3 are formed when cellulose is immersed in caustic soda. Phosphoric acid gives $3C_6H_{10}O_5, H_3PO_4$. The hydrate $2C_6H_{10}O_5, H_2O$ is formed in a solution of sodium thiosulphate, and $C_6H_{10}O_5, H_2O$ in a pyridine solution. Compounds are not formed in solutions of formic and acetic acid. Compounds with water and with phosphoric acid can be formed without change in the cellulose lattice. Cotton cellulose forms hydrates much more rapidly than does dried animal cellulose. C.

Cellulose Solutions: Ageing. S. Iwasaki and T. Sakano. *J. Soc. Chem. Ind., Japan*, 1933, 36, 507-511.

Regenerated cellulose solutions were subjected to ageing for periods from 24 to 216 hours and at temperatures from 13° to 25° C. The cellulose was then converted into nitrate and the relative viscosity and concentration of the acetone solution was determined. The effect of ageing on viscosity was determined from $K = \log \eta_r / C$ where η_r is the specific viscosity of the cellulose nitrate solution and C is the concentration. Tables of results for two kinds of linters are given, and the following equation is derived—$(\log \eta_r)/C = l + m\theta + n \log Z$ where l and m

are constants, θ is the ageing temperature, n is a constant characteristic for each kind of cellulose and is independent of the ageing temperature, and Z is the ageing time in hours. C.

Cotton: Conversion into Petroleum Products. E. Berl, and (1) H. Biebesheimer, (2) W. Dienst. *Liebig's Ann. Chem.*, 1933, **504**, 38-61, 62-71.

The authors discuss the possibility that vegetable matter is the precursor of petroleum and may be converted into this by the chemical and physical action of mineral deposits. By heating cotton with *N*-caustic soda (or chalk or dolomite) at 310-330° under 180-200 atm. pressure they have obtained a "proto-product" which becomes like asphalt in the air and yields petroleum-like oils on hydrogenation or cracking. C.

Nitrocellulose: Solubility in Organic Solvents. I. Sakurada and I. Kido. *J. Cellulose Inst., Japan*, 1933, **9**, (27)-(33).

The method of measuring the solubility of cellulose esters in organic solvents by determining the amount of benzene that can be added without causing precipitation is incorrect, as it only indicates the stability of the solution. The authors determined the solubility of two nitrocelluloses in a number of organic solvents, by plotting the solubility curves for mixtures of solvent with different concentrations of an indifferent non-polar liquid such as benzene. The concentration-solubility curve is S-shaped, and the form of the curve varies with the nature of the solvent and serves as a measure of solvent capacity. Two characteristic points are read from the curves, either the point at which the middle straight portion of the curve when extended cuts the solvent concentration axis, or the point on this axis corresponding with the dissolution of half of the nitrocellulose. Graphs and results are given for acetone, methyl ethyl ketone, acetic anhydride, ethyl acetate, propyl acetate, pyridine, amyl acetate, methyl formate, ethyl butyrate, methyl acetate, and nitrobenzene, mixed with different concentrations of benzene. C.

Potato Starch: Properties. T. C. Taylor and T. J. Schoch. *J. Amer. Chem. Soc.*, 1933, **55**, 4248-4255.

The absence of any insoluble material in potato starch in the sense in which it is present in cereal starches is established by several different methods. Organic phosphorus is shown to be randomly distributed in potato starch, and this circumstance must arise from a diversity of relatively simple and very similar amylose-phosphates. Insoluble material is attributable, principally, either to incomplete disorganisation of the associated material in the granule or to retrogradation. Both conspire to give the erroneous impression that potato starch contains a non-dispersible fraction comparable to the alpha-amyloses of the cereal starches. C.

Linseed Oil: Polymerisation. H. I. Waterman and D. Oosterhof. *Rec. Trav. Chim.*, 1933, **52**, 895-900.

Linseed oil, stand oil, and similar oils of a high molecular weight can be fractionated in a new high vacuum distillation apparatus in which the oil trickles in a thin film over the outside of an electrically heated frosted glass tube enclosed in a water jacket. The more volatile portions evaporate and are condensed on the water jacket, so that the oil is fractionated into distillate and residue. Little decomposition of the oil occurs owing to the short time of contact with the heated tube. By removal of the unpolymerised components of lower molecular weight from a stand oil by means of vacuum distillation, a polymerised product is obtained with better drying properties and consequently of a higher commercial value. C.

Soap; Selective Wetting by——. E. Berl and B. Schmitt. *Kolloid Z.*, 1933, **65**, 93-100.

