Vol. XV. No. 9 SEPTEMBER 1924

The Journal of the TEXTILE INSTITUTE

Official Journal for Communications (Transactions) released for Publication by the British Cotton Industry Research Association, British Research Association for the Woollen and Worsted Industries, Linen Industry Research Association, and British Silk Research Association.

THE TEXTILE INSTITUTE
ST. MARY'S PARSONAGE, MANCHESTER

THE JOURNAL *of the* TEXTILE INSTITUTE

Contents for September 1924

THE TEXTILE INSTITUTE

Head Offices—16 St. Mary's Parsonage, Manchester

London Rooms—38 BLOOMSBURY SQUARE W.C.1.

Telephone—16 CENTRAL MANCHESTER *Telegrams*—"CONTEXT MANCHESTER"

OFFICERS

President—JOHN EMSLEY, J.P. (Bradford)

Past Presidents—Sir WILLIAM E. B. PRIESTLEY, Sir FRANK WARNER, K.B.E., and Col. F. R. MCCONNEL

Vice-Presidents

GEO. L. CRAIG
WILLIAM FROST
GEORGE GARNETT
WILLIAM GREENWOOD, M.P.
Sir WILLIAM HENDERSON
Sir HENRY HIBBERT, Bart.
F. HOLROYD
WILLIAM JAFFE
Sir ALAN J. SYKES, Bart.

Honorary Treasurer—T. FLETCHER ROBINSON (Manchester)
Honorary Secretary—WILLIAM FROST (Macclesfield)
Honorary Solicitors—Messrs. KNOTT AND CASTLE, 3 Norfolk Street, Manchester (Successors to Robert Innes)
Auditors—A. E. PIGGOTT, SON AND COMPANY, 56 Mosley Street, Manchester

COUNCIL

Chairman—JOHN CROMPTON (Manchester)
Vice-Chairman—ERNEST T. HOLDSWORTH (Bradford)

W. LAWRENCE BALLS (Manchester)
ALDRED F. BARKER (Leeds)
F. W. BARWICK (Manchester)
WILLIAM T. BOOTHMAN (Bolton).
G. CLAPPERTON (Atherton, Manchester)
A. W. CROSSLEY (Manchester)
J. F. CROWLEY (London)
H. P. CURTIS (Manchester)
W. DAVIS (Nottingham)
HENRY P. GREG (Manchester)
OSCAR S. HALL (Bury)
W. HARRISON (Manchester)
*R. S. HAYWARD (Galashiels)
S. H. HIGGINS (Manchester)
WILLIAM HOWARTH (Bolton)
J. W. KERSHAW (Oldham)
JOSEPH H. LESTER (Manchester)
FREDERICK LYE (Rochdale)
WILLIAM MYERS (Manchester)
FRANK NASMITH (Manchester)
HARRY NISBET (Manchester)
J. ROBINSON (Bradford)
E. A. SWIFT (Bradford)
LUKE THORNBER (Burnley)
JOHH F. WHITE (Bradford)
R. S. WILLOWS (Manchester)
T. WOODHOUSE (Dundee)

**Ex-officio*—Section Hon. Secretary

The President, Past-Presidents, Vice-Presidents, Hon. Treasurer, Hon. Secretary, and Section Hon. Secretaries are *ex-officio* members of the Council.

General Secretary—
J. D. ATHEY, 16 St. Mary's Parsonage, Manchester. *Telephone*—Central 16.

Editor of Journal—
H. L. ROBINSON

COMMITTEES

The following are *ex-officio* members of all Committees—
Chairman of Council—JOHN CROMPTON
Vice-Chairman of Council—E. T. HOLDSWORTH
Hon. Secretary—WM. FROST
Hon. Treasurer—T. FLETCHER ROBINSON

Publications Committee—
Chairman—S. H. HIGGINS

W. LAWRENCE BALLS
F. W. BARWICK
H. J. W. BLISS
E. T. HOLDSWORTH
JOSEPH H. LESTER
WILLIAM MYERS
HARRY NISBET
W. ROBINSON
R. S. WILLOWS

and *Representatives of Research Associations*—
Wool—W. A. CROWTHER
Cotton—A. W. CROSSLEY and J. C. WITHERS
Linen—J. V. EYRE
Silk—W. S. DENHAM

Crompton Prize Fund Committee—
Chairman—JOHN CROMPTON

J. W. BARON
P. BILBIE
J. R. BRINDLE
A. E. G. BROOKES
H. P. CURTIS
T. C. DUGDALE
L. V. GLADWELL
WILLIAM HALLIDAY
JOSEPH HOLLAS
W. KERSHAW
W. J. RILEY
A. B. SHEARER
S. WATSON

Research and Inventions Committee—
Chairman—JOHN F. WHITE

W. E. BAKER
W. LAWRENCE BALLS
F. W. BARWICK
J. CHAMBERLAIN
JOHN CROMPTON
W. DAVIS
H. P. GREG
W. A. HANTON
W. HARRISON
S. H. HIGGINS
E. T. HOLDSWORTH
J. H. LESTER
W. MYERS
FRANK NASMITH
J. ROBINSON

SECTIONS

LANCASHIRE SECTION COMMITTEE—
Chairman—WILLIAM MYERS
Vice-Chairman—FRANK NASMITH

F. ARROWSMITH
W. T. BOOTHMAN
A. E. G. BROOKES
G. CLAPPERTON
W. P. CRANKSHAW
JOHN CROMPTON
H. P. CURTIS
J. H. DAWSON
W. GREENWOOD, M.P.
HENRY P. GREG
F. J. HARLOW
J. W. KERSHAW
FREDERICK LYE
H. NISBET
R. W. PENNINGTON
A. POLLITT
J. REID
T. FLETCHER ROBINSON
L. THORNBER
S. WATSON

YORKSHIRE SECTION COMMITTEE—
Chairman—JOHN ROBINSON
Hon. Secretary—E. A. SWIFT
Asst. Hon. Secretary—G. E. L. HIND

R. J. H. BEANLAND
A. M. BELL
GEO. L. CRAIG
HUGH DAWSON
GEO. GARNETT
G. R. GAUNT
W. GRAYSON
F. HARTLEY
E. T. HOLDSWORTH
C. HUTTON
H. JAQUES
E. MIDGLEY
G. T. OLDHAM
C. A. POLLARD
H. RICHARDSON
JOHN F. WHITE

IRISH SECTION COMMITTEE—

FRED BRADBURY
J. CLIBBORN HILL
J. F. HILL
WILLIAM JAFFE
WILLIAM H. WEBB (Randalstown)

SOUTH OF SCOTLAND SECTION—
Chairman—(To be appointed)
Vice-Chairman—NINIAN KEMP
Hon. Secretary—R. S. HAYWARD, Gala Mills, Galashiels

T. H. BALLANTYNE
JAMES HALL
JOHN HULME
R. STUART SANDERSON
R. TURNBULL
A. WILBY

LONDON SECTION COMMITTEE—
Chairman—Sir FRANK WARNER, K.B.E.
Vice-Chairmen—E. B. FRY, E. R. DEBENHAM, A. B. LAMBERT, PERCY J. NEATE, Sir SYDNEY SKINNER
Secretary—J. E. FEATHERSTONE, 38 Bloomsbury Square W.C.1.

B. ANTHONY-LANGSDALE
H. E. AYKROYD
A. B. BALL
S. E. J. BRADY
ERNEST F. DONNE
A. E. GARRETT
DAVID HAES
H. B. HEYLIN
JOHN HOWARD
JAMES A. HUNTER
T. ERNEST JACKSON
W. JAFFE
J. MACKINNON
G. K. MENZIES
PERCY W. NELSON
J. H. PEERS
J. R. QUILTER
A. G. ROLSTONE
H. GORDON SELFRIDGE, jun.
H. TILBURY
ALFRED WIGGLESWORTH
EDWIN WIGGLESWORTH

TEXTILE INSTITUTE FOUNDATION FUND

In accordance with a Scheme of Development, formulated in 1919, the above-named fund was created. In course of time it is hoped that the fund will reach a total of £50,000. Over £12,000 has already been contributed. Invested in War Stocks, the annual revenue is devoted to the special purposes named in the afore-mentioned scheme.

Subjoined is a list of donations of £50 and upwards—

		£
Crompton, John, Manchester		2,000
Mather, The late Rt. Hon. Sir Wm.		1,100
Tootal Broadhurst, Lee Co. Ltd., Manchester		1,005
Garnett, G. & Sons. Ltd.	505	
Garnett, Geo., Bradford	100	605
Bright, John & Bros., Rochdale		505
Belgrave Mills Co. Ltd., Oldham		500
Frost, Wm., Macclesfield		500
Priestley, Sir Wm., Bradford		500
Warner, Sir Frank, K.B.E., London		500
Crosses & Winkworth, Ltd., Bolton		260
Ashton Bros. & Co. Ltd., Manchester		250
Debenham & Co. (Debenhams), Ltd., London		250
Greenhalgh & Shaw, Ltd., Bolton		250
Rylands & Sons, Ltd., Manchester		250
Haworth, Richard & Co., Manchester		105
Swan Lane Spinning Co. Ltd., Bolton		105
Ambler, T. & Sons, Wakefield		100
British Cotton and Wool Dyers' Association		100
Colwyn, Rt. Hon. Lord		100
Dixon, Sir A. Herbert, Bart., Manchester		100
English Sewing Cotton Co. Ltd.		100
Foster, Col. H. A., Queensbury		100
Fothergill & Harvey, Ltd., Manchester		100
Gaunt, Reuben & Sons. Ltd., Farsley		100
Hall, Oscar S., Bury		100
Hall, Robt. & Sons (Bury), Ltd., Bury		100
Hollas Ltd., Bolton		100
Jaffe, W., Belfast		100
Macara, Sir Charles W., Bart., Manchester		100
McConnel, Col. F. R., Manchester		100
Patent Conveyor Ltd., Bradford		100
Smith, J. Sugden (John Hind & Co.)		100
Taylor & Littlewood, Huddersfield		100
Robinson, T. Fletcher, Manchester		55
Barlow & Jones, Ltd., Manchester		52
Armitage & Rigby, Ltd., Manchester		50
Beanland, R. & Co., Huddersfield		50
Ocean Cotton Spinning Co. Ltd., Bolton		50
Watts, S. & J., Ltd., Manchester		50
Wilkinson, John, Manchester		50
Wright, Frank, Bolton		50

Sandoz Standard Colours

for all branches of the Textile Trades

The practical services of our laboratories and British technical experts are always at your disposal

THE SANDOZ CHEMICAL CO. LTD

(Sole Consignees in Gt. Britain for Sandoz Chemical Works, Basle, Switzerland—English Branch W'ks: Clayton, Manchester)

BRADFORD

CANAL ROAD *Telephone*—6302
CRAVEN BANK CHAMBERS (Regd. Office)
Tel.–850 *'Grams*–"Sandoz, Bradford"

MANCHESTER

24 TIB LANE, CROSS STREET
Telephone—City 7737
Telegrams—"Xylene, Manchester."

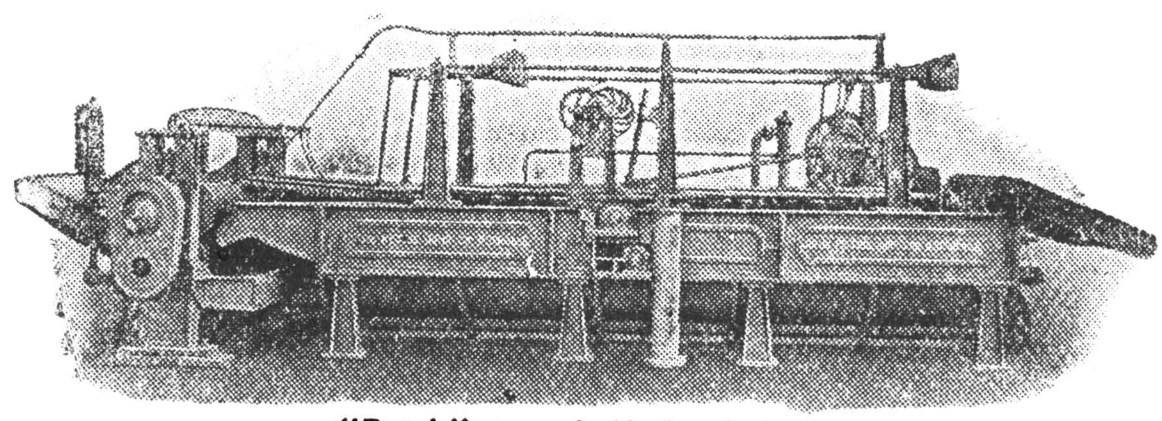
SANDOZ

AGENTS

LONDON : Skilbeck Bros., 205 Upper Thames St., E.C. 4
LEICESTER : A. W. Brook, 36 Charles Street
GLASGOW : Charles Hogg & Co., 9 Royal Exchange Square
WEST OF ENGLAND : Tom Young, Poundfield W'ks, Stonehouse, Glos.

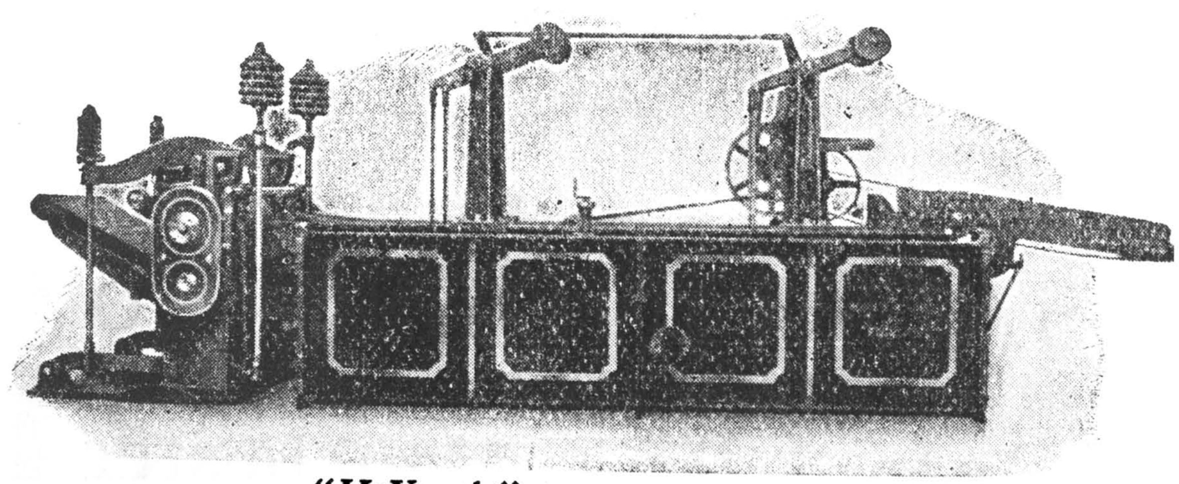
The COMBINED EXPERIENCE

of two Houses over a period of more than **60 Years**, in



"Petrie" type (self-cleaning)

Wool Washing *and* Drying Machinery



"McNaught" type

is at your service

PETRIE & McNAUGHT LTD

Telephone—1012 *Telegrams*—"LAVER" **ROCHDALE**

P. & C. GARNETT LTD

CLECKHEATON

Any size or form of tooth can be supplied. Made in Mild Steel

Also in Cast Steel with points which are Really Hardened

WORLD'S SPECIALISTS AND ORIGINAL MAKERS OF EVERY DESCRIPTION OF SAW TOOTH *and* BURR WIRE

Specialists in

OPENING *and* CLEANING MACHINERY

Inland Telegrams—"ARCOSARCOS AVE LONDON"
Telephone—LONDON WALL 6626 (10 lines)
Cables—"ARCOSARCOS"
Codes— A B C 5th and 6th EDITION, BENTLEY'S, MARCONI, ZEBRA

SOVIET HOUSE

ARCOS LTD

Capital—£1,000,000

49 Moorgate, London *EC* 2

Turnover (from June 1920 to May 1924)
£36,826,214

Sole Purchasing and Selling Agency in Great Britain for the Government of the U.S.S.R.

Arcos Imports from Russia—
Flax, Timber, Petroleum, Spirit, Oil, Metals, Ores, Crude Drugs, Chemicals &c.

Arcos Exports to Russia—
Manufactured Goods of all kinds

BRANCHES

CONSTANTINOPLE
Grande Rue de Pera No. 464

LENINGRAD
Ul Gertzena 24

MOSCOW
Tverskaya 1, (Ug. Ploschadi Revolutzii)

KHARKOFF
Chernoglazovskaya 1

TIFLIS
Prospekt Rustaveli 38

RIGA
Valdemara iela 61, dz. 3

Agents in U.S.A.—
Amtorg Trading Corporation, 136 Liberty Street, New York

"Buy Barnsley Bobbins."

Patent "Lockfast" Shields

APPLIED TO LONG AND SHORT-COLLAR TUBES

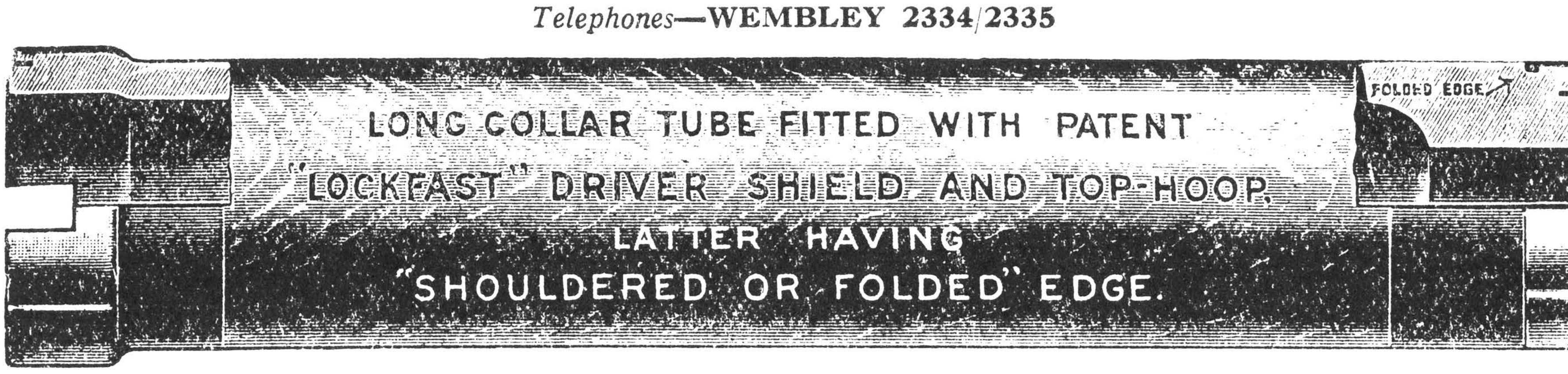
The waved Lock-fast edge considerably strengthens and stiffens both Shield and Bobbin and ensures permanent security of Shield to Bobbin

BRITISH EMPIRE EXHIBITION

(Palace of Industry: Cotton Textile Section, Hall D)

WE CORDIALLY INVITE YOU TO VISIT OUR STAND K 368

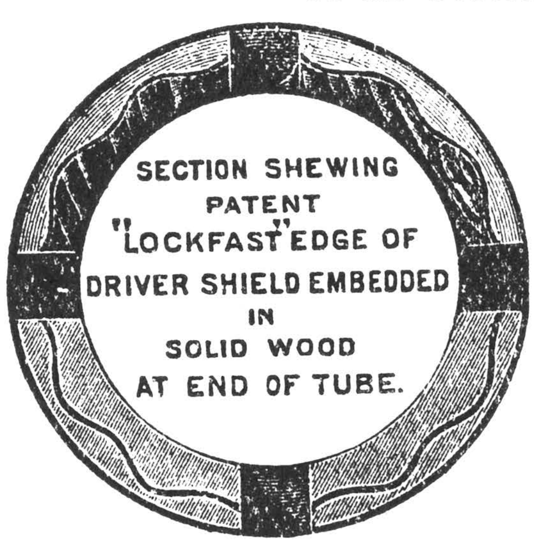
Telephones—WEMBLEY 2334/2335

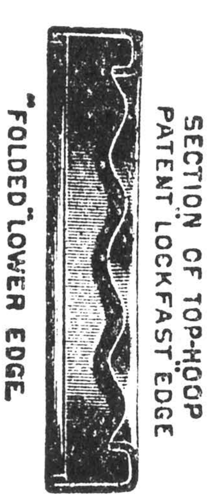


Every Shield or Bobbin marked or stamped :—

*WILSON*BARNSLEY LOCKFAST PATENT. Specify "BARNSLEY LOCKFAST" on all Orders and Indents.