The problem of separating binary powder mixtures by selective wetting in two non-miscible liquids is discussed. Small quantities of dilute soap solution (0·1 c.c. of 0·001 molar sodium oleate) have successfully been used to separate powdered mixtures of galena and zinc blende in conjunction with benzene and sodium cyanide. Further addition of soap solution results in both powders being equally wetted. Potassium ethyl xanthate may also be used as a flotation agent for metallic ore powders. Suitable separators for various other powder mixtures are discussed. C.

Surfaces; Chemistry of——. I. Langmuir. *Angew. Chem.*, 1933, 46, 719-733.

A report of the author's Nobel lecture on adsorption and other surface phenomena, with a list of references to the literature. C.

Surface Solutions: Properties. A. Marcelin. *Kolloid Chem. Beih.*, 1933, 38, 177-336.

An exhaustive review of surface film phenomena under the following chapter headings—Introduction and general remarks, historical, the physical state of "surface solution", methods and apparatus used, saturation and the surface solution of oleic acid, the dimensions of the oleic acid molecule, pseudo surface solutions (molecular lacquers) and their transformation to true solutions, work on surface solutions and pseudo surface solutions of other bodies than oleic acid, unlimited isothermal extension of the surface solutions, surface extension of soluble and volatile bodies, the equilibrium between the surface solution and the solution of the same body and the Gibbs' equation, the lowering of the metal-electrolyte-Volta effect from the presence of a mono-molecular layer on the liquid surface, surface solutions of mercury, surface solutions on solid surfaces, wetting, and polarity of the molecules, black spots and coloured layers on soap lamellæ, and coloured crystalline layers. C.

Mechanism of the Swelling of Gels. K. Krishnamurti. *J. Indian Chem. Soc.* (Prafulla Chandra Ray Commemoration Vol.), 1933, pp. 193-199 (through *Chem. Abs.*, 1933, 27, 5609).

Tyndall intensity of a 20% gelatin gel as it was allowed to swell in water increases at first and then diminishes as swelling proceeds. Previous theories of swelling are not adequate to explain these facts. The mechanism suggested is—in the early stages of swelling liquid is taken into the micelles; the liquid which is still further taken in diffuses into the intermicellary space. This view also explains observations on heat of swelling. W.

The Basic Amino Acids of Serum Proteins. R. J. Block. *J. Biol. Chem.*, 1933, 103, 261-267.

Fresh cattle serum has been fractionated by various concentrations of ammonium sulphate, sodium sulphate, magnesium sulphate, and sodium chloride. The various protein fractions as isolated by this procedure did not have the same chemical composition based on the determination of the amino acids, arginine, histidine, and lysine. It appears that the more soluble serum proteins yield the greater amounts of lysine on acid hydrolysis. The results are consistent with Sørensen's hypothesis, that the serum proteins are constructed of a large number of non-dissociable components. The proteins obtained by the usual physico-chemical methods are not of a constant amino acid composition. W.

Periodic Precipitation. R. Fricke. *Z. f. Electrochem.*, 1933, 39, 629-641; Disc. 641 (through *Sci. Abs. A*, 1933, 36, 954).

The periodic or Liesegang precipitations of $Ba(NO_3)_2$ contained in a narrow tube when HNO_3 diffuses through it are observed. After a chosen interval of inter-diffusion, the tube is cut into small lengths, whose contents are carefully analysed and deductions made with the aid of specially prepared solubility data. The concentration of $Ba(NO_3)_2$ tends to rise, attaining supersaturation, and finally depositing a crystal at a point determined by the condition of the wall among other factors. The deposition generally occurs a little beyond the position of maximum supersaturation. The precipitation leaves further up the tube a smaller maximum of concentration, which subsequently grows and produces a second precipitation. The results are in accord with the ordinary laws of diffusion and precipitation. W.

Primary Standard of Light. G. Ribaud. *Rev. d'Optique*, 1933, 12, 289-301 (through *Sci. Abs. A*, 1933, 36, 1207).

Describes a series of researches conducted on the standard of candle-power proposed by the Bureau of Standards The platinum in the crucible was melted by means of a h.f. induction furnace of the spark type dissipating about 3 kw. The range of values of brightness observed during any one melt or freeze of the platinum was generally less than 1%. The final value is given as 58·78 candles per cm^2. The author draws the conclusion that this form of the black-body standard of light is readily reproducible. Nevertheless, it is possible that some improvement of detail might be introduced. In particular it would be advantageous to use a horizontal tube instead of a vertical one, and so avoid the uncertainty introduced by allowing for the absorption of light in the total reflection prism. W.