CORRESPOND WITH BARNSLEY.





CORRESPOND WITH BARNSLEY.

Note the "folded" lower or inner edge of Top-hoop effectually secures same in position and prevents any coming endways off the Tube or Bobbin.

Patentees and Sole Makers—

WILSON & CO. BARNSLEY LTD.,

BARNSLEY, ENGLAND.

Telegraphic Address;
"WILSON, BARNSLEY."

Codes used: A1 and A B C,
5th and 6th Editions

Telephone:
No. 2 Barnsley.

REGISTERED TRADE MARK.
B BARNSLEY BOBBINS B BRITISH

Attendance:

Royal Exchange, Manchester,
Tuesdays and Fridays.

Exchange, Bradford,
Mondays and Thursdays.

Exchange, Huddersfield, Tuesdays.

MANCHESTER OFFICE - - - - 15, MARKET STREET.

THE JOURNAL OF THE
TEXTILE INSTITUTE

Vol. XV SEPTEMBER 1924 No. 9

PROCEEDINGS

EMPIRE TEXTILE CONFERENCE
AT THE BRITISH EMPIRE EXHIBITION AT WEMBLEY, LONDON
10th, 11th and 12th June 1924

THIRD SESSION—AFTERNOON MEETING (ii).—Thursday, 12th June

PROCESSES IN THE SPINNING OF WORSTED YARNS

By J. H. C. Hodgson

Worsted spinning under modern conditions may be briefly stated to comprise those operations which are necessary for the conversion of tops (that is, combed wool) into yarns. We can fairly claim that worsted spinning is a most important and vital part of the textile industry. It corresponds with the intermediate wheel in a machine, which enables both the preceding and succeeding wheels to function. There would be no combing of wool to produce tops unless these could be converted into yarn, and no manufacture of textiles could take place unless such yarn was produced by the spinning processes.

The art of spinning must date back to the remote ages when people first made use of animal or vegetable fibre for the making of garments. Some of the earliest records of this knowledge come to us from the East, Egypt, Babylon, China and India. The art also appears to have been practised in Mexico in very early ages, and so far as is known our knowledge of it was obtained without any communication with the Eastern lands. The early methods of making yarn do not appear to have changed for some thousands of years. Pictures on Egyptian monuments show the wooden spindle, actual types of which have been found in the tomb of Thebes, exactly the same as are being used in Egypt to-day. For thousands of years spinning was done by hand, and there was very little development of the appliances in use. There is no record of any machine having been invented to displace hand labour until the middle of the eighteenth century.

In 1738 a machine was patented by Lewis Paul, a Frenchman settled in this country, which adopted the principle of passing the sliver between two pairs of rollers, the second pair running faster than the first and thus drawing out the thread. Paul and Wyatt attempted to develop this idea, but without much success. In 1769 Richard Arkwright patented another machine applying the principle of drawing through rollers, until a thread of the required fineness was produced. About the same time in 1767, James Hargreaves hit upon the idea of the spinning jenny, the forerunner of the modern mule. Between the year 1774 and 1780 Samuel Compton was applying his own ideas to the spinning jenny, and ultimately succeeded in developing the mule. These inventions all related to spinning, but in 1775 patents were taken out for machines which performed certain of the preliminary operations. It is recorded that the first spinning machines in Yorkshire were erected at Addingham in the year 1787, Bradford following in 1794.

These inventions were used primarily for cotton, and subsequently were applied gradually to wool. It was not until about 1810 that hand spinning was generally superseded by machine spinning. It may be noted that most of the early inventions were confined to spinning, and that automatic machine spinning was in common use for some time before machinery was applied to the combing or weaving operations. Perhaps the main reason for this is the fact that most of the combing and weaving was done by men, while women and children were engaged in the spinning. The introduction of spinning machinery caused a quickened and increased output of yarn, thereby creating a big demand for the output of the hand combers and greatly augmented supplies for the weavers.

In the early days the spinning mills derived their power from the water-courses, but some experiments were made in which horses and even oxen were used. The invention of the steam engine by Watt in 1782, and its subsequent developments, brought about a great change, and mills began to be erected in which the power was provided by steam engines. The introduction of machinery made a great change in the industrial conditions of the time. Hitherto, practically all the work had been performed by the operatives in or about their own homes, and for some time after spinning mills were established it was the practice for the hand combers to bring their products to the spinning mill, and for the yarn, when spun, to be distributed to the weavers. These spinning mills seemed to grow up without causing any great commotion, but when at a subsequent period efforts were made to introduce machinery for combing and weaving there were riots in several parts of the country. This, I think, was accounted for by the fact that the demand for the yarns was generally greater than the supply.

The latter half of the nineteenth century saw the complete disappearance of all hand operations, and the application of machinery to all processes. The roller type of machine was principally applied to worsted spinning, whereas the mule was found more suitable for woollen spinning and is almost universally employed for this purpose, while only a small percentage of the worsted yarn spun in Yorkshire is mule spun. Although the last half century has seen many wonderful improvements in the details of spinning machinery, the essential principle has remained unchanged.

The operations in worsted spinning are so intricate and comprehensive in technical detail that it is quite impossible in the limited time at my disposal to deal with anything but a few of the main factors governing the production of a good, sound, level yarn, a yarn as free from blemishes as human skill and mechanical efficiency can produce. In the production of such yarns Bradford has a record of which she is justly proud; many and varied are the types of yarns produced there, and the enterprise, ingenuity, skill and artistic taste displayed do credit to all concerned. The beautiful fabrics manufactured from these yarns are at once the envy and admiration of the world, as visitors to the Bradford Chamber of Commerce Pavilion will readily acknowledge.

With such a record as this to maintain, and realising as practical hard-headed business men that we cannot live on our past achievements, it will be well for us to do a little stocktaking in order to ascertain where we are and what are our prospects for the future. In order to do this thoroughly every section of the trade must be prepared for a searching self-examination. Sorting, combing, spinning, manufacturing—all must do this if we are to maintain our prestige in the markets of the world. It has been said that "In time of prosperity the seeds of adversity are often sown." Have we during the recent great crisis, which undoubtedly was a time of prosperity for the trade, have we during this period sown the seeds of adversity ?

I will now proceed to deal with that section of the trade with which I have been most closely associated, the spinning of worsted coating yarns for the best Botany cloths. To ensure a good, sound level thread of this description several factors must be taken into account, first and foremost of which is the selection of the tops from which the yarn is to be made; the greatest care and discrimination is here required, particularly in blending, for no technical skill can overcome or prevent the evil effects of a top in your blend for which your machinery is not adapted. A cheap top can in the end prove a very costly experiment. My advice to spinners is to select a few of the most reputable top-makers in the trade, firms whose reputation has been made, and who are determined to maintain it at all costs, and having made your selection, and secured the tops you require, then rigidly adhere to the standards you have attained, when once convinced that you have reached and satisfied the requirements of the manufacturer.

Also, in building up for yourselves a reputation for good management and quality of production, you must know where the wool has been grown; this is most important, for wool grown in different countries, even when it is the same in quality, does not dye and finish or shrink the same. Latent defects in the tops cannot be corrected in the spinning, and lead to loss of reputation and prosperity, not only to the spinner but to the manufacturer and merchant. Having selected your tops for the blend you require, which should be as uniform in average length as it is possible to secure, you can now proceed with the various operations required for the working of them into yarn, the first of which is drawing. It has been said that 75% of the skill required in the spinning of a top into yarn needs to be exercised in the drawing. Whether this is a correct estimate or not I am not going to say; one thing, however, is certain, no sound yarn can be made from an unsound roving.

The object and purpose of drawing is to reduce a sliver or a number of slivers of wool down to a very small end of roving suitable for the spinning operation, and at the same time to level or secure uniformity in thickness. This reduction is brought about by means of two pairs of rollers, through which the slivers are passed. The front pair, travelling or revolving more quickly than the back pair, draw out the wool, thus making the sliver smaller in diameter. This is called drafting. The levelling of the sliver is brought about by the placing of two or more ends together, and this is known as doubling, and the whole purpose of drawing is to secure by these means a roving suitable for the spinning operation. A very safe rule in drafting is not to exceed by more than one the number of inches in the length of the material you are using. Thus, a top, the staples of which are 6 in. in length, should not be subjected to a greater draft than seven. The distance between the two pairs of rollers is known as the *ratch*, and is lengthened or shortened by moving the back pair forward or backwards according to requirements. The greatest care is required in the setting, so as not to break the fibres, but still sufficiently to control them during their movement forward in the drafting process.

There are three principal methods of drawing—French, open and cone. To produce a very soft full yarn from very short wool, the French system is the best, but if a good, sound level thread is required, with the fibres well straightened out, the ordinary method of English drawing is preferable, because of the greater variety of wool that can be drawn on one set of boxes. For fine merino wool for coating yarns, I give preference to the cone method. It makes less waste on account of the longer and more uniform lengths on the bobbins; secondly, the tension on the sliver is the same when the bobbin is empty as when it is full, because the bobbin is mechanically driven, while that of the open drawing is pulled round by the sliver and the tension regulated by washers under the bobbins. Thirdly, the flyers in the last three cone operations are made to enclose the thread and thus avoid its beating against the air and becoming wild and rough.

There are usually nine operations in a set of Botany drawing, through which the material must pass before it is ready for the spinning frame. The first is a can gill box, with a creel placed at the back; in this creel are four pairs of rollers set some 15 in. or 16 in. above each other. These are made to revolve by means of a chain which receives its motion from the box. On these rollers are placed the tops, the outside ends of which are passed through the back roller of the box, thence into the fallers and forward into the front rollers. As the material leaves the front rollers, having now been drafted, it is passed through a pair of smooth calender or drawing-off rollers into the sliver cans, thus completing the first of the nine operations in the drawing. Before leaving this I want to show how the reducing of the sliver has taken place. Six ends have been put up at the back of the box, each of which weighs 256 drams for 40 yards; this gives a total weight of sliver at the back of 1,536 drams for 40 yards, which 40 yards with

5 of a draft becomes 200 yards, and in being drawn out to five times its original length it has been made five times lighter than its original weight. Thus, the 1,536 drams has been brought down to 307 drams for 40 yards. I would here like to emphasise the necessity of combers and top-makers accurately adhering to the trade standard weights of slivers, for any deviation from the rule creates difficulties for the spinner.

Observe that the material has not only gone through the two pairs of rollers, but in its passage from one to the other has been drawn through the fallers containing a number of steel pins set very closely together, and this has the effect of combing or straightening the fibres, just in the same way as we straighten our own hair out when passing a comb through it.

The next operation is similar to the previous one, the only difference being that there is no creel required at the back of the box, it being fed from the cans into which the material was delivered by the first box, and also fewer ends are now put up—four instead of six. Thus 4 times 307=1,228 drams at the back, and this, with 5 of a draft, yields 246 drams for 40 yards at the front. Thus is the gradual reduction brought about.

From here we pass on to the spindle gill, and this is where we first begin to put the material on the bobbin, and, of course, to do this we begin to have spindles on which the bobbins are placed. Passing on, we come next to the first drawing box, and here we dispense with the use of fallers. In their stead small steel carrying rollers are used, over which the ends pass in their passage from the back to the front roller. On top of these metal carriers are placed smooth wooden carriers, whose purpose is to steady and control the movement of the fibres, and without which we are sure to get an uneven sliver.

I cannot attempt to describe in detail every operation in the drawing, but I must say a word or two respecting the next, which is known as the weigh box. Here must take place what is usually spoken of as pairing, and in Botany drawing it is usual to pair off at 13 lbs., that is, the four bobbins from the previous box must average in weight 13 lbs. each. These four bobbins, which are 14 in. by 9 in. in size, weigh, when empty, exactly 4 lbs. each, and this being so, and there being exactly the same length of sliver on each, why is there not the same weight ? To supply the answer to this we must turn back to the first three operations, that is, to the gill boxes. The front rollers of these boxes are deeply fluted, and around the top one, which is weighted by means of springs, runs a travelling leather apron. This apron is an endless one, and also runs over a wooden roller placed high above the other. If one of these aprons is a little thinner than the other it allows the top fluted roller to sink deeper into the bottom fluted roller, and thus deliver more than the other. This slightly longer length is, of course, thinner, and if pairing were not to take place a serious state of affairs would follow. Instead of getting the exact weight of roving we require at the last operation, we should have all kinds of varying weights.

The length of material put into the cans or on to the bobbin is governed by a knocker-off motion on each box, which automatically throws the driving belt on to the loose pulley and thus stops the box.

It would be impossible to deal with all technical details connected with these various operations in a short paper. I have said sufficient, however, to show the necessity for the greatest care being exercised. In charge of this particular branch of the industry should be placed a man whose heart and soul is in his work, and who has been thoroughly trained in all the various technical details appertaining to an overlooker's duties.

I must now pass rapidly to the next operation, and say a few words on the spinning process, which is but a continuation of what we have been dealing with. Having been supplied with a sound roving, we have now to make as good a yarn as is possible by the same means and methods as previously used, namely, the two pairs of rollers and supporting carriers. Of course the bobbins used here are very much lighter than those used in the previous operations, and the spindles can consequently be run at a much higher speed. The flyer spinning frame is chiefly used for thick and medium counts, but for fine Botany yarns the cap frame is by far the most suitable, because it can be run at a much greater speed than the flyer. The yarn when it leaves the front roller is carried at a great speed around the cap. By this means it receives the twist necessary to bind the fibres together and give the strength required, the amount of twist being regulated by the speed of the front roller and, of course, the speed of the whorl attached to the tube on which the bobbin is placed. If 10 turns of twist per one inch of yarn is required, then the bobbins must revolve 10 times whilst the front roller is delivering one inch of yarn. The brass tube with the whorl attached is placed on a stationary spindle fixed securely in the spindle rail, and the bobbin on which the yarn is to be wound fits on to this brass tube and revolves with it. These spindles with this closely fitting tube must be kept well lubricated or serious variation of twist will result, for being friction-driven by means of a tape around the whorl (which tape receives its motion from the cylinder), anything that retards the free movement of the tubes at once produces softer twist. Here again the greatest care is required from the overlooker in charge, back and front rollers must be regularly examined to see the proper tension is kept upon them, oiling of spindles and rollers must be regularly and systematically attended to, and the young people under his charge must be very carefully trained in their respective duties.

We now pass on to the twisting room, and be it observed we have now finished with all drafting. Here we twist two or more ends together for the purpose of adding strength to the yarn, just in the same way as we bring strength to the rope by twisting and thus binding its strands. The number of ends is determined of course by knowing what are the requirements of the manufacturer. Generally speaking, it is two ends or two fold that is required in the coating trade. The twist in this operation is put in by the same method as in the spinning, but the threads are passed around the delivery rollers instead of between them as in previous operations. Also the twist is put in in the opposite direction. The speed of the delivery rollers must be constant and regular in their delivery of the yarn; the spindles must also be constant and regular. When these two ends are being twisted together, the attendant of the machine must be careful not to allow three or more ends to get into one thread, otherwise serious results are sure to follow unless the fault is detected in the winding or warping operations. Hence the necessity here again for the most careful supervision and training of the workpeople by the overlooker.

We now pass on to the winding, which is a very simple operation and comprises the putting of two or more bobbins of the twisted yarn on to a cheese or bobbin suitable for the warping. The weight of the warp required and the number of threads you can run in your warping creel determine the number of bobbins to be put on to your cheese in the winding operation. Here let me suggest that all spinning frames should be fitted with length knockers-off, so that the bobbins of different frames may all contain the same length of yarn, thus minimising waste in the twisting, winding and warping.

There are many kinds of winders, of which the most generally efficient is the split-drum winder. From the twist bobbin placed on a stationary spindle the thread is drawn by a paper tube called a cheese. This tube, fixed on a spindle, is resting on a split drum revolving at a great speed and causing the paper tube also to revolve. As the tube revolves it empties the twist bobbin and builds the yarn into the form of a cheese.

Our next operation is the warping, and in the making of the warp and the putting of it on to a beam after it is made the greatest care is required, for this is the last operation before the materials are passed on to the manufacturer. Suppose a warp is required of 2/32's counts, 4,000 ends and 560 yards in length, the calculation weight of this would be 250 lbs., and for this I should take 268 cheeses of 15½ oz. each, and place them into the creel, and from these cheeses run 15 sections, less 20 ends, and thus get the necessary 4,000 ends. The length put on to the swift is regulated by a clock or register. The machine is fit up with an automatic knocker-off motion, thus ensuring the correct length for each section. On the left side of the swift, where the first section is built, are placed wooden inclines up which the yarn rises slowly by means of the jack travelling backwards as the machine is running, and after the first section is put on there is the same incline as before, but now made by the yarn, and remains so until the number of sections is completed. In setting the jack to commence a new section, it must be so adjusted that the first end is placed on the swift alongside the last end of the previous section. On no account must it be allowed to ride on the top, or you will get dragging or tight ends when beaming off. This is certain to show in the finished piece owing to its increased tension. If a cheese of a different quality of yarn or a differently twisted yarn were to be inadvertently placed in the creel 15 distinct stripes would be likely to show, owing, of course, to there being 15 sections in the warp. The putting of the warp on to the beam requires very great care on the part of both the beam-setter and the beamer.

So much for the actual turning of the top into yarn. There is no industry where the repetition of the processes is more constant and regular, and care must be taken in the arrangement of the machinery and premises to eliminate all waste of time and energy. Not only do we require the machinery exactly to be fitted to deal with the particular kind of material used, but we must also have our buildings made exactly to accommodate that machinery. In my opinion the drawing should be placed in the top rooms of the mill, so that tops are put into work at the point furthest from where the finished yarn is to be despatched, and every operation should carry the material one step nearer to the delivery door, thus avoiding the unnecessary carrying to and fro of materials. How many thousands of hours are wasted by operatives waiting for hoists? How much time and energy are expended in the unnecessary carrying of bobbins or materials? Our business is one of constant and perpetual repetition, and the accumulated and recurring waste of lost minutes in the course of even a single year is almost beyond estimation. It is a business in which there is no such thing as a trifle.

While the greater part of the worsted spinning machinery is engaged on the manipulation of the various classes of wool, a fair proportion is used for dealing with other materials, such as mohair, alpaca, cashmere, camel hair, goat, horse, cow, and even human hair. Blends containing two or more of these materials are made, and silk, cotton and other vegetable fibres are also used for blending purposes. It might be of interest to enumerate some of the different purposes for which these materials are used. All classes of wool go to the making of cloth in the nature of coatings, dress goods, linings, shawls, furniture upholstery, curtains and carpets. A large quantity is also used for hosiery purposes, both for hand and machine knitting. Mohair is used for the manufacture of dress goods, linings, light coatings, casement cloths, all classes of pile fabrics, such as furniture and motor car upholstery, imitation skins, tablecloths, rugs and mats and curtains, also for shawls and scarves, braid, button coverings and boot-laces. From alpaca yarns, dress goods, linings, hosiery and umbrella cloths are manufactured. Cashmere is used for dress goods, shawls and hosiery. From camel-hair are made dress goods and shawls, while the stronger and coarser sorts are used for inter-linings, carpets and belting. Samples of yarn in the various stages of production can be seen in the Wool Textile Section of the Palace of Industry, and also in the Mohair Section of the South African exhibit.

In conclusion, I wish to say that I do not think the skill, artistic taste and quality of the fabrics displayed in the Bradford Chamber of Commerce exhibit have ever been excelled in the history of the trade. They not only represent hours of work and thought by the designer, dyer and manufacturer, but are also a testimony to the skill of our spinners. These cloths in order to be repeated must always be exactly the same in every detail right from the raw wool to the finished article, and a spinner must never forget that when he contracts to deliver yarn, that not only does he give his bond to supply a certain quality, but he also guarantees his drafts, twists and every other detail of management right through the mill to be exactly the same as previous deliveries in every minute detail. It is only thus that the manufacturer can rely on the same results in repeating such wonderful effects as are produced in the fabrics shown in this exhibition.

Sir Henry Whitehead (Ex-President of the Bradford Chamber of Commerce) occupied the chair at the Section before which the foregoing paper was given, and in introducing Mr. Hodgson, Sir Henry said that wool might claim to be the oldest textile industry in the world. They read of it very early in the Bible; Joseph had a coat of many colours, and it might be safely assumed, seeing that all previous references were to the wearing of sheep skins as clothing, that at that early date an idea had formed in men's minds to introduce some form of cloth. Coming down the ages, one found Plato and Herodotus mentioning the fact that weaving and milling were known in their day, and in the early stage of British history Boadicea was described as having worn a coat checked with many colours. Herodotus referred to the cloth of which those coats or clothing were made as being composed of strands of wool. It might be inferred that those strands of wool were the product of the spinning wheel, and however crude they might be, they were the initial stages in the spinning of wool which had ultimately developed into the perfection we saw to-day. In the manufacture of worsted coatings, said Sir Henry, it was essential that wool should be spun to the greatest perfection possible to obtain by mechanical means. The worsted cloths woven to-day were very closely cropped, so that the slightest imperfection in the thread was readily seen and produced a defect for which any manufacturer would have to make an allowance. The object therefore of worsted spinning to-day was to produce from the wool a yarn which was perfectly level in character and which would, no matter into what design it might be woven, produce a perfect cloth. Mr. Hodgson had given them a detailed description of the method of worsted spinning. Nottingham was very much concerned with hosiery, and no doubt friends who were present from that city had been interested to hear of the methods by which a perfect yarn was produced.

Discussion

Mr. E. B. Fry (London), in opening the discussion, said that Mr. Hodgson had referred to the question of producing a very full, soft yarn from very short wool, and had stated that the French system was the best. It had always seemed to him rather peculiar that the Bradford trade had not adopted the French system of combing and spinning to a very much greater extent. There was, and had been for years, continual complaint of the competition of the French light dress goods with the corresponding Bradford trade. Bradford people had the greatest difficulty in producing the fullness and softness of handle that were characteristic of the French light fabrics. The bulk of those fabrics were made on the French system from extremely short wool, and much of the noil that was sent from Bradford went into their production. It seemed illogical that Bradford should supply French spinners with raw material at a comparatively small price and then to complain about those fabrics coming on to the market in opposition to the Bradford cloths. The typical worsted thread, as produced by Bradford, was, of course, the smooth, even yarn in which the fibres, theoretically, should be approximately the same length—the nearer they were to the same length the better result would be produced from the Bradford type of machinery. Very short fibre could not be handled satisfactorily by the Bradford system of combing. The only machine which would handle the shortest of fibres such as those that the French fabrics were made from was the Heilman comb. He had raised this matter in Bradford several times. At a lecture given some fourteen years ago, he suggested that the Bradford trade should adopt the Heilman comb, not as a competitor to the Noble comb, but as an adjunct to it, and that they should take out, if anything, a rather better noil than ordinarily and should comb that noil on the Heilman comb, following it by the Bradford process of drawing, not necessarily mule-spinning, and so produce a yarn to give that particular effect which the Bradford people found so difficult to obtain. They would have a supply immediately available from their own raw material and in his opinion Bradford could capture the light dress fabric industry practically in its entirety. There had been an attempt to introduce the Heilman comb into Bradford, but unfortunately it had not been the right type of comb. The type which had been introduced, the Societé Alsacienne, was more a competitor of the Noble and suitable for combing wool of over two inches in length, whereas the type that should be adopted, if the trade in question was to be captured, was the Offerman-Grun, which would take fibre down to three-quarters of an inch in length and comb it satisfactorily. That type of comb could be made a very valuable adjunct to the Bradford trade, and he was confident it would enable them successfully to meet French competition.

Mr. Hodgson, in reply, said that Mr. Fry's remarks were directed to combing, whereas the branch of the industry in which he had been particularly engaged was the spinning. He thought the Bradford climate was more suitable for the trade for which they were noted than for the short fibre trade to which reference had been made. Attempts were made in Bradford many years ago to comb and spin and manufacture French cloths which competed with them. Those attempts were not successful, in fact, one firm which was concerned had to close its doors. The principal difficulty was the climate. Moreover, the spinners in Bradford had not, up to the present, been driven to compete with the French; their trade had been generally well employed and fairly profitable.

The Chairman, with an experience of some fifty years as a worsted spinner, said that the principal reason in former days for Bradford not adopting French methods of producing yarn was the question of wages. He happened to be one of those individuals who had experimented in spinning worsted yarn on the mule. Wages in their district had never at any time enabled them to compete successfully with the French spinners in the matter of price, although the wages paid in France since the war were much nearer our standard. One of the difficulties of Bradford had been to find out why the finer counts sold by the French spinners were so near in price to the coarser ones. It was because of similar suggestions to that of Mr. Fry, which had been made on many occasions, that he decided to make his experiment. His experience had been, however, that it was impossible to run that plant on a paying basis unless it was run night and day. If conditions had been different, Bradford might have gone further into the matter, but, as had already been stated, in ordinary times they had sufficient business to keep them going, and the experience of those who had experimented with the French system had not been such as to induce them to follow the French example.

Mr. E. B. Fry did not think it was so much a question of mule spinning as of combing. They could produce the typical French yarn, or a sufficient approximation to it, on the cap frame running at a high rate of speed better than they could on the mule. It was purely a question of the length of fibre that was used in the French productions that enabled them to get that fullness and softness of handle that the Bradford trade had never been able to secure. There was no comb in Bradford that could comb wool of sufficiently short staple to produce that particular effect. They must get a comb that would handle fibre down to three-quarters of an inch in length. The Offerman-Grun had been used in Bradford, but only for the hosiery trade. Provided they left the short fibre in the yarn, they could get almost as good an effect from cap spinning as from mule spinning, and, with the very much higher rate of speed, they could cut out the question of the cost involved in the spinning.

Mr. Hodgson said that he remembered that in 1895, when Botany tops reached a record low price, they bought some of the French tops, of which Mr. Fry had been speaking, at 14½d. or 14¾d. and made them into special yarn. They tried to use those tops as they were delivered by the French, but they were not successful, and they had to gill them all several times and add a considerable quantity of oil before they could get them to spin at all. They did, however, sell those yarns at less money than they could sell the English yarns, because they bought the tops cheaper, but for no other reason; in fact, they cost a little more to spin. They had to treat those tops according to their English methods by adding oil and doing away with the advantage that the French enjoyed in order to spin them on the cap. He did not think they could have been spun on the cap unless they had received that treatment.

Mr. Fry inquired whether they were put through the English drawing, and, upon receiving a reply in the affirmative, said they could not have had a short fibre; it could not have been handled.

Mr. Hodgson—It depends on the size of your front roller whether you can get your ratchet near enough.

Mr. Fry—It is not a question of the ratchet; it is a question of controlling the very short fibre between the two rollers.

Mr. Hodgson—You can do that if you get your ratchet near enough.

In reply to Mr. Fry's further remarks, the Chairman said that their efforts to meet competition should be applied to the nearest point at which the competition occurred—that was in the manufactured cloth. It had been sought to do that by the introduction, as he had stated, of mule-spinning plant and French drawing. He was not very conversant with what happened to noils when they were used in France, but he thought that these yarns were spun rather on the woolling system than on the worsted system, because the woolling system, with its heavy percentage of oil, was distinctly the better system to produce the yarn. In the Batley and Dewsbury districts, yarn was spun out of materials which had been used before and broken up, and the staples were not more than a quarter to three-eights of an inch in length; they were assisted by the oil. With regard to those yarns of the intensively soft feel—the cloth produced by noils was an extremely short cloth—it must of necessity be a milled cloth, which was not fashionable to-day. French spinners who made yarns which were severely in competition with our best English makes bought long and fine staple wools. Yorkshiremen were never accused of neglecting the opportunity of making a profit, and if Bradford could see an opportunity by introducing cloths of the descriptions named, they would have been only too pleased to do it. Their experiments had been unsuccessful, not because of the price, but because of lack of ability to produce the article.

Mr. W. H. Carey (Nottingham) proposed a hearty vote of thanks to Mr. Hodgson for his very interesting paper, which he was sure had been much appreciated.

Mr. E. Priestley (Stanningley) seconded. Unlike the old lady whose excuse for not attending church was that the parson read his sermon, read it badly, and that it was not worth reading, they could say that Mr. Hodgson had read his paper well, it had been well worth reading and was extremely informative and interesting to them all. The motion was cordially adopted.

On the motion of Mr. P. J. Neate (London), a vote of thanks was accorded to the Chairman for all he had done to make the meeting a success.

Mr. W. H. Carey (Nottingham) then took the chair, and in a few introductory remarks, said that it was a very happy thing that the Bradford and Nottingham Conferences should be held so close together. A short time since, one of the finest mannequin displays which had been given in this country was held conjointly by Bradford and Nottingham at Claridge's Hotel, where were shown the most beautiful products from both places. He was convinced that it was the desire of many who were present at that display that the two cities might be associated together by the beautiful Nottingham lace trimming the Bradford goods. Sir Henry Whitehead had gone back into the distant past so far as wool was concerned. He was afraid that Nottingham could not go so far back in regard to the materials they used, but they could claim that for dress purposes and trimming purposes they made goods which were at any rate equal to any in the country. For the last two years they had been doing all they possibly could to make public the beautiful goods that Nottingham produced. They had now a system of publicity by which they were trying to bring forcibly before the people of England and of the world the fact that Nottingham was unequalled in the production of lace goods. Mr. Litchfield had for some time past been very prominent in this publicity campaign, and there were few men, if any, in Nottingham who knew the ins and outs of the trade as he did.

Mr. Litchfield then read his paper.

MACHINE-MADE LACE INDUSTRY WITH PARTICULAR REFERENCE TO EMPIRE TRADE

By James L. Litchfield

INTRODUCTION

The chief world centres for the production of machine-made lace are the United Kingdom, France, Germany and Switzerland. In each of the countries named the industry has, in the main, become centred in certain well-defined districts and around certain well-known cities and towns. Thus, in England—Nottingham, with smaller centres in the south-west and in Ayrshire; in France—Calais, with smaller centres at Lyons and Caudry; in Germany—Plauen and Barmen; in Switzerland—St. Gall.

Despite the connection between needlepoint and pillow lace in the days preceding manufacture by machinery, to-day there exists a clear division between the mechanical imitation of needlepoint lace, viz., machine-made embroidery, on the one hand, and, on the other, the manufacture of machine-made pillow lace on the "Leavers" or go-through machine, of plain and spotted nets on the net machine, and of lace curtains on the curtain machine. It is not the purpose of this paper to deal with embroidery. I do not propose to give any statistics or make any reference to that industry beyond remarking upon the wonderful progress which it has made in the districts surrounding Plauen and St. Gall and in the Voralberg.

I shall therefore confine myself to the mechanical production of lace in the United Kingdom and France, asking you to note in passing two important points, viz.—

(1) That in Germany there are said to be upwards of 600 lace and lace curtain machines in addition to a large number of embroidery machines and some 80,000 (or more) machines of the "Barmen" type. Unfortunately, the German export statistics do not distinguish between lace and embroidery (except in the case of linen lace where the export is negligible), and consequently it is not possible to show the extent of the German lace trade with the British Possessions Overseas. The largest recorded export from Germany to the British Possessions was £195,950 (lace and embroidery) in 1910, that is less than 25% of the British exports of lace alone to the same markets in that year.

(2) That there are approximately 600 "Leavers" or go-through lace machines and 300 to 350 curtain machines in the United States of America, where, however, the industry has not yet reached that stage of development which enables it to produce a surplus for export.

MECHANICAL EQUIPMENT

United Kingdom—In July 1923 it was estimated that from 5,450 to 5,700 lace machines of all types were engaged (more or less) in the industry as follows—

Type of Machine.	Number.
"Leavers" and go-through	1,950 to 2,000
Plain net	2,500 to 2,600
Warp	300 to 350
Curtain	700 to 750
Totals	5,450 to 5,700

These machines are in the main very largely composed of the latest and most efficient types, a small proportion only of obsolete and obsolescent machinery having been retained. In this direction, the equipment of the United Kingdom compares more than favourably with equipment abroad.

France—Reliable statistics are not available, but it has been reported that in Calais alone some 3,000 machines of all types are engaged; in Caudry and Lyons at least another 1,000 will be found.

ESTIMATED OUTPUT

In 1910 the total export of lace including nets and curtains manufactured in the United Kingdom, whether of cotton, silk or other material, amounted to £4,384,162; in 1920, when the unit of value had increased about four times, the value exported amounted to £8,753,596, falling in 1921 to £2,754,395, when the unit of value was still more than double that of pre-war.

The Nottingham Exporting Houses have always calculated that export trade accounts for at least 75% of output, and it may therefore be assumed on this basis that output in the three years named, but in terms of value only, amounted approximately to £6,000,000 in 1910, £11,500,000 in 1920, and £3,750,000 in 1921. In France, the value of the lace exported in the same three years (as taken from figures supplied by the Statistical Department of the Board of Trade) is declared to have been as follows—

In 1910	£2,688,877
In 1920	£5,588,691
Falling in 1921 to	£3,333,271

Note—The statistics supplied by the Board of Trade are given in sterling and the conversion from francs is therefore an official reckoning.

The consumption in France itself of lace, the product of French manufacture, is known to be somewhat larger in proportion to export than is the case in this country. If therefore the export of French machine-made lace is assumed to be 66⅔% of the total output, we may conclude that in 1910 the French output would have a value in sterling (in round figures) of £4,000,000, in 1920 of £8,500,000, and 1921 of £5,000,000.

The world consumption of lace therefore from these two main manufacturing centres may be fairly estimated as follows—

1910		1920		1921
£10,000,000	...	£20,000,000	...	£8,750,000

A 10% addition would certainly cover the output of this type of lace both in Germany, the United States, and any other centres.

In comparing these values, regard must be paid to the alteration in the unit of value in the three years named. Thus, in the United Kingdom, taking the unit as one "rack" of "unfinished" lace from a machine 186 inches in width, at 4s. 6d. we find that this value had grown to at least 18s. in 1920, and had fallen from that peak to 9s. or 10s. in 1921. Reliable figures to allow similar comparison for lace of French manufacture are not available.

EMPIRE TRADE IN LACE

As far as available, the following official figures, Tables I. and II., reveal the extent to which British Possessions Overseas provide markets for lace. It is to be noted in the totals that the term "lace" includes plain and spotted nets, mosquito nets, lace curtains, laces for dress, lingerie and millinery purposes, made on every type of machinery and from cotton, silk or other materials.

Two other tables are given, namely, Table III., showing the exports in detail to British Possessions Overseas for the four years 1910, 1920, 1921 and 1922, and Table IV., showing the value of lace exported from China to certain countries in the years 1913, 1920 and 1922. In this connection it must be noted that practically the whole of the Chinese lace is hand-made, and is produced at a wage cost with which neither England nor France can compete, and is of such growing importance that it must be taken into account when estimating the world consumption of lace.

Table I. shows clearly that the British Possessions Overseas take from 19·8% to 24·3% of the total lace export of the United Kingdom.

Table II. shows that these same markets (certain other countries included) take not more than 4·1% of the total lace export of France.

Table III. shows details of lace export to the Overseas Dominions. Particulars have been added for the year 1922 in order to show the great recovery in the Empire markets in that year in comparison with 1921—an improvement possibly due to the preferential treatment accorded to British goods and to the extra duties imposed by the Australian Government with the object of correcting the incidence of depreciated exchanges. For example, when the franc stands between 75 and 80 to the £1 sterling, an additional duty of 42½% is imposed, adjustment following the movement of the franc.

TABLE I.—United Kingdom—Exports

Year	1910	1920	1921
Exports to British Possessions	£909,508	£1,737,807	£662,252
To Foreign Countries	£3,474,654	£7,015,789	£2,092,143
Total Exports	£4,384,162	£8,753,596	£2,754,395
Percentage of Exports to possessions of total	20·5%	19·8%	24·3%

TABLE II.—French Exports

Year	1910	1920	1921
French export of lace to "Other Countries" (including British Possessions Overseas) ...	£62,865	£149,279	£139,914
Total French exports of lace	£2,688,877	£5,588,691	£3,333,271
Percentage of exports, line 1 to line 2... ...	2·3%	2·6%	4·2%

Note (1)—French exports of lace to British Possessions Overseas are included only under the heading of "Other Countries." The value of the statistics therefore consists in the calculations made in line 4, Table I., and line 3, Table II., showing the percentages which denote the relationship of exports to British Possessions from the United Kingdom and to "Other Countries" (including British Possessions) from France, to the total lace exports from both countries.

Note (2)—Converted sterling values by Board of Trade.

TABLE III.

Statements showing the value of Lace and Embroidery (United Kingdom manufacture) exported from the United Kingdom, and registered as consigned to the undermentioned British Overseas Dominions, India and Egypt during the years 1910, 1920, 1921 and 1922, so far as the particulars are available.