Specific Arthritis in Sheep. H. R. Seddon and H. R. Carne (N.S. Wales Dept. Agric.). *Vet. Research Rep.*, 1933, No. 6, Pt. 3, 95-108 (through *Chem. Abs.*, 1933, 27, 5363).

The bacillus causing the disease was isolated and its cultural characteristics are discussed. When they were grown in Hiss' serum water as a nutrient medium, various strains of the bacillus showed differences in the fermentative ability; lactose was fermented by all strains; glucose, levulose, galactose, sucrose, salicin and maltose were fermented by most strains; and raffinose, mannitol, dulcitol, glycerol, arabinose and inulin were fermented by certain strains. Glucose, levulose, maltose and lactose were fermented by all strains of *B. pyogenes*; nearly all strains fermented galactose, but less than 50% of them fermented sucrose, raffinose, mannitol and dulcitol, and only one fermented glycerol, arabinose or inulin; salicin was not fermented. W.

Protein Nature of Enzymes: An Investigation of Pancreatic Lipase. D. Glick and C. G. King. *J. Amer. Chem. Soc.*, 1933, 55, 2445-2449.

The use of 10% sodium chloride solution as an extracting agent for lipase from pancreas powder has been shown to produce more active preparations than can be obtained by other solvents previously used. Pancreatic lipase has been found to be precipitated quantitatively by saturation with magnesium sulphate. An activating effect of magnesium salts upon the enzyme has also been observed. The term "lipase value" as now used in the literature to indicate enzyme purification has been shown to be unwarranted. Instead, the expression of activity in terms of lipase units per milligram of nitrogen has been supported. The extraction and precipitation technique herein described for pancreatic lipase permits greater purification than other methods previously recorded. The solubility characteristics and general behaviour of the enzyme point strongly toward its being essentially a globulin. W.

Laboratory Drying Agents. J. G. *Chem. Tr. J.*, 1933, 93, 198 (through *J. Soc. Dyers and Col.*, 1933, 49, 402).

The pressures of water vapour, in mm., in equilibrium with various drying agents at room temperature are—

Calcium chloride	0·2000
Sodium hydroxide (fused)	0·1600
Potassium hydroxide (fused)	0·0030
Alumina	0·0025
Concentrated sulphuric acid	0·0020
Barium oxide	0·0010
Silica gel	0·0010
Barium perchlorate	0·0010
Magnesium perchlorate	0·0005
Magnesium perchlorate (+$3H_2O$)	0·0003
Phosphorus pentoxide	0·0002

Magnesium perchlorate does not become sticky on absorption of moisture; it remains porous, and diminishes in volume. It is able to absorb over 30% of its own weight of moisture and can be regenerated by heating at about 200° C. for 10 hours. One form of commercial silica gel is impregnated with a substance, which changes in colour when the gel has become saturated with moisture, the product corresponding to $2SiO_2{\cdot}H_2O$. It has the disadvantage of being rapidly exhausted, but may be regenerated by heating at 105° C. until the original colour returns. W.

The Protein Problem: Methylation of Arginine. W. Zimmermann and A. Canzanelli. *Z. physiol. Chem.*, 1933, 219, 207-214 (through *Chem. Abs.*, 1933, 27, 5343).

Arginine yields two trimethyl derivatives with Me_2SO_4, depending on the base used for neutralising the H_2SO_4. With Me_2SO_4 and $BaCO_3+Ba(OH)_2$ the product is $Me_2NC(:NH)NH(CH_2)_3CH(NHMe)CO_2H$ (I) (Engeland and Kutscher, *Chem. Abs.*, 7, 1180). With Me_2SO_4 and MgO the product is the α-betaine $H_2NC(:NH)NH(CH_2)_3\underline{CHNMe_3OCO}$ (II). The *trimethylarginine* (I) forms a *diflavianate*, decomposition 225-8°, a *chloroaurate*, melting at 174°, and does not react with HNO_2. Hydrolysis by $Ba(OH)_2$ converts it into *α-methylornithine* (*flavianate* melting at 222-3° decomposition, *picrate* melting at 205-6°, *chloroaurate* melting at 130-2°). The *arginine-α-betaine* (II) forms a *diflavianate* melting at 190° (decomposition), a *picrate* melting at 168-9°, a *sesquichloroaurate* melting at 195-7°, and a *dichloroaurate* melting at 190°. Hydrolysis by $Ba(OH)_2$ converts it into *ornithine-α-betaine* (*flavianate* melting at 240-2° decomposition, *picrate* + H_2O melting at 91°). Ornithine-α-betaine was prepared also by treatment of δ-benzoylornithine with Me_2SO_4 and MgO. Partial hydrolysis of I gave *trimethylcitrulline* (*picrate*, decomposition 214-6°). In the methylation of arginine it is believed that II is first formed and then undergoes rearrangement to I if the neutralising agent is strong enough to overcome the acidity. The guanidine grouping in the protein mol. does not undergo methylation under conditions which leave the peptide linkage intact. All isolated products containing Me in the guanidine group result from migration of a Me first present in the α-position. W.

Oil-resisting Rubber. W. J. S. Naunton, M. Jones, and W. F. Smith. *Oil and Col. Tr. J.*, 1933, **84**, 988.

Paper presented at a meeting of the London and District Section of the Institution of the Rubber Industry. Outstanding conditions in designing an oil-proof rubber were summarised as follows—(1) The rubber should be preferably unmilled (i.e. latex compounded) or, if milling were essential, it should be reduced to the minimum. (2) Oils open up the structure of rubber, and, therefore, accelerate oxidation; hence, an anti-oxidant should always be employed. (3) The rubber should be cured with a liberal amount of sulphur, since apart from blooming there is no objection to free sulphur, or, if cured by means of an accelerator, a thiuram accelerator should be employed. (4) The cure should be pushed as far as ageing requirements and the danger of reversion will allow. (5) The softener should be one having no deleterious effect on oil-resistance. (6) The filler should be essentially magnesium carbonate, and the quantity as much as the nature of the finished article will allow. (7) Where the article will not be called upon to give service at low or higher temperatures and not to possess high-grade physical properties (tensile and extension), the oil-resistance can be increased by the use of a large proportion of ethylene polysulphide resins. (8) Where the finished article will be called upon to give service at higher temperatures, such as hot oil gaskets, the best results will be obtained by using Duprene. (9) Where extreme resistance to oil combined with high-grade physical properties are required, the best combination would be a mixture of Duprene with an ethylene polysulphide resin. W.

"Indicator Foil": Use in *p*H Measurement. P. Wulff. *Chem. Fabrik*, 1933, **6**, 441-443.

"Indicator foil" consists of a cellulose membrane specially treated with reactive groups so as to adsorb the indicators of Clark and Lubs. The foil is slightly acid, since neither cellulose nor the reactive groups are neutral, hence the foil must be graduated against ordinary indicators before use. Since the colouring matter may diffuse from the foil into the solution, the shade rather than the depth of colour should be taken for comparison with the scale, and a high indicator concentration should be maintained in the foil for the same reason. The concentration must be lowered for badly buffered solutions, but the colour intensity is maintained by triply folding the foil. Some dozen different foils are available, each for a special *p*H range, and some are of specially low indicator concentration, or arranged to show *p*H gradations on one foil. A list is given of processes in which foil is successfully used, together with references to the literature. C.

Patents

Viscometer. J. G. A. Rhodin (Ilford). E.P.399,802 of 11/1/1932.

The invention employs a known method of measurement which depends upon the viscous drag which is exerted upon the walls of a movable rod or other element immersed in a channel through which a fluid under test is caused to flow. The apparatus consists of a slidable rod or other movable body immersed in a channel through which the fluid under test is caused to flow and capable of movement in the direction of fluid flow against the action of a spring or weight control, in combination with means for causing the fluid under test to flow through the channel at a predetermined velocity or at a velocity which depends in a definite way upon the position taken up by the movable body. The movable body may be acted upon by a substantially uniform control force and arranged by its movements to vary the area of its surface which is exposed to the action of the fluid under test in such a manner that an increase in the viscosity of the fluid passing through the channel will bring about a decrease in the surface area of the movable body exposed to the action of the fluid. Alternatively the apparatus may be arranged so that the surface area of the movable body which is immersed in the stream is invariable and in this case the control force acting on the movable body must be arranged to increase as the body moves in the direction of fluid flow so that an increase in the viscosity of the fluid will cause the body to move into a position in which the control force will be increased sufficiently to compensate for the increase in shear force per unit area due to the increased viscosity. In either case the velocity of flow of fluid near the movable wall is either maintained uniform or else made to depend upon the position of the movable wall in such a way that every position of this movable wall will correspond to a definite viscosity of the fluid flowing through the restricted channel. C.