Lace and Plain Net and Articles Thereof (Except Embroidery) of Cotton

Country to which Consigned	1910	1920	1921	1922
	£	£	£	£
Australia	265,414	537,897	189,049	457,217
New Zealand	69,662	84,483	24,783	48,997
Canada	318,391	469,812	203,047	225,871
Union of South Africa	71,647	50,621	30,125	40,829
India	72,934	182,137	23,999	143,157
Egypt	57,245	130,051	80,578	89,733
Totals	894,158	1,617,996	623,328	1,106,261

Lace and Articles Thereof (Except Embroidery) Wholly of Silk

Country to which Consigned	1910	1920	1921	1922
	£	£	£	£
Australia	2,509	(a) 49,491	(a) 18,265	(a) 16,239
New Zealand	1,023	(a) 16,999	(a) 1,949	(a) 3,941
Canada	6,347	(a) 12,775	(a) 2,472	(a) 2,803
Union of South Africa	275	(a) 1,126	(a) 849	(a) 1,596
India	68	(a) 297	(a) 66	(a) 224
Egypt	24	(a) 277	(a) 362	(a) 87
Totals	10,388	82,684	24,736	25,905

Lace and Articles Thereof (Except Embroidery) of Silk Mixed With Other Materials, If Known as Silks

Country to which Consigned	1910	1920	1921	1922
	£	£	£	£
Australia	Details not available	19,359	10,290	20,657
New Zealand		8,204	367	2,883
Canada		2,322	1,283	3,105
Union of South Africa		1,871	313	1,547
India		2,240	1,553	587
Egypt		25	—	—
Totals	4,962	37,127	14,198	29,223
Grand Totals ...	£909,508	£1,737,807	£662,262	£1,161,389

(a) Machine-made only.

TABLE IV.—China—Exports of Lace

Statement showing the value of Lace *exported* from China to the undermentioned countries during the years 1913, 1920 and 1922.

Countries	1913	1920	1922
	£	£	£
Hong Kong	11,032	6,802	22,492
Singapore (including Straits Settlements) ...	87	4,264	2,645
Netherland East Indies	—	1,272	2,330
India and Ceylon	56	2,630	2,403
Great Britain	3,305	72,206	81,839
Denmark	—	4,387	459
Belgium	—	758	1,831
France	25	4,513	1,656
Italy	—	2,654	3,756
Japan	2,415	1,204	8,746
Canada	29	26,330	28,613
United States	286	592,166	720,869
Australia and New Zealand	672	154,849	159,940
South Africa (including Mauritius)	55	10,393	10,053
Turkey, Persia, Egypt, Aden &c.	111	9,594	3,964
All other Countries	571	15,562	6,062
Total	£18,644	£909,584	£1,057,658

Note (1)—The value of hand-made lace is not separately recorded. Exports to Hong Kong are subsequently re-shipped to the United Kingdom, Europe, the United States and elsewhere.

Note (2)—Particulars for 1910 are not available.

Acknowledgement is made of the great assistance rendered by the Statistical Department of the Board of Trade and Professor A. W. Flux.

Discussion

Mr. Henry P. Greg (Manchester) gathered that most of the raw material of the lace trade was cotton. Was there any other material used, or likely to be used, in the lace trade; for example, was artificial silk making its way ?

Mr. Litchfield replied that pre-war at least 85% of the English output of lace was manufactured of cotton. At the present time cotton accounted for two-thirds of the output. Artificial silk was growing very much in popularity, and in Nottingham they were making much more of silk than they did in pre-war days. In addition they were using a large quantity of wool on the lace machines for the manufacture of those artificial silk and woollen fabrics which they had commenced to produce in some quantity during the last three years.

Mr. Greg said he understood that artificial silk was very smooth, and inquired whether there was any difficulty in working it on the lace machines.

Mr. Litchfield thought he could say quite clearly that the whole of that difficulty had been overcome since 1913. At that time he was engaged with a firm that first experimented in the use of artificial silk. They had to resort to all manner of devices in the machines, such as the introduction of friction bits and so on, in order to overcome the difficulty of breakage of yarn. Now they were using very large quantities without any difficulty mechanically. One of their chief difficulties was the question of dyeing, but he thought that that, too, would be overcome. Replying to a further question by Mr. Greg, Mr. Litchfield said he did not think it was possible to introduce fancy effects on the lace machines; they must have a perfectly smooth yarn. The Nottingham Trade would not use tinsel and metal, because of the rough usage to which their new machines would be subjected by that type of rough yarn. Although the difficulties might have been overcome in the hosiery trade, he did not think it was possible in the lace trade, nor was the type of yarn referred to a type from which lace was manufacturable.

The Chairman said that those engaged in the lace trade were constantly experimenting with machinery, and he thought that Mr. Litchfield would agree that what seemed impossible at the present time might be very easy a little later.

Sir Henry Whitehead, in proposing a vote of thanks to the Chairman for presiding, and to Mr. Litchfield for his interesting paper, said that although quite ignorant of the details and technicalities of the manufacture of lace, he could appreciate what they in Nottingham were endeavouring to do for the trade. He thought that both Nottingham and Bradford had reason to be satisfied with the efforts made at the display at Claridge's to demonstrate the superiority of their goods to anything that the world could produce and to disabuse the minds of the general population that it was necesssary for those articles to be obtained from other countries. He thought they might congratulate themselves also upon having taken advantage of the opportunity afforded them by that great Exhibition to show that they were not behind the times and that the efforts they had been making for many years would be continued in the future to open the eyes of the public to the fact that the British made article was superior to anything that the world could offer.

Mr. John Emsley, J.P., of Bradford (President of the Textile Institute), seconded the vote of thanks. This was the first time they had had a united conference of all the textile industries of the country. He was confident that good results would accrue from the development of this idea, and that such conferences would be of great assistance in enabling them to understand each other's point of view and so to overcome the difficulties with which their industries were confronted from time to time. The resolution was cordially adopted, and the Chairman and Mr. Litchfield briefly returned thanks.

THIRD SESSION—AFTERNOON MEETING (iii)
Thursday, 12th June

The Chairman (Mr. Alfred Wigglesworth, London), in introducing the reader of the first paper, Sir Sydney Skinner, said that there were very few men in London, or indeed anywhere else, who knew more about the retail distribution of textiles or could treat the subject with more originality. Manufacturing was only one side of the medal, and the other side, that of retail distribution, was just as important. The whole system of distribution of goods had changed so much in one short lifetime as to be hardly recognisable.

Sir Sydney Martyn Skinner, J. P. (President of Drapers' Chamber of Trade), then read his paper on "Retail Distribution of Textiles."

RETAIL DISTRIBUTION OF TEXTILES

By Sir SYDNEY M. SKINNER
(*President, Drapers' Chamber of Trade*).

The Conference is to be congratulated, I think, on the breadth of subject embraced in the various papers which have been read. Several of these have been highly technical, with others of quite a specialist nature; but all have subscribed to a fuller and better knowledge of the trade in textiles which we are met to foster and extend. My particular province seems small by comparison—it is my work to sell what you produce; and it appears so simple an operation as scarcely to call for much in the way of elaborate description. Yet I suppose, speaking for the distributive trade, we are a very necessary adjunct to your organisation. You manufacture your interesting fabrics with one object—to let the public have the benefit of your ingenuity and industry. I represent an institution which endeavours to find that public for you. A service which appears somewhat less difficult than the infiniteness of scientific detail suggested by the technology of the subject, but involving processes which command some amount of skill in their manipulation. In comparison, however, with the highly interesting story of the discovery of a dye, or the chemical properties of a fibre, and each new in its particular relation to the subject proper, I can only re-tell a tale that is well known and should be familiar.

The art of selling is supposed to be as old as human nature itself. If this is so, fabrics must have been the first of the commodities to claim the attention of the women at all events. The Biblical story of our first parents is well authenticated, in its allegorical sense, certainly; Eve must have passed very quickly from a petticoat of leaves to a becoming dress of reeds, nicely balanced, we can well believe, as to colours and decorations. The rest was easy. You will remember in the delightful romance of Anatole France how the females of Penguin Island learned the essentially feminine uses of personal adornment, thereby leading, no doubt, to the development of a trade in textiles. The love of a bright fabric is undoubtedly pretty primitive. A native of the South Seas will gladly barter a pearl to be the proud possessor of a yard of decorative material! And if primitive, therefore very natural. With the grain of the wild grasses the men made beer, and with the straw the women made frocks. You will take this, of course, as a generalisation; but it seems to have some historical warrant.

Though the art of selling is old, the retailer is a comparatively modern institution in business. The small boy in the class, asked who was the first man to open a cash business, promptly replied "Julius Cæsar," because his standards all bore the device S.P.Q.R., which the writers in the comic papers have made us believe meant "Small Profits and Quick Returns." At school, so far as I remember, it read somewhat differently. Herein the small boy was partly right, because the Romans were large traders, and always, I believe, on a cash basis. We have come to look upon the Cæsars as wholesalers, compelling markets in quite an Imperial way. But the S.P.Q.R. legend is altogether admirable; it is a slogan of excellent force and acceptability. The shopman who sells quickly can surely sell the most—I don't think we need trouble ourselves about the profits. The profits nearly always come in a large and well organised business. But you, as manufacturers, certainly want the retailers to get rid of as much as they can. Of course, if we must talk of profits, you (the producers again) are as much interested as are we (the sellers). The more you produce the more you sell, and the more the profits you make the more you are able to produce, and the more we can sell the more we can ask you to produce. It is obvious from this that a big business is made by keeping the profits as low as possible. It is well, perhaps, that the manufacturers should bear this in remembrance when they are planning their commercial battles against the poor distributor. To be serious, all the big businesses of the world have been built up on low prices. I don't mean by this the old shopman's dodge of underselling his competitors to get his trade, losing a part of his profits in the action. I mean rather the boom in trade when general prices are what the public can easily pay. It applies to textiles as to everything else—we can sell more when we can give the best value for the least outlay. Necessarily, the most expert business man will get the biggest business. That obtained in the old day, and it will always be so.

There have been huge trading bodies in the past concerned in the wide distribution of commodities. History calls to mind many a gigantic confederation of commercial interests; but there has never been a time when retail distribution held so large a place or wielded so great a power. It is the era of the big retail businesses. The confederations I refer to traded the products of one nation to another, having the world for their market. So have these retail businesses of which I speak, only in a more limited sense. For the most part they are local in their spheres of influence, no matter how wide the particular localities may stretch. Yet they boast a volume of business which these old leagues might well have envied. The budget of a big modern retail business is the equal of many an ancient Principality. Many of these businesses have been built up in our day—the Gargantuan stores of the Metropolis and the principal towns, and the multiple shops, controlled from a main centre, are distributive agencies on a similar plan. The problems that confront the business man to-day are in effect new to him. Buying and selling is his trade, which he knows thoroughly, wherein tradition is a help; but the distribution of huge stocks received in bulk and given out in small parcels to the multitude is an extension of his trade for which the precedents are few. It calls for a different sort of knowledge, or rather he must add a new agency to his knowledge. We call it organisation. But this is only for want of a better word. Where the old retailer was domestic in his dealings, the new retailer is a nationalist. The shopkeeper bought a piece of this fabric and a length of that, employing an errand boy to deliver his parcels; the retailer of to-day buys a thousand pieces of cloth and uses a fleet of motor cars and all the ramifications of postal and railway organisation to serve his customers. That measures the difference between the old and the new. And it is a bigger difference than perhaps we imagine. The errand boy was a factor easily controlled, and his existence did not widen the circle of trade experience. The fleet of motor vans and the various aids to transport argue a proposition which is a business in itself.

It seems difficult to suggest a limit to the possibilities of modern retail distribution. Big businesses must grow bigger; there is no standing still in business. The introduction, one by one, of the wonders of our civilisation have made for an expansion in trade which must strike us all as a sort of miracle, because we have in our lifetime seen this revolution in the making. The parcel post, the telephone, the railway train, effecting a change which we can only term marvellous, are but the prelude to the more tremendous possibilities of wireless and the air machine. To be able to sit in an office and give a personal order for goods to a factory a hundred miles away—actually speaking to the producer, and then have the goods delivered the next morning as a causal result of the conversation—that is a commonplace of our business life which never fails to appear to me as a page out of a fairy book. And it is even more like the touch of a magician when the customer, in turn, can buy without shopping; ordering a new dress in the morning which will be worn the same evening. This shows, I think you will agree, a very perfection of method in shopping organisation which will carry us to an extraordinary increase in retail distribution.

Side by side with the advances made in the science of production, does not this increasing facility in the means of distribution point to tremendous possibilities in the future of the textile trade? The mechanical achievements of the loom, with the skill of the inventor and the knowledge of the chemist, will result in the production of textiles in amazing quantity at a cheaper price per yard. There should be no fabric, under these conditions, beyond the purse of the average citizen. The great distributive agencies of the country, taking up the task, will introduce those goods which are necessary, and many hitherto regarded as luxuries, into the homes of the people. With the newer facilities which I have attempted to indicate, no output should be so large that it cannot be safely negotiated.

To come down to actual practice in the field of retail distribution, and particularly as it applies to textiles, what are the means taken to secure the end desired ? First, of course, you have the shops, large and small, all over the country, shops which have increased in number as the result of the tremendous impetus given to trade in a variety of ways. The invention of machinery, the increase in population, the larger consumption caused by a general reduction in price (itself the result of easier means of production) and a widening demand for commodities as the standard of living gets higher. Next you have the resulting prosperity from better means of native production, and a wealth which comes from wealth. And finally, a demand which is created by that new handmaiden of retail trade—advertising. The greater of these is perhaps the latter, so far as the mere driving force is concerned. This is also the force which is least understood even by its practitioners. We in the retail trade have come to realise somewhat of its power, but I am not so sure that the manufacturers have yet arrived at a full belief in its capacity to compel business. For those reasons which are obvious, we may all subscribe to knowledge. The greatly extended field of production in raw material as the Empire grows and our activities get peopled with earnest men determined to put Nature to full use we can understand. Larger sources of supply tend to easier prices in raw material, leading to more material in the piece—that follows naturally. To keep pace with this inflow, machinery has to be provided, human ingenuity is put to its fullest test, and factories grow and output gets beyond its ordinary limits. It is then that the resort has to be made to methods which will create demand. And this is where I think we embrace a new factor—we call to our aid the art of printing. All the mechanical arts have outgrown the necessities of that age of small productiveness which many of us can remember. We are speaking comparatively, of course, although the improvement in factory machinery has multiplied our products amazingly. Of these arts, printing and its allies have made a progress which has put its mark on modern trade progress.

The invention of steam wrought the first wonder. No longer did people dwell in small communities, with simple wants easily satisfied. Travel is a great educator. It is human nature to want the things that other people enjoy. The steamship brought in bulk to our shores the handicrafts of other peoples, hitherto the treasures of the rich, now made a commonplace of life. The art of printing filled a domestic role, but in no sense a humbler role. By its means came to be distributed the riches of the earth, no matter in what quantity they were brought to us. By its help the little shop of the village became the great store of the city, addressing a public altogether out of reach without it.

I wonder whether we are aware of quite what the art of printing and the invention of the processes of illustrative reproduction have done for retail trade in making possible those means of distribution upon which alone a huge trade can flourish. Take the subject of textiles, in which we are particularly interested to-day. By no means, that I know, can you make known your activity in production without it. The distributor can only sell to his customers by telling them of the goods he has to sell. By personal representation, however wide his circle, he can only talk to a limited few. The methods of approach are cumbrous, and at best uncertain if not ineffective. The art of printing at once enlarges his appeal as by a wave of a magician's wand. The newspapers in a day will broadcast his news to all our millions, process blocks will give a tolerable representation of the fabrics he has to offer, the post will carry him orders from the remotest corner of the King's dominions. There is an urgency in it which will create demand.

So far we have considered the applicability of these means to our domestic necessities. By various applications of the art of colour printing we can now give pretty accurate pictures of all the fabrics we have to offer; some of them are marvellously true. In the case of cotton textiles, by the further aid of embossing we can portray plain colours with absolutely the truth of the actual pattern. The only drawback here is the expense. But with the further improvement in our processes I see a day not very far distant when fabrics in colour will be reproduced with the faithfulness of a drawing and in one operation, reducing the cost to that of a single printing. In a few years at most it will be possible for our daily advertisements to be done in six or more colours with the ease of our present newspaper production and with no more expense. Already catalogues are printed, as you may have seen, in four or more colours simultaneously. These are not perfect, but they are wonderful productions, and promise a future of great usefulness in the selling of fabrics particularly.

Using these means for our home needs, we can also extend their usefulness to create and maintain colonial demand. No one will pretend that we have expended much effort in the exploitation of those other markets which are ours by right. I take the rather insular view that we have the first right to predomination in the distribution of our merchandise in our own British markets. But it occurs to me that the foreigner is often there when he has no right to be, dealing in commodities which we have come to regard as specially ours. This does not operate, of course, so much in relation to textiles—British cottons and woollens hold the markets. Even so, there is a large field for expansion here. And I see no reason why the retail distributor at home should not second the efforts of the manufacturers in making and extending markets abroad.

The trade with our colonies and dependencies is often, I fear, left to push itself. Looking over the newspapers which come from those parts of the world, it does seem to me that a great deal more could be done on the spot to further British trade interests; and it also appears that something more could be done than is being done at the sources of supply to give an impulse to colonial trade. There surely is a trade worth having in all our dependencies abroad. The big retailer at home is certainly looking with a jealous eye on the opportunities that would seem to be awaiting him in these remote spots of the earth. With improved means of transit, the grant of extra postal facilities &c., trade from abroad with the shops here would be an important factor I am sure. I am speaking now from the point of view of a customers' trade with the home shops, additional to what the manufacturers can effect for themselves with the colonial retailer. Already the foreign trade of the larger London retail houses is considerable; since the war we have been able to approach the public overseas, and we have built up a constantly growing revenue from this source. This trade is only an incident in the year's business as yet; whereas I feel sure that by a concerted action it is possible to obtain a trade that should at least go far to double our output of textiles. Because we must remember that in all these countries textile goods are a necessity of everyday life, and the need is a recurring one.

I am afraid I have spoken at a great length in these generalisations. In dealing with such a subject as the merchandising of fabrics, or any other commodity, it is only possible to speak in a very general way. It is perhaps easier to lay down a campaign and work it out to its logical conclusions. To buy a million yards of fabric and devise a plan for its distribution is definite in its purpose and object—a personal problem only. But I hope I have expressed myself with sufficient clarity on the main theme, and shown that however great the energy of the producer the enterprise of the retailer is no less. Provided that the goods offered meet the needs of the public, either as everyday commodities or in an exceptional way as luxuries, there is no output of the factories which the retail institutions of the country cannot distribute, to the mutual advantage of the producer, distributor and consumer.

Discussion

The Chairman, in calling for discussion, said that they had listened to Sir Sydney Skinner with great pleasure and profit. He had struck a note which needed emphasis. Hitherto to a large extent the trade of the world had been carried out by enterprising merchants travelling in a wholesale way and selling goods manufactured in this country for retail distribution in outlying parts; but conditions had changed so much in the course of a few decades or even of a few years that it was difficult mentally to keep pace. Multiplicity of transport was now enabling firms in London to distribute goods throughout the whole world without the slightest difficulty. The difference could readily be appreciated between the old system whereby a shopkeeper, say, in Toronto, had to apply to a certain merchant there for goods of which he had heard as new, and the present system whereby he had direct communication with the man on the spot in London. After hearing Sir Sydney Skinner's paper he asked himself the question once again, why England was the home of a merchant race ? In his opinion it was simply the result of restlessness, due in part to an abominable climate, which made men wish to get out of England, much as they loved it and much as they desired to return. But, having got out of it, they did not desire to travel as sightseers, they wanted to carry their business with them. That adventurous spirit had made the British the heirs of the Phœnicians. Last year he had the good fortune to visit Carthage, which was one of the settlements of the Phœnicians, and he saw all that remained of it, and could not help recalling that beautiful picture in the Royal Exchange, London, which represented the Phœnician merchants exchanging their wares for the tin of the Early Britons. Sir Sydney had referred to the wonderful improvement which had taken place in the reproduction of textiles for illustration, particularly in the reproduction of colour. We were on the verge of the discovery of the successful transmission, not only of images but of colours, by wire or wireless, and it was easy to picture a future—perhaps the next generation—in which a man in Toronto might be shown a sample book page by page as the leaves were turned over in London and enabled to select and to wire back what he wanted !

Colonel McConnel (Manchester) desired to ask whether the concentration of the retail trade in London was or was not a good thing. It seemed to him that the retail trade of the country extended far beyond London, and the matter must be viewed from the aspect of what was best for the country as a whole and for the entire trading world. Then there was the question whether another branch of retail work represented by multiple shops had resulted to the advantage of the community as a whole. No doubt the large shops would like additional postal advantages, but the subject had to be explored from more than one point of view. He himself was not connected with the retail trade, and he looked at the question rather from the point of view of the manufacturers. The point was as to the best way of distributing the manufacturers' supplies not only to London but through the country and the world at large.

A Visitor from Bradford asked if Sir Sydney Skinner could give any practical suggestion as to how the Bradford manufacturers could help the retailers to sell Bradford goods. The retailers might sell a vast amount of foreign goods, and this would not help Bradford at all.

Mr. Amos (New Zealand) said that while he would like to thank Sir Sydney Skinner for his paper, he could not agree with all that he had said. Sir Sydney Skinner seemed to think that it would be a good thing for the big stores to cater for the Colonial trade. But from the point of view of the overseas man like himself, it would be a very bad thing. Sir Sydney Skinner had also said that the overseas markets in the British Dominions were the right of the British manufacturers, and with that he certainly agreed. Moreover, he would like to inform those present that the foreigner had not got into those overseas markets as he had got into certain others. In New Zealand the British manufacturer was given a preference of 10% or 15% on different classes of goods. An endeavour was made to keep the Colonial markets free for the British manufacturer. He was inclined to blame the British manufacturer for not making enough of those markets. It was rather different now, but before the war the manufacturer did not seem to care whether he did the Colonial trade or not. He was afraid that the manufacturer despised the Colonial trade because it was a small one in comparison with the trade elsewhere. The speaker maintained that the British Dominions should be, and would be, if he catered for them, the home manufacturer's best customers. Everybody knew that Australia was this country's second best customer. As for New Zealand, it bought £12 worth of goods per head of population against 15s. per head which was the purchase of America. The manufacturer could best cultivate those markets by going out to them and cultivating them on the spot. It was the manufacturer who should cultivate them, not the big retail stores.

Mr. H. B. Heylin (London) said that Sir Sydney Skinner had spoken of advertising in six or more colours; he himself was more interested, however, in proper descriptions in advertisements. In some advertisements the goods were not described as fully or as accurately as they should be. He would give one instance, not applicable to the retail stores. He was walking down Euston Road the other day, and noticed some old second-hand goods on view, including certain kinds of artificial silk stockings, and some of these were marked "Perfect Silk, 1s. 6d. per pair," and others "High Silk, 1s. 3d. per pair." In some cases he thought that the great houses of London were guilty of such practices; it might not be done intentionally; he thought it was due often to want of knowledge. On going into shops he often found that he got some very misleading statements with regard to the quality of materials. He could name many shops in London where he had been given entirely inaccurate descriptions simply through want of more definite knowledge with regard to textiles. The people who were responsible for selling textiles behind the counter should be better educated in that particular line so that they could convey the right information to the customers. He could give scores of illustrations from people who had gone into shops and asked for particular articles and had not been able to get them. The assistants behind the counter had been trained to say, "This is just as good." A better knowledge of textiles was required, and he hoped that the Textile Institute would take up this question.

Mr. Thomas I. Walton said that he had listened with great pleasure to the paper and thought that the author was to be complimented on the way in which he had handled it. He had risen for the purpose of trying to allay certain ideas in people's minds on the question of distributing goods. A manufacturer could not distribute his goods. He might have twenty sorts of cloth in his factory and he could not go and sell those goods as a retailer went; if he did he would be up against the merchant, and, of course, the merchant was the medium whereby the distribution of goods should take place. Therefore the proper system for the distribution of goods was for the manufacturer to sell to the merchant, the merchant to the wholesale houses, the wholesale houses to the retailer, and the retailer to the customer. He was convinced that it was not possible to do away with the middleman, although sometimes they did not feel satisfied that the merchant and the wholesale dealer should get a bigger commission than the manufacturer himself got. Incidentally he remembered reading Foster Fraser's *Through Siberia*, in which that author exposed the weakness of the British in not advertising their goods abroad. The speaker had been abroad to several places and always he had to search for the English goods, although America, Japan, India and other nations seemed to be well organised from the point of view of advertising in foreign countries what they had to sell. He thought the postal authorities would do well to provide cheaper facilities for the distribution of goods. True, there had been great advance since the days of the packman, and there would be greater advance still if distributing agencies went ahead in the way the Chairman had just suggested. In fifty years' time the goods would be walking to the door ! From the point of view of integrity, also, there was much ground for congratulation. There were a few dishonest tradesmen, but he believed that the vast bulk of men engaged in this business furnished goods as they advertised them, and that in honesty the British tradesman was the equal and, indeed, the superior of any outsider that could be mentioned.

Mr. Barker (London) said that he would like to allay the fears of the gentleman from New Zealand. They all knew, for example, that the firm of which Sir Sydney Skinner was the head did a great deal of advertising, and if its activities were going to interfere with the retail trade in New Zealand, what about the interference with the retail distributors in the suburbs of London itself ? Yet, speaking personally, he did not think that all this advertising by the big central firms made the slightest difference to the suburban trader, except in the favourable direction of educating the public in the matter of such goods as the suburban house, as well as the central stores, had to sell. From the growth of suburban stores in London it did not appear that they were badly hit, and he thought that retailers in general should be thankful to the larger firms.

Sir Sydney Skinner, in reply, thanked those present for the cordial reception of his paper. The papers read at that Conference were not meant altogether for the audience immediately in front of the platform; they were intended rather for a wider public who would read them in full or in abstract in the Press. The various points raised in the discussion illustrated the difficulties which different people had to contend with in their particular spheres. The first question was as to the best way of getting their manufactures before the purchasing public. He could answer that with perfect frankness and in a very few words, though in doing so he would be "up against" one of the speakers. He could claim to be a practical man of affairs; he had been connected with the distribution of goods since he was a youth, and he had seen this question operating in all its various phases during the last thirty or forty years. So far as the manufacturers were concerned, he had had occasion at times to say very unpopular things about them, but the view he had taken was this, that in this old country of ours, within certain limits he thought it could be claimed that they had the best manufacturers in the world, and also the best operatives in the world. He had travelled pretty widely in various countries, and he had seen nothing better in the way of factories, looms and machinery than this country possessed, but he had said more than once, and he would say it again, that he thought the Englishman in business was far too modest. He did not claim himself to be a modest man, and, moreover, he thought that modesty in business, at all events from the point of view of selling goods, was a thing which should not exist. If this country of ours possessed the finest manufacturers and operatives, the finest factories and machinery, why did it not let the world know more about them ? This was an age of advertising. A man built up his business by making known the excellence of his goods the wide world over. In the public mind there was a receptive faculty which would always accept the written word at somewhat of its face value. If in Lancashire or Yorkshire there was produced a certain type of goods, and skill, knowledge, and enthusiasm went into their production, why not let the world know something about it ? He was in America eighteen months previously, and there he found that the finest textile goods were British goods. They were of such excellence that they over-rode all tariffs and "got there" all the time. The same thing applied to other goods as well as textiles. But the Americans and the Canadians were not allowed to know enough about the quality of these goods, and the same was true certainly of New Zealand and of other markets. He was at a small meeting of his club not many weeks ago, and he went from that meeting with a friend of his who was a manufacturer in this country to a club in the West End of London where they met three or four gentlemen from the Colonies. This manufacturer asked the advice of one of these Colonials as to how to place his goods outside this country; goods of excellence, the best of their kind. And the reply to this manufacturer was, "You have got splendid goods but you will never get them there because you never tell the people about those goods. Our people do not dream about your goods; they do not know anything about your goods, but tell them what you have to sell and then they will begin to make inquiries." If the goods were properly advertised and made known, the imagination of the public would get to work and business would be created. He had not been in business for the last thirty or forty years without knowing something about the difficulty of the distribution of goods from the manufacturer to the public. If the immediate difficulties could be overcome there was a factor at work which was going to be of immense benefit to the manufacturer, namely, that the men in the retail distribution business were those who were close to the public all the time. What they had to do was to communicate the knowledge they possessed to the manufacturers of the country so that the goods which met the public desires might be produced. Somehow the foreign manufacturer did come closer to the ultimate source of distribution than did the English manufacturer. It was said that a statesman was successful in proportion as he kept his ears to the ground of public opinion. The retailer had his ear to the ground all the time, and what he desired to do was to communicate his knowledge to the manufacturer of the goods. The foreigner managed to get closer into touch with those who could afford him information, whereas the British manufacturer was fenced off in all sorts of ways. This applied apparently only in this old country of ours. It did not apply to America or to any country that he knew of in Europe. In those other countries the retail distributors were in closer touch with the home manufacturer. He was sure that what he was stating was fact and not theory. If only the British manufacturer could be made aware of the position and the connection between home manufactures and retail distribution could be made closer, the trade of this country would increase tremendously.

The question had been raised in the discussion as to the effect of the big stores. He wished to make it plain that he had not written his paper as the head of a London business, but as President of the Drapers' Chamber of Trade, which represented thousands of drapers throughout the country. It was open to any man, he believed, to build up a big business in any suitable distributing centre. He had no fear of competition. He believed that the more trade that was done, the more trade there would be for each member of the business community who was able to avail himself of what was going. The more they could educate the public to the need for certain goods or for goods of a certain quality, the more would they all benefit by increased sales. It was not a question of sharing out a fixed quantity among many competitors; it was the creation of fresh business which might benefit all. The competition of the big London or provincial stores need not be feared; what they had to fear was their own ignorance, their own insularity, their own lack of organisation. He would undertake to build up a store in any district in England given certain essential conditions—capital, knowledge, industry, and the employment of youth. With these things secured, stores might be found growing up in every distributing centre in England just as in America. In American towns with a population of 50,000 or 60,000, big distributive stores might be seen doing a fine business, while in towns of 500,000 or 600,000, there were stores such as England did not possess. He was told that this was due to the fact that the people of America spent more money. As a matter of fact the amount spent per head was very little more than here. The thing that needed to be done in this country was to educate the public to employ its spending capacity in the right channels. Something had been said in the discussion about misdescription of goods. He quite agreed this was due largely to lack of knowledge. It was the manufacturers' job to educate the trade and to educate the public to expect certain goods. All goods should be exactly what they were advertised to be. If there was wilful misdescription in an advertisement, it was a case of snatching at a very small advantage to lose a much bigger trade in a short time. Trade was based on confidence. Once the trader got the confidence of the public he had got his business. He would never get that confidence by any adventitious methods. This lesson was exactly the same whether it was directed to the manufacturer or the wholesaler or the retailer. In conclusion, he repeated that there was no other country in the world which merchandised its goods as well as this country or merchandised them as cheaply, and he hoped that our manufacturers would derive great advantage and profit from the British Empire Exhibition.

The Chairman said that they had to thank Sir Sydney Skinner for a most admirable paper and, he had almost said, a still more admirable address in reply to the discussion. It had been made clear that afternoon that the function of the manufacturer and of the seller or distributor were quite distinct. He believed that the special type of mind which was successful in manufacturing could scarcely expect to be successful also in distribution. Somebody had alluded to cheaper selling abroad. If this was true, the cause was, without doubt, taxation. In this country we were taxed three or four times more than in France, and naturally a trader had to pay taxes out of profits, and this led to increased selling prices. In thanking Sir Sydney Skinner he referred to the immense work which he and his firm had done in London. One saw its effects in the people who, for example, thronged that Exhibition. When he remembered how people were dressed twenty or twenty-five years ago, and then looked around him to-day, he found a phenomenal change, and this was largely due to better distribution methods which Sir Sydney Skinner along with others had been the means of inaugurating.

A vote of thanks was accorded by acclamation.

Mr. Eldred F. Hitchcock, C.B.E., then read the following paper—

TEXTILE EXPORT TRADE, WITH SPECIAL REFERENCE TO COUNTRIES WITHIN THE EMPIRE

By Eldred F. Hitchcock, C.B.E.

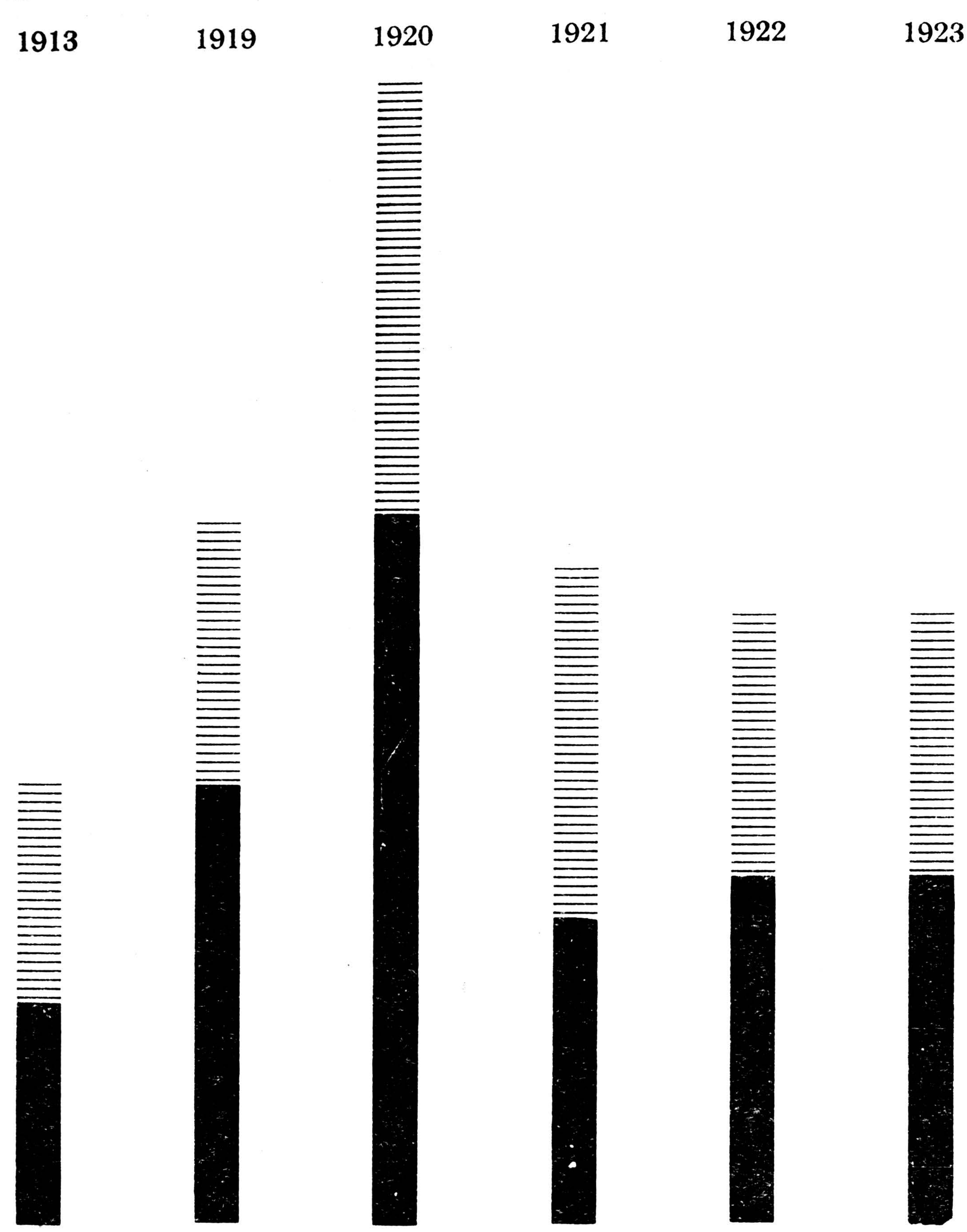
TEXTILES—BRITAIN'S MOST IMPORTANT INDUSTRY

No British export industry approaches the textile trade in size or importance. This fact is not always realised, and few people are aware that the export of textiles from Great Britain constitutes the main source of revenue from customers abroad.

During the last hundred years important textile industries have been built up in all the chief industrial countries of the world, especially in Europe, and Great Britain is facing, as never before, the severest competition. The entry of its goods to foreign markets is increasingly penalised, for, apart from the expansion of their own textile industries, the erection of tariff barriers to protect themselves and, temporarily at any rate, the inequalities which result from

Diagram I.

Export of Textiles (Black) compared in values with all Manufactures—



depreciated exchanges, relatively low taxation, and low real wages have made more difficult the sale of British goods abroad, particularly to Europe, our textile exports to which are steadily falling, over 85% of our textiles having now to find markets in other parts of the world.

It is true that for the time being, so far as Europe is concerned, this country enjoys comparative immunity owing to the rapid appreciation of the franc, which has increased French costs, and to the financial dislocation of Germany. That state of affairs is, however, temporary, and the textile industries of this country will yet feel the full blast of European competition.

In spite of all difficulties, however, the export of textiles to-day constitutes not less than one-half of the value of our exports of all manufactured goods. Diagram I. shows the position, the detailed figures of which are given in Table I. (Appendix).