Wire Bending Testing Machines. Bruntons (Musselburgh) Ltd and G. Elvidge (Musselburgh). E.P.399,994 of 1/11/1932.

The invention relates to machines in which wires are gripped between a pair of relatively movable clamping members and extend through a guide which is arranged for oscillatory movement along an arcuate path so as to cause the wires to be bent successively in alternate directions until breakage takes place. The means for actuating the deflected part of the wire, i.e. the guide, comprises a bar which is provided with a plurality of pivoted supports between which the wire to be tested is disposed. This arrangement enables various other modifications to be employed which improve the operation and accuracy of the machine. Thus, the guide may conveniently be arranged for the accommodation of interchangeable collets through which the wires to be tested are passed, so enabling a large range of sizes to be tested without substantial alteration to the machine. The collets may be spring-loaded and guide pegs or equivalent devices may be provided to give automatic alignment of the wire. C.

Viscometer. Glasplakatefabrik Union G.m.b.H. (Karlsruhe, Germany). E.P. 400,840 of 22/3/1933.

The viscometer comprises a vessel that is provided with an upper and lower mark and is connected to a vertical capillary. The capillary at its lower end runs into a wider tube that is connected with a receiving vessel at atmospheric pressure. Further, the wide tube has a branch tube that also is in communication with the atmosphere. With this construction the liquid flowing out from the capillary does not fill the enlarged lower tube but only flows along its walls. At the junction of the capillary with the wide tube a liquid surface is formed, which, if the lower tube is of suitable width and shape, has only a comparatively slight curvature and accordingly exerts only a small traction action. In order to reduce the traction action to a minimum it is advantageous to construct the apparatus so that the junction of the inner surface of the capillary with the inner surface of the larger lower tube is formed by a plane horizontally-disposed annular surface. For the purpose of determining the height at which the liquid remains in the capillary, a scale is provided on the capillary with its zero point in the plane of the horizontal annular surface. The dimensions of the capillary and the volume between the marks may be chosen so that the kinematic viscosity can be calculated by multiplying the actual or corrected time of flow in seconds by a power of 10. C.

Fluid Transparency-determining Apparatus. W. W. Triggs, London (Light Sensitive Apparatus Corporation, Niles Center, Illinois, U.S.A.). E.P. 401,514 of 23/12/1932.

Apparatus for determining the transparency of a fluid comprises a photo-electric cell, means directing rays of light upon the cell, means for forming a film of predetermined thickness of the fluid to be tested, and means to indicate the intensity of the light falling upon the cell. C.

10—ECONOMICS

Cotton Weavers' Wages: Calculation. T. Ashurst. *Text. Weekly*, 1933, **12**, 316-317.
The history of the present weaving wage system is reviewed. The author considers the pick basis of payment the most satisfactory and discusses a recommendation of the B.C.I.R.A. Production costs have recently been increased by the large number of small orders. The disparity in costing systems used by different firms is responsible for the differences in price quotations. The more-looms system is discussed and claimed to have no ill effect on the operatives. C.

Cotton Trade Index, October 1933. W. H. Slater. *Text. Weekly*, 1933, **12**, 275.
The cotton trade indices for October 1933 are as follows, the figures in brackets showing the percentage change since leaving the gold standard. *Raw Cottons*—American, 77·30 (+40·8); Egyptian, 58·46 (+18·8). *Yarns*—American, 92·6 (+14·7); Egyptian 83·2 (+10·4). *Piece Goods*—113·1 (+3·9). *All Cottons*—95·8 (+11·0). *All Commodities*—102·6 (+3·1). C.

Cotton Yarn: Costing. W. H. Slater. *Text. Weekly*, 1933, **12**, 250-251; 303-304.
The author answers criticisms of his previous articles on costing yarn on the finished and sold product. The critics defend the use of the dry weight of yarn at the spindle point as the basis of costing, instead of the weight of conditioned yarn. An independent analysis shows that both methods arrive at the same result (See *Summary*, 1933, 610.) C.

Japanese Cotton Goods: Trade in Near East. R. Hagen. *Wirtschaftsdienst*, 1933, **18**, 1613-1615.
The anti-Japanese boycott in China and the increasingly high tariffs in the British Empire have forced Japan to look for markets in the Near East. A political treaty with Abyssinia has ensured an outlet there for Japanese goods, but even reckless price cutting to below cost has failed to hold the markets in Egypt, Persia, and Turkey. The first two countries are developing their own cotton industries, while Turkey has just concluded a commercial treaty with Russia, from whom she can obtain all her textile requirements. Japanese goods obtained a foothold in Iraq on account of their cheapness, but tariffs against cheap goods have recently been erected and preference given to England. Japanese markets in Syria are also menaced on political grounds. Tables are given showing a general decrease in imports from Japan for most Near Eastern countries in 1932. C.