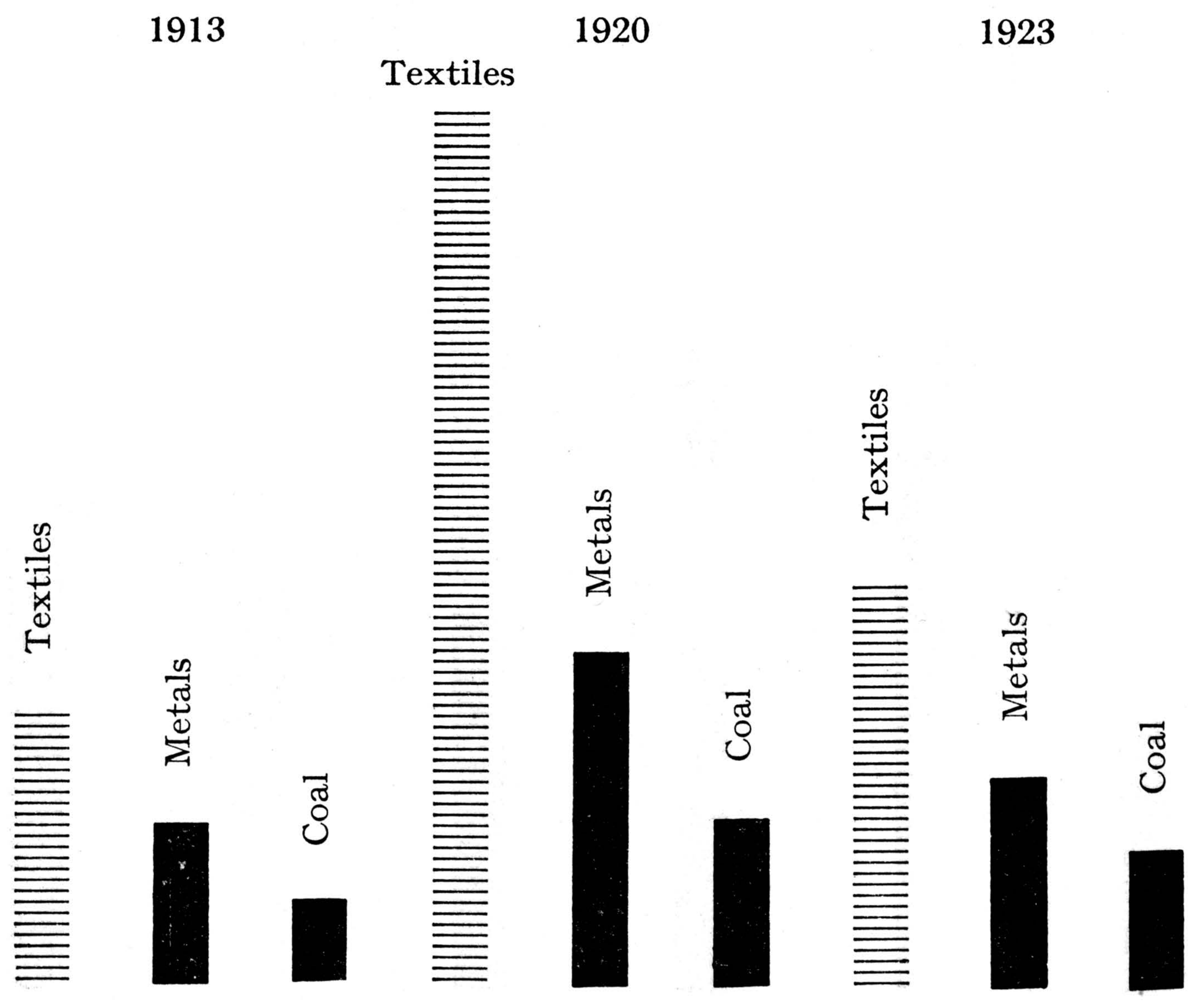
In 1913 the total value of all exported manufactures from this country was £414,000,000, of which textiles contributed £201,000,000. During the post-war period this proportion has been even greater, rising in 1920 to as high as 60% of the total. In both 1920 and 1921 our textile exports were between five and six times, and are now almost four times, the value of our exports in coal.

During the year 1923, in which our total exports of manufactures were £580,000,000 in value, the textile industry was responsible for £292,000,000, and during the first four months of this year that proportion has been well maintained, the figures being £104,000,000 out of £196,500,000. In quoting these figures from the Board of Trade Returns, we should, however, bear in mind that there are such things as unremunerative sales and bad debts, for these two factors during the past few years have heavily discounted the results of our export textile business.

When we compare textiles, not only with the total of all other exported manufactures but with the other great groups of industries, their relative importance becomes all the more marked. Diagram II. and Table II. (Appendix) in more detail set out the comparisons. The value during 1923 of our exports

Diagram II.

Textile Exports compared with Metal Exports and Coal Exports



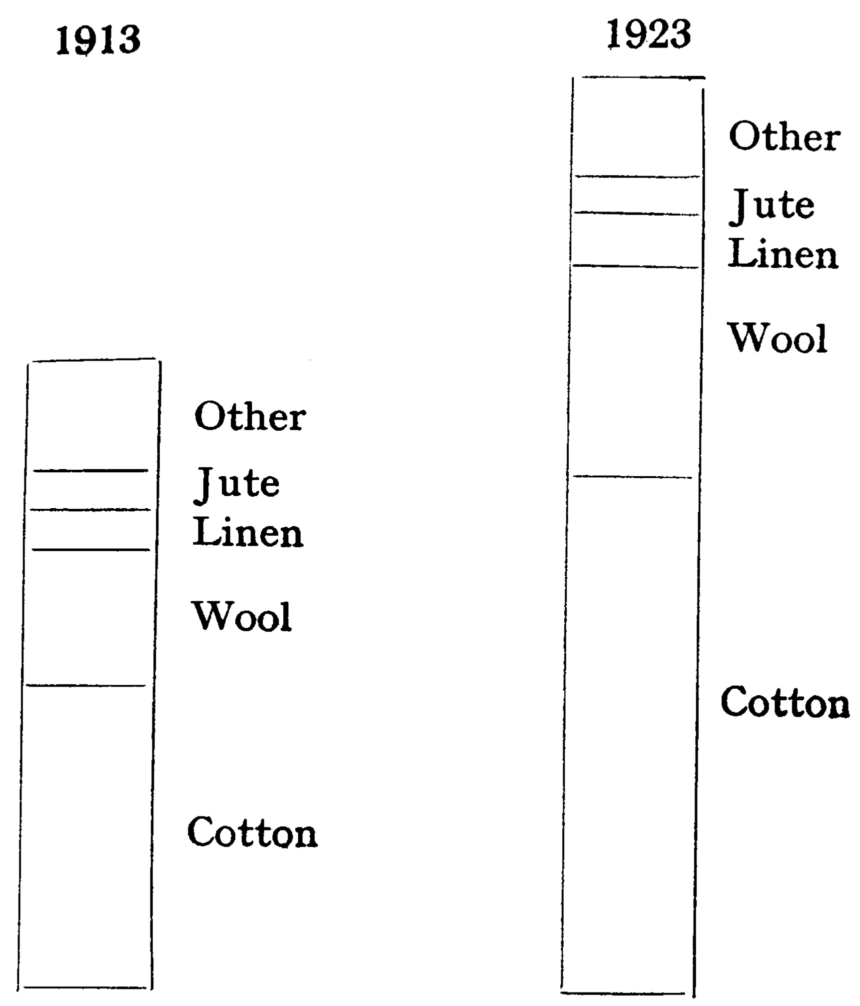
of coal and all other fuel was £110,000,000, and our combined exports of iron and steel and non-ferrous metals, machinery, electrical equipment, cutlery and all other metal products did not exceed £153,000,000; whilst textiles, as mentioned above, exceeded £290,000,000. In other words, our textile exports during 1923 were almost three times the value of our coal exports, double the value of our iron, steel and non-ferrous metals and everything produced from them, and over three times the value of our combined exports of locomotives, ships and all vehicles, chemicals, pottery, oils and fats, leather and leather manufactures, paper, and rubber, these comprising all the main categories of our exports. During the first four months of this year textile exports have been an even higher proportion of the whole. It will be obvious therefore that an examination of the position regarding our textile exports is of first-class importance.

GENERAL FEATURES AND RELATIONS OF TEXTILE TRADES TO ONE ANOTHER

Before proceeding to examine the markets to which our textiles are exported, it will be useful to consider in brief outline the general features and relationships of the textile trades to one another.

DIAGRAM III.

DIFFERENT TEXTILE EXPORTS COMPARED IN VALUES



From Diagram III. and figures in Table III. (Appendix), it will be obvious that the cotton trade is first in importance, with the distinction that the bulk of its raw material has to be obtained from the United States, whilst in the case of the wool trade and other smaller, though by no means unimportant, industries, such as jute, the Empire is self-supporting.

It is more difficult to compare exports in quantities than in values, owing to the difficulty in arriving at a common denominator. It is, however, interesting to look at the relative amounts of cotton and wool piece goods (of the main categories) and yarns exported before and since the war as shown in the following figures, to which further reference will be made.

EXPORT OF COTTON AND WOOL GOODS

Quantities in Millions.

	1913	1919	1920	1921	1922	1923
Cotton, sq. yards	7,546	3,763	4,435	2,902	4,184	4,141
Wool, sq. yards	220	233	273	121	190	220
Cotton yarn, lbs.	210	163	147	145	202	145
Wool yarns	80	32	37	35	62	56

During the first four months of this year export of cotton piece goods was 1,482,700,000 sq. yards, compared with 1,396,200,000 for the similar period of 1923, and wool piece goods was 68,819,000, compared with 66,880,000 sq. yards. During the last few months, however, the tendency shown during the past year of the decline of worsted goods has been accentuated. From an export of 22,566,000 sq. yards during the first four months of 1923 the export for this year has dropped to 19,775,000 sq. yards. This decline in our worsted export trade is nothing new, but has been aggravated by the increasing of foreign tariffs. The decline during the ten years previous to the war was over 30%.

Cotton Goods

Before the war the value of our exports of cotton goods was about £126,000,000 per annum, equivalent to about 62% of the total value of all textiles exported. This proportion has been substantially maintained during the post-war period, although in quantity the pre-war square yardage of 7,546,000,000, valued at £98,000,000, had by 1923 been reduced by 3,400,000,000 sq. yards, although the value was £138,000,000. Lancashire has had to cut down its working week and its wages by one-half, and its costs of production are therefore higher than would otherwise be necessary. The increase of total cost with almost a 50% reduction in quantity is obviously accounted for mainly by the very high price of raw cotton, which is now, value for value, the most expensive fibre in the world. Whereas an undue increase in wool, silk or linen prices normally results in the substitution of the less expensive cotton, in the case of cotton at an abnormal price people are apt either to go without or to pay even a somewhat higher price for a superior article made from wool, silk or linen which gives relatively better value. Although at first glance the export position of cotton may appear relatively sound, the severe restriction of consumption resulting from the high price of the raw material is a very serious matter indeed for Lancashire, whose goods, unlike the productions of the woollen, silk and linen trades, are consumed for the most part by nations having the least purchasing power per head. Of our total production of cotton cloths, 75% to 80% is normally exported, and meets the great bulk of the world's import requirements.

Woollen Goods

When we come to wool textiles, I find a difficulty in nomenclature, as everyday terms often have a different significance when used in a technical sense. Further the classifications made in the trade returns, such as that between "woollen" and "worsted," is often unreliable, more especially, perhaps, where imports are concerned. I propose in general to use the terms "woollen" to include "worsted," unless it is necessary to particularise.

Before the war the export of woollen goods contributed £36,000,000, or 18% of the total value of our textile exports. During the post-war period this proportion has increased; in 1923 it was 22% of the total, or £63,000,000. During the first four months of 1924 woollen exports have jumped to 27% of the total.

Confusing Board of Trade Statistics.—Whilst the export of cotton goods has decreased in quantity almost by 50%, the quantity of woollens exported in spite of at least 10% reduction in output, owing to the reduced working week, is now practically on a par with the pre-war figure of 220,000,000 square yards, so far as can be estimated from the confusing figures now given in the trade returns, which before the war were given in terms of linear yards, and are now given as square yards. Whereas the difference between linear and square yards for cotton goods is almost negligible, in woollen goods the difference is as much as 33⅓%. It is therefore unfortunate that the Board of Trade returns, which give most carefully both the actual linear and square yardage for cotton goods for pre-war and post-war, should neglect to do this in the case of woollen goods, where the difference is of greater importance.

A closer co-operation between the trade, especially the merchanting section, and the officials of the Government Departments concerned, seems desirable to render these returns of greater utility. At the same time attention should be directed to other discrepancies. For example, by estimating from the Board of Trade yardage returns, it would appear that during 1923 imports of woollen goods into this country from France were about 25% of the pre-war amount. If, however, we look at the French export returns, which are given by weight and are comparable both for pre- and post-war years, we find that the quantity was over 90%. Such discrepancies render trade returns practically valueless for business or any other purposes. In any case we now have to arrive at our post-war and pre-war comparisons by estimation only.

The Importance of the Merchant.—Here I would remark that Government Departments and a large part of the public seem to imagine, quite erroneously, that the selling of goods overseas is part of the function of a producer of goods. The two functions have nothing necessarily in common. Quite apart from the important factor of finance, merchanting requires not only very special knowledge, organisation and experience, but can be and is better done from such a centre as London than from an industrial town in Yorkshire or Lancashire, and it would make for better administration if our merchants were more adequately and regularly consulted. To sell goods is often more difficult than to produce them, and it is British merchants to whom a very large part of the credit for our marvellous world position in the textile trade should be given. It is upon their efforts and facilities that our future trade depends.

Although the export trade in woollens is of great importance, a prosperous home trade is no less essential. The amount sold in the home market has, during the last two or three years, however, been much below the normal, and one cannot help but think that, apart from decreased purchasing power owing to trade depression, high distributive and retail costs and charges have something to do with the restriction of business, especially when we consider that for every extra 1s. per yard charged by the manufacturers less than 4s. is directly added to the cost of a suit or costume. In this connection we must, however, remember that labour charges constitute a much higher proportion of costs in the making-up stages than in cloth manufacture, and that Trade Boards are apt to be less elastic in meeting changing economic circumstances than results from direct negotiation between employers and employed in the textile industries.

Anyone acquainted with international statistics, and especially with the diversity of methods and units adopted by various countries in their trade returns, will appreciate the complexity of arriving at anything but the most approximate figure as to the total yardage exported by other countries.

I have, however, attempted to reduce the pre-war woollen cloth exports of Germany, Czecho-Slovakia, France, Belgium, Austria-Hungary, Poland and Italy to a common denominator, and I find the total figure is probably not more than 200 million square yards. Britain therefore is responsible for at least one-half of the world's exported woollen textiles, and, in value, a considerably higher proportion, owing to the superior quality of her productions.

The various subsidiary woollen trades cannot be treated in detail here, though it should be realised that our Empire markets take 75% of the exports of the carpet, flannel, blanket and rug industries.

Linen Goods

Of the remaining textile exports, linen comes first in importance, the pre-war export amounting to the value of £8,250,000. In 1920, the export increased to over £22,000,000, due mainly to the very high price of flax, but it is now on the level of approximately £11,750,000. Before the war the export to markets within the Empire was £1,360,000, and it is to-day about £1,650,000, the main market, however, being the United States, the export to which last year was almost £3,750,000.

Jute Goods

Of jute goods the export is now in value even less than before the war, the comparative figures being—1913, £5,340,000, and last year £5,060,000. As this product is used largely for packing goods, the Empire takes a relatively small proportion, about 10%, whilst Calcutta is, of course, an active competitor of Dundee.

Silk and Artificial Silk Goods

Of our exported silk goods, which during 1923 were of an approximate value of £2,600,000, compared with £2,160,000 pre-war, Empire markets now take about one-half, compared with less than one-third before the war, but this trade is being rapidly surpassed by **artificial silk,** the export of which is rapidly increasing, especially to countries within the Empire, and last year totalled almost £3,500,000, the quantities taken by the Empire being—

1921 ... £733,000. 1922 ... £1,695,000. 1923 ... £2,250,000.

Apparel, including Hosiery

Of made-up goods the export in value has increased from £21,000,000 in 1913 to £26,000,000 in 1923, which, of course, means a decline in quantity. Of this section, hosiery is the most interesting and important, its exports in value having increased two to three times, and with every indication of further expansion. Before the war, of its export of £2,600,000 over £2,000,000 was taken by Empire markets, but this proportion of 75% has now been reduced to two-thirds, the United States having become an increasingly growing market for knitted goods. The following table gives the figures for each year.

Hosiery Exports

In 000's £ Sterling.

-	1913	1919	1920	1921	1922	1923
Total	*2,638*	*4,801*	*8,971*	*3,862*	*6,078*	*6,153*
Of which to British Empire	2,028	1,302	5,282	2,162	3,985	4,000
Of which wool	*1,966*	*2,797*	*7,182*	*2,715*	*5,179*	*5,000*
Of which to British Empire	1,533	660	3,214	1,325	2,776	2,700

Yarns, Cotton and Wool

It is obvious that from the point of view of revenue and employment, this country would prefer to export piece goods rather than yarn, especially as competition of the piece goods from which our yarn exports are made is of itself a competitive factor, particularly on the Continent, and especially from Germany. It does, however, constitute an important and valuable trade. Our export yarn trade in cotton and wool is as follows—

	1913	1919	1920	1921	1922	1923
Cotton	£15,006,291	£33,907,909	£47,585,814	£23,924,879	£26,474,623	£21,011,911
Of which to British Empire	2,902,082	3,265,537	9,890,759	6,723,034	5,930,275	3,227,872
Of which to Germany ...	5,141,022	937,710	2,714,193	3,715,736	6,187,198	5,165,864
Wool	8,040,415	12,966,186	17,401,777	8,563,828	11,678,267	10,676,270
Of which to British Empire	818,779	1,450,783	3,588,925	1,770,120	2,996,142	—
Of which to Germany ...	4,314,291	438,217	2,072,112	2,104,160	2,770,307	2,031,752

Of the cotton yarns it will be seen that in 1922 just over 22% was taken by the Empire, which by 1923 had declined to 15%, India being by far the largest market, and Australia the only market to show any appreciable increase in quantity, her pre-war import of 1,445,600 lbs. having increased to 2,686,000 lbs. in 1922, whereas Canada's pre-war figure of 3,560,100 has now been reduced to 1,888,000 lbs. Germany took last year £5,165,864 worth of cotton yarns, against a total for the British Empire, including India, of £3,227,872, the yarns for Germany being more expensive than those shipped to India. Holland followed Germany very closely in 1922 by taking from us £5,206,477 worth of yarn, a proportion of which probably went to Germany, but this amount fell to £3,053,000 in 1923. Cotton yarn imports fell from 11½ million pounds to 7½ millions last year.

Of wool yarns the Empire has increased its proportionate takings from 10% to 25%, mainly owing to a heavy increase of imports into Australia. Although Germany may rapidly assume her pre-war position, when she took over 60% of our total wool yarn export, the exports to the Dominions given below are interesting, especially in view of the movement in Australia for the establishment of local manufacturing concerns—

		1913	1922
Wool yarn exported to Australia		1,705,300 lbs.	6,084,700 lbs.
	Value	£226,644	£1,698,954
,, ,, South Africa...		24,100 lbs.	651,200 lbs.
	Value	£3,800	£145,068
,, ,, New Zealand...		144,100 lbs.	544,800 lbs.
	Value	£20,650	£140,195
,, ,, Germany		43,354,200 lbs.	13,894,300 lbs.
	Value	£4,314,391	£2,770,307

It should be noted that our reduced export of yarns is partly at any rate compensated for by the reduced imports, which have fallen from 33 million lbs. in 1916 to 16 millions in 1923. We are paying now for one-half of the pre-war quantity approximately the same amount as we paid before the war, i.e., double the price.' It may be added that the Board of Trade figures of "woollen" and "worsted" yarns do not appear even approximately to reflect the true figures for each classification.

COST OF IMPORTED RAW MATERIAL

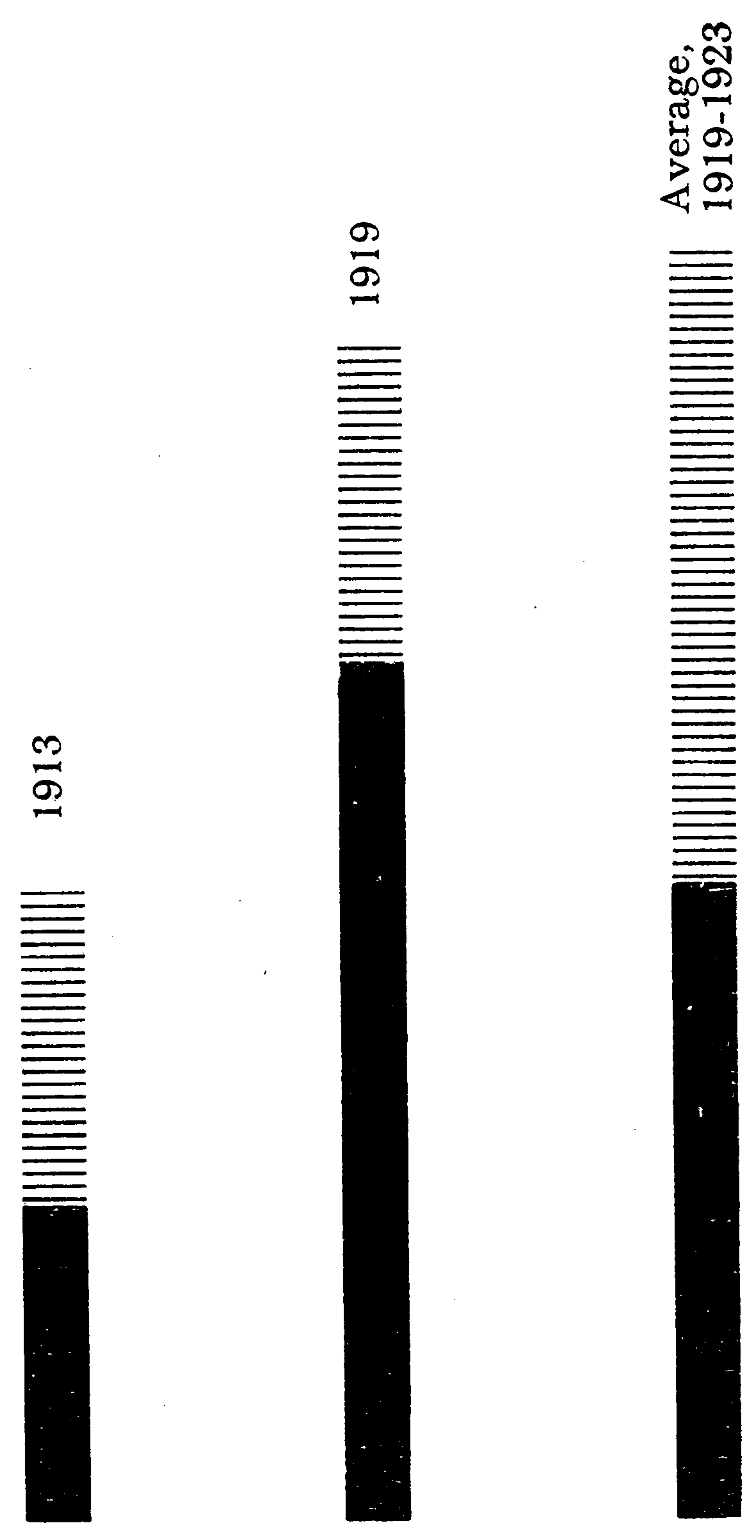
I have already referred to the detrimental effect, especially upon the cotton trade, of the high cost of raw cotton during the post-war period, as a result of which world consumption of finished goods has been considerably restricted, for it must be remembered that the cost of the raw material is by far the largest item in the cost of cloth production. Especially is this important in view of the fact that the great bulk of our raw cotton has to be obtained from the United States of America.

In the case of wool, over 80% of the import comes from the British Empire, and if we add to it the hole production approximately 90% of our wool consumption is actually obtained within the Empire, and of the finer wools the Empire has a virtual monopoly.

For jute we rely upon Indian supplies, and for such fibres as sisal for binder twine, our East African possessions provide the finest in the world.

DIAGRAM IV.

IMPORTED RAW MATERIAL RETAINED (SHADED) COMPARED WITH VALUE EXPORTED TEXTILE GOODS



Deductions from Import Figures

From Diagram IV. above and Tables III. and IV. in the Appendix one outstanding fact emerges. Before the war imported raw material for the textile trades retained for consumption was about £100,000,000, and the value of the exported finished or semi-finished goods £200,000,000, i.e., just about double.

It is obvious, of course, that in any given year the value of imported raw material retained does not necessarily bear a constant relation either to the value of the production or the finished goods exported during the same period. It is interesting to note that during the post-war period (five years) the value of retained raw material was £1,044,000,000, or a yearly average of £209,000,000, and the value of the finished articles exported during the same period £2,087,000,000, or a yearly average of £418,000,000, i.e., just about double as in a pre-war year. It will also be noted from the above figures that during the last three years the value of exported goods in relation to the value of the imported raw material has considerably increased, showing that home consumption of textiles during this period has declined. On the other hand, the import of foreign textiles, especially woollens, has increased, especially during the last six months. Here are the figures for the first four months of this year, compared with the same period of previous years of the import of wool cloths.

	1922		1923		1924
Import of wool cloths, sq. yds.	3,926,402	...	6,264,673	...	9,904,489

In relation to the pre-war imports of wool cloth, these imports, which include mainly dress goods, are small. The relatively large pre-war imports did not, however, disturb our manufacturing industry, for they were produced, quality for quality, at approximately our own level of cost, and were never more than 10% of our production. To-day the case is very different, our costs of converting wool into cloth being appreciably higher than Continental costs. The British consumer does not get the benefit of the lower cost of production of these imported goods, and the British producer reaps all the disadvantages. As I mentioned at the beginning of this paper, the full blast of Continental and especially German competition is in front of us.

OUR TEXTILE EXPORT MARKETS

The title of this paper concerns the textile shipping trade with special reference to the Empire. I do not consider that the present figures relating to our Empire markets, impressive as they undoubtedly are, adequately convey the importance, especially for the future, of these countries within the Empire to the textile trades of this country. They have to be viewed in relation to other questions, such as that of raw materials and the political relationships which, in international affairs, have so great an influence in economic life. Beyond, therefore, giving the table below showing the present actual importance of the British Empire as a market for our manufactured goods. I propose dealing with the matter of our export trade on its merits.

EXPORTS TO BRITISH EMPIRE COMPARED WITH TOTAL TEXTILE EXPORTS

(In Million £'s)

	1913		1919		1920		1921		1922		1923	
	Total.	To B.E.	Total.	To B.E.	Total.	To B.E.	Total.	To B.E.	Total.	To B.E.	Total.	To B.E.
Cotton pce. goods	98	51	179	62	316	153	137	71	142	71	138	62
Wool pce. goods	28	9	83	13	117	33	46	13	47	15	52	17
Carpets	1·15	1	2·3	·6	4·5	2	3·2	1·8	2·8	1·8	3·3	2
Hosiery	2·6	2	4·8	1·3	9	5·2	3·8	2·2	6	4·1	6·0	4
Linen	8·2	1·3	11·3	1·4	22	3	9·6	1	11·6	-1·6	11·7	1·6
Jute	5·3	·6	9·3	·9	13	·2	4	·5	·5	·4	5	·4
Silk	2·2	·7	3·7	·8	5·2	1·9	2·3	·8	2·3	1·3	2·6	1·2
Art. silk... ...	—	—	—	—	3	1·6	1·7	·7	2·6	1·7	3·5	2·3
	149	65	293	80	489	197	207	90	208	96	222	90
Percentage to British Empire		45%		27%		40%		43%		44%		40%

On page P456 I gave a table showing the total yardage both of cotton and woollen goods exported before and since the war, from which a very extraordinary comparison can be drawn. Whereas from a pre-war annual export of 7,500,000,000 sq. yards of cotton piece goods the 1923 export had fallen by as much as 3,400,000,000 sq. yards, the 1923 export of 220,000,000 sq. yards of woollen goods corresponded almost exactly with the quantity exported in 1913. In making this comparison with pre-war years we should not, of course, forget that during the last ten years the population has increased, and that, so far as woollen goods are concerned, the world consumption to-day is certainly greater than before the war. We are therefore not yet getting proportionately our pre-war share of the business, while France has increased her share. The following table gives the post-war export of cotton and of woollens compared with pre-war exports, expressing the pre-war figure as 100. This enables us to see at a glance the relative exports each year.

	1913	1919	1920	1921	1922	1923	1924 First four months only
Cottons	100	50	58	35	55	55	58
Woollens	100	98	122	55	86	100	103

We have to find some explanation of the discrepancy between the two trades, and I think this is found in the following factors—

The relatively higher price of cotton goods as compared with woollens has proportionately restricted consumption of cotton goods. People are even tempted to purchase linen, silk and woollen goods instead of cotton goods, the price of which, value for value, is less attractive.

The Far East and Indian markets for cottons, consuming pre-war one-half of our exports, have drastically reduced their takings. Unlike the woollen trade, the cotton industry has no great markets outside the Far East, but must rely upon those where the purchasing power of the masses is a low one, and can respond with great difficulty only to unduly high prices.

The large sale to this country of raw cotton enriches the American producer, whose Government then proceeds to restrict the entry to that market of our manufactures. On the other hand, the import of raw wool enriches the British Empire producer, whose Government and whose peoples give special facilities for the import of the British manufactured product. Further woollens, unlike cottons, are the staple textile requirement of countries of the highest purchasing capacity, whilst cottons are the staple textile requirement of countries with low average spending power. If we take India we find that her imports of cottons and woollens pre- and post-war are as follows—

British Textile Exports to India

	1913	1923	1923 as % of 1913
Cottons	2,434,000,000	1,633,000,000	67%
Woollens	21,489,000	4,944,000	23%

Before the war India was the second most important market for our woollen exports. In spite, however, of a reduction in her imports of British woollens from 21,500,000 sq. yards in 1913 to under 5,000,000 sq. yards in 1923, the woollen trade has been well able to make up the difference elsewhere. For the cotton trade the reduction from 2,500,000,000 sq. yards in 1913 to little over 1,500,000,000 in 1923 has been a disaster. The collapse of our cotton exports to the Far East has been on an even more disastrous scale than in India, the reduction being from 1,200,000,000 sq. yards in 1913 to 400,000,000 in 1923.

Strangely enough, however, the very opposite has taken place in woollen goods, the pre-war export of 29,250,000 sq. yards in 1913 to Japan and China having increased by 1923 to over 53,000,000 sq. yards. In the case of cotton, only one-third of the pre-war quantity, but for woollens an increase of one and three-quarter times, as the following figures show—

Cotton and Woollen Exports to China and Japan

	1913	1923	1923 as % of 1913
Cottons	1,183,600,000	413,000,000	34%
Woollens	29,230,000	53,146,000	180%

It must be remembered that during 1922 and 1923 raw wool was a very cheap commodity, in fact the cheapest fibre, and that the export figures which we have quoted are based on goods produced at prices probably at least 25% below present costs. This does not, however, by itself constitute a sufficiently good explanation, and I think it will be proved in course of time that the world, and especially the Far East, is now wearing a far higher proportion of wool than of cotton, and that a part of the disproportion between the two trades is a permanent feature. If this is to be cured it can only be done by a particularly attractive price level for cotton goods, and the exercise of the greatest ingenuity in producing and introducing new styles and designs and finishes of cloths. In addition to the factors I have mentioned, I would add two further factors of some importance. (1) The more developed state of the cotton industry in India and the Far East as compared with woollen production. So far as the lower grade of cotton manufacture is concerned, I doubt whether it is worth while even trying to recapture it. The future of Lancashire must depend more upon finished goods. (2) The great war demand for clothing was mainly for woollen goods. In proportion to its output, the cotton trade contributed very little to war requirements, although its use for explosives was of the utmost importance. As a result, at the end of the war stocks of cotton goods were very much greater than were stocks of woollens. After the war the Bombay Government took a census of cotton goods and found at least a year's supply, and I believe that to be true the world over, for its general results were confirmed by censuses of textile goods taken by the British Government. Consequently, when the shortage of raw cotton supplies forced the price of cotton sky high, merchants stopped or reduced their commitments for future deliveries, preferring to work hand to mouth on relatively low-priced stocks than commit themselves for delivery ahead on very high levels of value. As stocks diminish replenishment will become increasingly urgent, but the crucial factor will still be that of price. The abnormal raw cotton position is at the root of the difficulties of the cottton trade, and the only solution is the production of larger cotton supplies, if possible within the Empire.

The relative importance of different markets in respect of our cotton exports can be readily seen below—

In Million Sq. Yards	1913	1921	1922	1923
India	2,434	1,230	1,581	1,633
Far East	1,184	399	497	413
Levant and Balkans	734	378	369	397
South America	681	189	309	419
Europe	394	180	575	347
West Africa	234	139	187	207
Australia	167	115	228	171
Canada	110	18	42	54
U.S.A.	91	63	111	201
S. and E. Africa	80	65	101	109
New Zealand	42	17	33	38

Fluctuations of the Post-War Period

As mentioned before, the woollen trade has, to an extraordinary extent, maintained its volume of exports, the quantity being now approximately on a level with the pre-war figure. That does not mean to say that the situation is at all normal when measured by the pre-war position. I give below a short table showing the approximate percentage of goods (in sq. yards) taken by the chief markets before and since the war.

	1913	1919	1920	1921	1922	1923
British Empire	43	18	22	25	37	30
Europe	30	70	52	30	20	14
N. and S. America	21	8	16	25	25	31
Japan and China	6	4	10	20	18	25

Two notable facts emerge. Europe, which before the war took 30% of our woollen exports, in 1919 took up to 70%, and her imports from us have now scaled down gradually to 14%. The Far Eastern markets, from 6% before the war have gradually increased their takings to 25% for 1923, whilst for the first four months of 1924 China and Japan have doubled their imports in woollen goods from this country compared with the similar period of 1923. As between different markets, great variations have taken place during post-war years, but it has been remarkable how a falling off of the one market has been compensated for by the resuscitation of markets in other parts of the world. Unlike the cotton industry, which depends for its markets very largely upon particular countries, the woollen industry finds its markets throughout the world.

The conclusion of the armistice found Europe particularly denuded of textiles, whilst her great textile areas, for the most part curiously enough near frontiers devastated and ruined, were unable to meet the great and continuous demand for clothing. Germany's textile machinery was, however, intact, but dependent as she was for wool and jute upon the British Empire and upon Liverpool and America for cotton, she found, at any rate for a period, her entry to these raw material markets substantially barred, even if her internal political disorganisation had permitted her textile machinery to function fully.

The temporary reduction of Continental production gave an artificial fillip to the expansion of British textile exports to the Continent. World and Continental demand temporarily focussed on this country, and Great Britain poured goods into Europe to an extent never before known, and not likely to be repeated in the future. Never have any industries ever held such undisputed sway in the world markets as did our wool textile industry in 1919 and 1920, and the same is true to a lesser extent of cottons, as the following figures show—

	1913		1919	
Cottons, to Europe	519,000,000	sq. yds.	1,034,000,000	sq. yds.
Out of a total export of	7,075,000,000	,,	3,524,000,000	,,
Woollens, to Europe	55,000,000	,,	160,000,000	,,
Out of a total of	220,000,000	,,	220,000,000	,,

Forty-four per cent. in value of our cotton exports in 1919 went to Europe, and whereas before the war Europe had paid us for woollen goods £6,500,000, in 1919 the woollens we exported to her cost over £50,000,000. During the period 1919 and 1920 the whole world, and especially Europe, bought and over-traded to such an extent that an edifice was built up which was later to collapse like a pack of cards. The sudden and totally unprecedented slump in prices corresponded to the abnormal and unreasonable rise which had taken place. Europe's textile machinery is now appreciably greater than before the war and it is unlikely that Europe ever again will take from this country even the proportion of the textile requirements which she took before the war.

Russia—It is sometimes imagined that in spite of Europe's increased capacity to supply the bulk of her textile requirements from her own production, European import of woollens from this country will in any case increase owing to the great Russian demand. It is pointed out that Russia has a population greater even than that of the United States, and that no stocks exist in the country. This deduction entirely ignores the experience of the past and circumstances of the present. In pre-war years Russia was almost self-supporting so far as her textile requirements were concerned, and although Poland is now a separate nationality, we may take it that, by reason of her position and experience, she will still be an important supplier for Russia's textile needs when trade revives. Even assuming, however, that Russia's prosperity were now equal to her pre-war position, we have to remember that out of our pre-war export of 7,500,000,000 sq. yards of cottons Russia took direct only $3\frac{3}{4}$ millions of yards, or less than $\frac{1}{2}$%, whereas her indirect imports of British goods mainly through Germany were but an insignificant portion of the £2,000,000 of piece goods Germany took from Lancashire before the war. Before the war countries like Roumania, Spain, Sweden, Norway, Denmark and Greece each took larger quantities than Russia.

When we come to woollen goods, the position is much the same. Russia's import from us direct was less than 3%, and from Germany and Austria about the same proportion. The very factors that have caused Russia to be no longer self-productive constitute an obstacle to her paying for the goods she needs. As her agriculture revives, however, there will be a period when her import of textiles may be of some importance, but we shall have to be wary that when this revival takes place our European experience of 1919 is not repeated with even greater losses.

We now come to consider the main markets for woollen goods shown in the order of their pre-war importance, as follows—

CHIEF WOOLLEN EXPORT—PRE- AND POST-WAR

(In 000's Sq. Yards)

	1913	1923	% of Pre-war
Canada	31,656	28,884	90%
India	21,489	4,944	23%
Australia	20,670	18,505	90%
Argentine	15,302	15,155	100%
U.S.A.	15,210	17,363	114%
China	14,958	19,608	131%
Japan	14,272	33,538	235%
Germany	9,808	1,913	12%
France	9,113	3,278	36%
New Zealand	4,630	4,827	105%
South Africa	4,460	4,632	104%

It will be seen that by far the greatest increase has taken place in the Japanese and Chinese markets, and if we look at the first four months of 1924 and compare them with the same period of last year, we find that the Far Eastern imports have this year almost doubled. On the other hand, our exports to France, which last year were one-third of the pre-war figure, are now only 16%, whilst Germany is still insignificant. The British Empire as a whole shows a steady maintenance of its position, although Canada shows a reduction of something like 10%, and is this year reflecting some of the depression of the American market.

Apart from Europe, the most extraordinary falling off is that of India. although her woollen imports from this country in relation to her total imports are 52%, compared with 67% before the war, the difference being accounted for by increased proportionate imports from China and Japan.

In the Appendix will be found Tables V. to IX., showing the total imports into some of the British Empire markets. Whereas Australia in 1913 imported woollens to the total value of £2,146,000, of which £1,890,000, or 86%, were obtained from the United Kingdom, the latest returns showed that she is at present importing 97% of her woollen goods from the United Kingdom. In the case of New Zealand, woollen imports from this country were before the war 96%, and she is well maintaining this figure, whilst the percentage figures for South Africa are practically the same as for Australia. Canada's proportionate imports from this country are less than before the war, for she takes in the main medium class goods in the production of which other nations can readily compete with us, but our exports to her helped by the tariff are still 80% of the total.

Tariffs

I referred earlier in this paper to the disability with which the textile industries had to contend, owing not only to depreciated exchanges and lower wage costs, but to the systems of tariffs and restricted import licenses which deliberately bar the entry of our goods to markets abroad, and increase the work and difficulties of our exporters, besides raising prices and thereby restricting demand. It is true that British goods, owing to their excellence and to the great detailed knowledge and reputation which our merchants possess throughout the world, have successfully climbed most of the tariff barriers which have been set up, but undoubtedly this is a very serious factor which is increasing, not decreasing, in intensity, and which will have to be taken into account, although for obvious reasons I do not wish to enter into a controversy from which it seems political prejudice cannot be excluded. I will, however, give one instance which illustrates the point I wish to make. On referring to the trade returns, it will be found that over a period of years our export of worsted tissues has seriously decreased, and I give below the figures, dividing worsted tissues into "All Wool" and "Mixtures."