Raw Cotton: Imports into Poland. *Wirtschaftsdienst*, 1933, **18**, 1601.
Cotton consumption in Lodz during the first six months of 1933 shows an increase over the corresponding figures for 1932, and many factories are working at almost full capacity. Attempts have been made to cut out Bremen by direct importation into the new Polish port of Gdenya, but in spite of the erection of American offices and favourable freight charges, Bremen has appropriated nearly all of the business for the Lodz cotton trade. It is hoped to induce some of the Bremen cotton deliveries to come via Danzig. C.

Raw Cotton: Prices, 1932-1933. J. A. Todd. *Empire Cotton Gr. Rev.*, 1933, **10**, 294-299.
Tables are given showing (1) the history of cotton prices from 1899 to 1933, (2) spot prices of American and Egyptian cottons in Liverpool, Alexandria, and New Orleans on the last Friday of each month from August 1930 to August 1933, and (3) monthly spot prices of various kinds of cotton in Liverpool over the same period. C.

11—INDUSTRIAL WELFARE, INDUSTRIAL PSYCHOLOGY, AND EDUCATION

Colour Vision: Abnormalities. —. Polack. *C. r. Acad. Sci.*, 1933, **197**, 1003-1005.
The author discusses abnormalities of colour vision such as Daltonism and, Rayleigh, Nagel, and Daubeny-Huddart types. He concludes that normal colour vision cannot be reduced to three fundamental colours, and that it has two physiological characteristics, the position of maximum luminosity in the spectrum and the extent of the unitonal regions, one or both of these factors being modified in cases of abnormality. C.

Heald Varnish Dermatitis: Occurrence. L. Schwartz and C. L. Pool. *J. Ind. Hyg.*, 1933, **15**, 214-225 (through *Bull. Hyg.*, 1933, **8**, 663).
An outbreak of dermatitis affecting the forearms of 19 weavers out of 32 in two

mills was traced to heald varnish containing a chlorinated ceresin and cumarone resin. It is believed that in the warm, humid shed the varnish gave off hydrochloric, sulphonic and sulphuric acids. C.

Annual Report of the Industrial Health Research Board to 30th June 1933. Medical Research Council 1933, 13th Report, p. 36 (through *Bull. of Hyg.* 1933, 8, p. 723).

The account given in this report of work completed and in progress during the past year displays a wide range of subjects, each bearing upon the efficiency of the human factor in industry through the influence exerted by occupational environment upon the physiology and psychology of the worker. An adequate picture is presented of the work of the Board as a whole, grouped under various headings; noise, which is receiving special attention, is found to have but slight effect on efficiency for tasks not involving listening and none upon lost time; the effects of inhaling dust are proving unexpectedly difficult to study, but the cause of "cardroom asthma" has been shown to be histamine present in the dust; new problems are being disclosed as heating and ventilation are investigated intensively and new instruments have been devised to tackle them; sickness absenteeism and labour turnover are being found closely allied in causation; colds and influenza claim steadily about 40% of absenteeism, while loss of time due to "nerves" may be considered in one factory but absent in another; vocational selection and accident proneness are demonstrating the importance of the personal factor. These are only some of the many matters of importance to industry which are receiving attention. Problems, instead of diminishing in number, increase as the modern tendency of industry develops; simultaneously the activities of the Research Board must increase, in order to keep pace with the needs of efficiency. H.

The Morbid Anatomy and Histology of Asbestosis. S. R. Gloyne. *Tubercle,* 1933, 14, 445-451, 493-497, and 550-558 (through *Bull. Hyg.*, 1933, 8, 811). H.

The Size Frequency of Industrial Dusts. J. J. Bloomfield. *Pub. Health Rep. Wash.*, 1933, 48, 961-968 (through *Bull. Hyg.*, 1933, 8, 786).

Measurements establish that outdoor dusts are much smaller than industrial dusts; thus nearly all outdoor particles are less than 1 micron in average diameter, the median size being 0·5 micron, while only 21% of industrial particles are less than 1 micron, the median size being 1·5 microns. No two industrial dusts have the same size frequency, yet the particles fall within very narrow limits, the majority being between 1 and 3 microns. The results indicate that in conducting industrial dust studies our concern should only be for those particles ranging in size from 0·5 micron to 5 microns. In practical application a high correlation existed between the intensity of exposure to dust so measured and the degree of silicosis and active tuberculosis. H.

Diagnosis of Anthrax in Animal Skins by Culture and Precipitin Tests. D. C. Russu. *Arch. Roumaines Path. Experim. et Microbiol.* 1932, 5, 505-523 (through *Bull. Hyg.*, 1933, 8, 834).

The author has examined 325 specimens of skin, derived from various animals, for anthrax infection, using both direct cultural tests and the precipitation method of Ascoli. The cultural test showed 99 of the skins to be infected with anthrax. The precipitin test, using as antigen a heated extract of the skin, gave 49 positive results. Thus, half the skins that were shown to be infected when examined culturally would have been passed as uninfected if the precipitin test alone had been employed. Using an extract prepared in the cold, 70 skins gave a positive precipitin test. Thus, using this method, between a quarter and a third of the infected skins would have escaped detection. The author notes that his results are in general agreement with those of Reichel and Eidherr, who found the cultural superior to the precipitation method in comparative tests on 177 samples of skin. H.

Dermatitis from Chemicals used in Removing Velvet Pile. L Schwartz and L. Tulipan. *Pub. Health Rep. Wash.*, 1933, 48, 872-875 (through *Bull. Hyg.*, 1933, 8, 787).

In order to produce patterns in velvet, one fibre is used for the pile and another in the foundation; then portions of the pile are removed by applying solvents through a stencil. The solvents vary according to the materials used in the pile and foundation; they include a 30% solution of aluminium chloride, hydrochloric acid, sulphuric acid, calcium thiocyanate, acetone and caustic soda. All these materials are skin irritants. The acid solutions are applied in the form of a spray, which is more hazardous than the use of aluminium chloride in the form of jelly. After the solvent has been put on, the charred pile is removed from the designs by scraping with a spoon. Four cases of dermatitis occurred where dilute sulphuric acid was sprayed on; the cases ceased when the firm substituted aluminium chloride paste, but cases of dermatitis have been known from this velvet remover. Workers using the spray gun and scraping charred pile should wear rubber gloves and long sleeves, and do such work under an exhaust hood. H.

Injuries to Health caused by Dust in Hemp Works. Kolesch and Lederer. *Arch. f. Gewerbepath. u. Gewerbehyg.*, 1933, 4, 617-633 (through *Bull. Hyg.*, 1933, 8, 787).

The authors have made investigations at two large hemp works in Germany and here give the results of dust counts in the workrooms and of the clinical and X-ray examinations of 205 workers. The hemp which comes from Italy, Hungary, Poland and Russia is after gathering steeped for a time in water and then compressed into large balls, in which state it is delivered to the factories. Considerable dust arises at the opening of these balls and in sorting out the material and also in the various other processes to prepare the fibres for making ropes. The authors made about 70 dust counts in the workrooms at the mouth level and found with the Zeiss konimeter in the carding rooms from 300 to 800 dust particles per c.c. of air, of which 100-120 were under 5μ and with the Owens dust counter 226 to 250 particles per c.c. of which 100-110 were under 5μ. These figures were less than expected and this was found to be due to the air containing a number of large particles up to 90μ long and more which only passed the slit opening if by chance they were in a suitable direction.

The chemical analysis of the dust showed that 13% of the ash consisted of SiO_2 which came from sand and dirt and also from the silica contained in the woody parts.

Many of the workers suffer from a disease known as "hemp fever" (analogous to "mill fever" in the Lancashire cotton mills, which affects them for a few days on starting work, or resuming work after a holiday, or even on a Monday, and may go on recurring for many years. The patients complain of a sense of heaviness in the chest, lassitude, shivering, headache, cough, nose bleeding, vomiting and fainting, accompanied by a slight rise of temperature. Some workers never suffer from it at all and in some no attacks recur after the first year.

Opinions differ as to the ætiology of this disease. The workers themselves say it is more common with Neapolitan hemp and support that it is caused by the sulphur which that hemp contains. Some authorities consider it is caused by hemp grown on the sea coasts and that salt is in some way responsible; others that it is due to a purely mechanical dust irritation. The authors take the view that it is an allergic condition caused by the protein from some plant or from mildew which is frequently found on the threads.

In the combined clinical and X-ray examination of the 205 workers, 119 were found entirely negative, 86 had definite changes in the lungs, of whom 14 had tuberculosis, 32 emphysema and bronchitis, 9 fibrosis, and 17 had changes at the hilus. In no case was any sign of silicosis found and this is attributed to the particles carrying the silica being too large to reach the alveoli. H.

The Human Element in the Textile Industries. T. Oliver. *J. Text. Inst.*, 1933, 24, P101-P107.

Carding Engine Dust Removal Device. *See* Section 2A.

Ionised Air: Physiological Effects. *See* Section 8G.

NOTES—In the references to publications abstracted the name of the publication is followed by the Year, Vol., Issue No., or Date if necessary, and Page No. (or Nos.).

Literature relating to the composition and manufacture of dyestuffs is not dealt with in the abstracts of this *Journal*.

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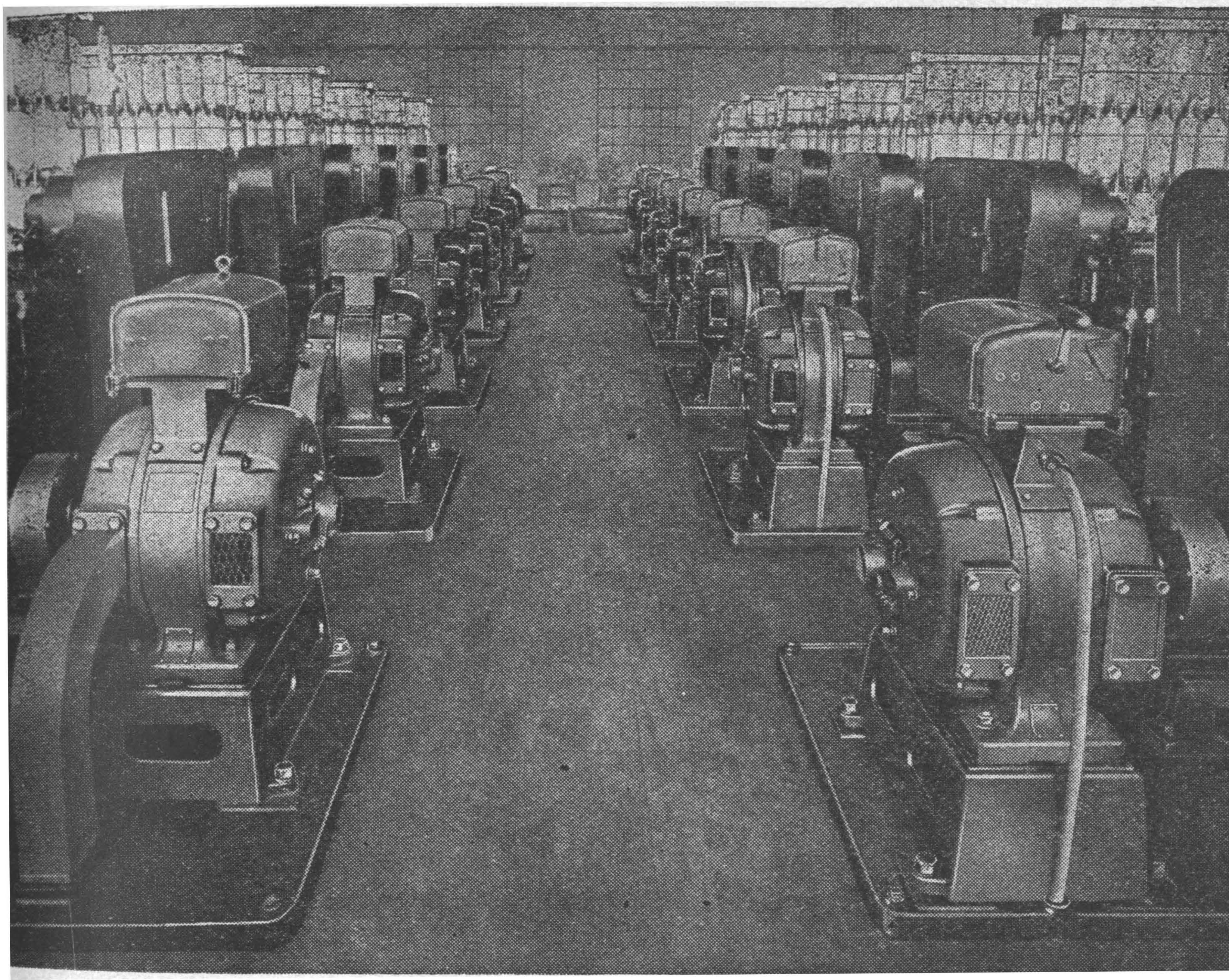

INDIVIDUAL MOTOR DRIVES IN A COTTON MILL

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