WORSTED TISSUES

(In 000's of Lineal Yards)

Triennial Averages	All Wool	Mixtures
1902-4	21,733	82,592
1905-7	22,830	78,768
1908-10	23,385	61,509
1911-13	22,239	46,808
Year 1922	26,371	23,498

It will be observed that in the "All-Wool" goods the position is satisfactory, and that we require to examine a little more closely the export of "Mixture" goods, of which the largest class was "stuffs, dress goods, linings, lastings &c." Our chief customer for these goods was the United States, to which the exports were as follows—

Triennial Averages	000's Lineal Yards
1902-4	22,380
1905-7	25,381
1908-10	18,735
1911-13	9,224

The increase in 1905-7 was due to the extremely heavy exports in 1905 (32,594,000 lineal yards), and the fall in the following triennium was caused by the unprecedented low exports (14,887,000 lineal yards) in 1908, a result of the financial crisis of 1907. The adverse tariffs of 1909 and 1913, and the more recent Fordney tariff, have practically destroyed this trade, leaving in 1922, 2,623,000 square yards of goods under 12 ozs. per square yard, and 1,122,000 square yards of lastings, altogether equivalent to about 2,996,000 lineal yards. This example gives some of the past history of the effect of tariffs from America. A detailed consideration of the French tariff (aided by the French exchange) will show very disquieting results unless we are content to scrap part of our textile industry in favour of some other trade less embarrassed by foreign tariffs, and it should be remembered that apart from the asset of the skill and experience of employers and workpeople, the fixed capital value of the industry is at least £300,000,000. Any consideration of the tariffs requires much detailed examination, and I merely add in the Appendix some information concerning the preferences given by the Dominions.

SUMMARY

I will now as briefly as possible sum up and draw certain conclusions which appear to me to be of practical importance to the future of our textile industry.

(1) The textile trade is our largest export industry. Before the war approximately 50% of the value of all manufactures exported from Great Britain consisted of textile goods (£201,000,000 out of £414,000,000), and since the war the proportion has been more than maintained (£292,000,000 out of £580,000,000 in 1923).

(2) Sixty per cent. of our textile exports (in value) consist of cotton goods (£177,000,000 out of £292,000,000), wool goods contributing approximately half of the difference (£63,000,000), and linen goods being next in importance with a value of about £12,000,000.

(3) Before the war the annual value of textile productions exported, viz., £200,000,000, was just double the value of the imported raw material retained for consumption, i.e., £100,000,000. During the post-war period (1919-1923) this relation has been maintained, the average annual cost of the imported raw material retained for consumption being £209,000,000, while the average annual value of textile productions exported was £418,000,000.

(4) During the post-war period world consumption of wool goods has at least equalled the pre-war quantity, whilst world consumption of cotton goods has decreased by almost 50%.
Wool piece goods exported from Great Britain both in 1913 and in 1923 amounted to approximately 220,000,000 sq. yards, of a value of £28,000,000 and £52,000,000 respectively, the price in 1923 being 86% higher than in 1913.
Cotton piece goods, on the other hand, exported in 1913 were approximately 7,500,000,000 sq. yards, and in 1923, 4,100,000,000 sq. yards, a reduction of 3,400,000,000 on the pre-war quantity, the comparative values being 1913, £98,000,000, 1923, £138,000,000, the price in 1923 being 160% higher than in 1913.

(5) The export of wool goods has been maintained in spite of a loss in export to India, Germany and France of over 30,000,000 sq. yards.

		1913	1923	*Decrease*
India	Sq. yards	21,500,000	4,900,000	16,600,000
Germany... ...	,,	10,000,000	1,900,000	8,100,000
France	,,	9,000,000	3,200,000	5,800,000
		40,500,000	10,000,000	30,500,000

This decrease has been offset mainly by an increase in exports to the Far East, China and Japan having taken 24,000,000 sq. yards more during 1923 than in 1913.

	1913	1923	*Increase*
China	14,900,000	19,600,000	4,700,000
Japan	14,300,000	33,600,000	19,300,000
	29,200,000	53,200,000	24,000,000

During the first four months of 1924 the exports to China and Japan have been double the quantity exported during the similar period of 1923, whilst the further decrease to France for the same period has been slightly more than compensated for by an increase in exports to India and Germany. Although the export of wool goods in bulk is well maintained compared with the pre-war figure, this has been at the expense of the worsted trade against the woollen industry. Whereas the exports of wool textiles during the first four months of this year show an increase on last year of 5,000,000 sq. yards, the worsted exports are down by about 3,000,000 sq. yards.

(6) The reduction in the quantity of cotton goods exported is accounted for largely by the failure of Lancashire's main markets in the Far East and India, where a decrease of 1,400,000,000 sq. yards has taken place without any compensating factor elsewhere.

	1913	1923	*Decrease*
India	2,400,000,000	1,600,000,000	800,000,000
Far East	1,200,000,000	400,000,000	800,000,000
	3,600,000,000	2,000,000,000	1,600,000,000

The decline in cotton piece goods imports has been general throughout practically all markets.

(7) A notable feature of the position is that in the Far Eastern markets, where the import of cotton textiles has received such an enormous check, wool textile imports have very greatly increased as compared with pre-war years. No general explanation, such as the internal dislocation of China or the reduced purchasing power of the peoples of the Far East can account adequately for this state of affairs. It would seem that the discrepancy between import of wool and cotton goods into the Far East results from—

(i.) The undue cost of cotton goods compared with other textiles. In other words, the difficulty in which Lancashire finds itself is due to inadequate supplies of raw material.

(ii.) A change in habit, as a result of which wool clothing is displacing to an increasing extent the use of cotton clothing. This factor is a very serious one for the cotton trade, for it has the element of permanence. The fact that the yellow and darker races of the world are increasing at double the rate of the white races may, however, become the all-important factor in the world demand for cotton cloths as against clothing made from wool and other fibres.

(iii.) The competition in the lower grades of cottons of Indian and Japanese industry. In all probability this section of the trade cannot be recaptured by Lancashire, and we must depend increasingly upon our finished goods, and incidentally reduce our finishing costs.

The solution of the difficulties in (i.) and (ii.) is one common to both, viz., a more attractive price for cotton goods, and therefore an increase of raw cotton production with a corresponding fall in price.

(8) Whereas in the cotton trade the reduction in exports is due very largely to the high price of the commodity and to a lesser degree only to the competition of protected textile industries in Lancashire's main markets, the difficulties of expansion in raw wool textile exports arises from competition from protected industries abroad.

The great increase of wealth and consumption of goods by the population of America, for example, is not reflected in her purchases of textiles from this country, owing to her excessive tariffs against textiles produced by us. Last year we bought from America over £80,000,000 of raw cotton for manufacturing purposes. It is true that this will ultimately be paid for by export of goods from this country, but they are not textile goods. The following example is one case demonstrating the effect of the American tariff on our export trade in mixed worsteds, the main market for which was the U.S.A. In 1905 the export to U.S. was 32,494,000 yards. The adverse tariffs of 1909 and 1913 gradually reduced it first to 18,735,000 yards and then to 9,224,000 yards. The recent imposition of the Fordney tariff completed the work of destruction by reducing the export in 1922 to 2,996,000 yards.

The ideal conditions for expansion of our textile trades would be new countries with large raw material and food resources in which industrial development was subsidiary to raw material production, selling their products to us, and in exchange giving us special facilities for disposing of our manufactured goods. These conditions are met by our Dominions overseas.

(9) The Empire supplies us with the great bulk of our raw wool requirements, and gives every facility and preference to the import of manufactured textile goods from this country. Australia, with a population of only five and a half millions, compared with America, of a population of one hundred and ten millions, took from us 1,000,000 square yards more woollen goods in 1923 than was imported from us by America, a yearly average of over 40,000,000 sq. yards of cottons over the years 1922–23. Australia's textile imports from this country was about 97% of her total. The same is substantially true of our other overseas Dominions, Canada with her comparatively small population of eight and three-quarter millions taking last year over 11,500,000 square yards of woollen goods more than our total exports to the U.S.A. New Zealand, with a population of little more than a million people, took before the war more textiles than the whole of Russia.

It is clear that unless we develop still further our relations with Dominion markets, not only of the export of manufactured textiles from this country, but of the import of raw material, and especially raw cotton, from them to us, our textile trade will fail to develop in proportion to the world consumption of textile goods. The crux of the matter is Empire production of raw materials, especially raw cotton, and a reduction of our dependence upon America, coupled with the closest possible trade relations between all communities within the Empire.

(10) Great Britain depends for its world trade upon the world-wide reputation of its goods and their intrinsic value. In technical skill, experience of its employers and workpeople, and in the magnificent organisation of its merchants, it is second to none among all textile industries of the world. In order to safeguard the future of this great and important industry, having an invested fixed capital of over £300,000,000, a cheap and sure supply of raw material is essential. Apart from foreign tariffs, the danger ahead of the woollen trade is an undue increase in the price of raw wool, which the statistical position undoubtedly seems to imply. The insuperable obstacle to the revival of the cotton trade is the high price of raw cotton owing to shortage of supply.

APPENDICES

TABLE I.—Export of Textiles Compared with all Manufactures from U.K.
(Million £'s)

	1913	1919	1920	1921	1922	1923
Total all manufactures ...	414	642	1,121	589	568	580
Of which textiles comprised ...	201	389	636	273	292	292
Percentage to total manufactures	48%	60%	57%	46%	51%	50%
Analysis of Textiles—						
Cottons	126	239	402	179	187	177
Woollens	36	96	135	55	58	63
Other textiles	18	30·4	50	21	24	26
Apparel	21	23·8	49	18	23	26

TABLE II.—Export of Textile Industry Compared with Other Industries

(Million £'s)

	1913	1919	1920	1921	1922	1923
Total textile exports	201,378	388,681	635,770	272,907	292,638	292,143
Coal	50,727	83,214	99,627	42,952	72,529	99,836
Cokes and other fuel	2,932	9,084	20,692	3,428	5,204	10,099
Total fuel	53,659	92,298	120,319	46,380	77,733	109,935
Iron and steel, and manufactures thereof	55,350	64,423	128,943	63,603	60,862	76,202
Non-ferrous metals and manufactures thereof	12,036	14,370	25,868	11,655	11,523	14,515
Cutlery, hardware, implements and instruments	7,129	7,945	13,611	9,002	6,426	7,415
Electrical goods and apparatus	5,386	5,708	11,604	13,040	7,318	10,226
Machinery	33,602	30,741	63,457	74,607	51,538	44,509
Total metals	113,503	123,187	243,483	171,907	137,667	152,867
Vehicles (including locomotives, ships, aircraft &c.), total ...	24,508	13,903	60,165	58,204	49,504	27,780
Chemicals, drugs, dyes and colours	19,533	27,015	40,730	19,106	20,269	25,690
Earthenware, glass &c. ...	7,426	7,919	18,324	12,044	10,923	12,333
Oils, fats, resins	4,444	13,227	13,615	5,209	5,973	6,992
Leather and leather manufactures	5,279	7,146	11,672	4,727	5,119	5,766
Paper and cardboard	3,679	4,231	12,817	7,725	6,747	8,770
Rubber	3,088	7,352	11,549	4,652	4,999	5,280

TABLE III.—Export of Textile Goods

(In Million £'s)

	1913	1919	1920	1921	1922	1923
Total	201	389	639	273	293	292
Of which—						
Cottons=	126	239	402	179	187	177
Woollens=	36	96	135	55	58	63
Linen=	8	11	22	10	11	12
Jute=	5	9	13	4	5	5
Hosiery=	3	5	9	4	6	6
Silk=	2	4	5	2	2	3
Art. Silk=	—	—	3	2	3	4
Other textiles=	3	6	7	3	3	3
Apparel=	18	19	40	14	17	19

TABLE IV.—Import of Raw Materials

(In 000's £'s)

	1913	1919	1920	1921	1922	1923	4 months 1924
Cotton total ...	70,570	190,771	256,765	73,310	87,320	93,499	42,977
Of which from British Empire	1,932	57,336	71,276	22,808	27,686	8,933	4,530
Retained for consumption	61,427	179,361	223,078	65,052	81,904	86,189	38,446
Wool total	37,736	104,753	93,957	43,403	62,667	50,348	29,490
Of which from British Empire	29,145	101,743	78,001	38,660	54,785	42,890	13,856
Retained for consumption	24,152	81,211	58,421	24,145	35,943	20,386	15,634
Other fibres	14,200	20,300	32,000	10,800	13,300	11,500	5,535
Total raw materials (in millions) imported and retained ...	100	284	314	100	129	117	
Total textiles exported ... ... (Million £'s)	201	389	639	273	293	292	

	Pre-war (1912)	Post-war (5 years)	Post-war (Av. Yearly)
	£	£	£
Total imported raw materials	100,000,000	1,044,000,000	209,000,000
Total exported finished goods	200,000,000	2,087,000,000	418,000,000

TABLE V.—Australia

British Woollen Exports to Australia

	1913			1920		1921		1922		1923	
	1000 lin. yards	1000 sq. yards	%	1000 sq. yards	%	1000 sq. yards	%	1000 sq. yards	%	1000 sq. yards	%
Woollen tissue ...	9,668	12,891	9·1	10,694	5·7	7,025	9·0	17,047	15·0	13,944	9·2
Worsted tissue ...	6,223	7,779	9·9	4,477	5·75	2,215	5·4	5,081	8·1	4,561	7·25
Total ...	15,881	20,670	9·3	15,071	5·7	9,240	7·9	22,128	12·0	18,505	8·3

Australian Imports

	Year 1913	Year ended 30th June 1920	Year ended 30th June 1921	Year ended 30th June 1922	Year ended 30th June 1923
	Value £	Value £	Value £	Value £	Value £
Woollen Manufactures Textiles — Woollen Piece Goods— Total Imports ...	2,146,067	3,437,230	5,990,903	3,142,448	5,116,890
Of which from United Kindgom	1,821,389	3,331,081	5,702,073	3,053,588	Details not available
British percentage ...	86	97	95	97	—

TABLE VI.—New Zealand

British Woollen Exports to New Zealand

	1913			1920		1921		1922		1923	
	1000 lin. yards	1000 sq. yards	%	1000 sq. yards	%	1000 sq. yards	%	1000 sq. yards	%	1000 sq. yards	%
Woollen tissues ...	2,304	3,072	2·2	3,826	2·0	1,095	1·4	2,507	2·1	3,439	2·3
Worsted tissues ...	1,325	1,656	2·1	1,962	2·5	662	1·6	907	1·45	1,388	2·2
Total ...	3,629	4,728	2·15	5,788	2·2	1,757	1·5	3,414	1·85	4,827	2·3

New Zealand Imports

	1913	1920	1921	1922	1923
	Value £	Value £	Value £	Value £	Value £
Woollen Manufactures Piece Goods, Woollen, of pure or mixed wool—					
Total Imports ...	402,528	2,413,721	1,137,338	830,325	1,154,887
Of which from United Kingdom	385,145	2,335,726	1,111,685	793,337	Not available
British percentage ...	96	97	99	96	—

TABLE VII.—South Africa

British Woollen Exports to South Africa

	1913			1920		1921		1922		1923	
	1000 lin. yards	1000 sq. yards	%	1000 sq. yards	%	1000 sq. yards	%	1000 sq. yards	%	1000 sq. yards	%
Woollen tissues ...	1,715	2,287	1·9	3,252	1·75	1,598	2·0	2,893	2·4	3,854	2·6
Worsted tissues ...	1,635	2,044	2·6	1,440	1·9	874	2·15	972	1·55	778	1·2
Total ...	3,350	4,331	2·0	4,692	1·8	2,472	2·1	3,865	2·2	4,632	2·2

South African Imports

	1913		1920		1921		1922		1923 Jan. to Nov.	
	Quan.	Value £	Quan.	Value £	Quan.	Value £	Quan.	Value £	Quan.	Value £
Woollen Manufactures— Cloth and Piece Goods										
Total Imports	—	355,300	—	1,752,334	—	829,718	—	693,457	—	713,080
Of which from United Kingdom ...	—	314,848	—	1,720,893	—	775,179	—	669,639	—	Details not available
British percentage	—	88	—	98	—	98½	—	97	—	—

TABLE VIII.—Canada

British Woollen Exports to Canada

	1913			1920		1921		1922		1923	
	1000 lin. yards	1000 sq. yards	%	1000 sq. yards	%	1000 sq. yards	%	1000 sq. yards	%	1000 sq. yards	%
Woollen tissues ...	15,097	20,129	14·2	12,502	6·7	3,884	5·0	9,466	7·9	13,547	9·0
Worsted tissues ...	9,222	11,572	14·8	16,030	20·5	9,218	22·5	17,533	28·0	15,337	24·0
Total ...	24,319	31,701	14·0	28,532	11·6	13,102	11·2	26,999	14·7	28,874	13·6

Canadian Imports

	Year ended March 1914		Year ended March 1921		Year ended March 1922		Year ended March 1923		Nine months ending December 1923	
	Quan. yards	Value $	Quan. yards	Value $	Quan. yards	Value $	Quan. yards	Value $	Quan. yards	Value $
Woollen Manufactures—										
Wool Fabrics, woven ...	—	—	—	—	—	—	—	—	—	—
Wool Piece Goods	—	—	—	—	—	—	—	—	—	—
Felt Cloth (not otherwise provided for—										
Total imports ...	78,753	59,901	50,166	163,812	38,038	91,907	21,414	51,511	10,603	31,429
Of which from										
United Kingdom	15,676	17,163	25,465	78,318	16,036	50,038	3,370	9,682	1,357	5,058
United States	42,644	22,312	21,995	63,240	15,600	20,492	9,006	21,026	5,146	19,288
France ...	15,685	16,739	1,109	8,091	—	—	—	—	—	—
Belgium ...	—	—	—	—	—	—	9,020	20,757	4,100	7,083
Flannels, Plain, not Fancy—										
Total imports ...	901,226	154,449	845,656	493,842	643,294	295,404	1,063,164	479,867	1,186,001	548,690
Of which from										
United Kingd'm	792,052	128,947	826,089	483,173	630,267	289,498	1,048,832	473,572	1,164,106	539,804
Lustres &c.—										
Total imports ...	3,833,855	1,168,625	1,800,424	1,681,195	1,949,745	1,208,155	2,640,376	1,456,062	1,346,127	747,880
Of which from										
United Kingd'm	3,819,515	1,164,295	1,789,598	1,664,341	1,936,077	1,191,072	2,630,955	1,447,793	1,341,702	742,068
Overcoatings—										
Total imports ...	1,607,501	1,330,213	69,031	211,820	49,049	84,003	174,060	287,061	260,107	392,304
Of which from										
United Kingd'm	1,521,251	1,268,621	64,925	199,501	46,341	77,601	170,753	277,771	255,394	378,570
Worsteds and Serges, including Coatings										
Total imports ...	Included with Overcoatings for this year.		6,453,434	17,097,360	6,053,591	10,329,758	7,763,661	11,630,159	4,595,853	6,689,999
Of which from										
United Kingd'm			5,238,820	14,566,067	5,297,056	9,001,126	7,344,721	11,007,787	4,119,676	6,027,575
Tweeds—										
Total imports ...	2,150,353	1,284,616	2,585,883	5,378,147	1,925,303	2,448,274	3,568,098	3,551,511	3,131,319	3,015,554
Of which from										
United Kingd'm	2,083,728	1,252,765	2,139,688	4,513,330	1,706,666	2,072,431	3,479,248	3,414,791	3,094,873	2,941,338
Dress Goods &c. (not exceeding in weight 6 ozs. to the sq. yard, grey or unfinished, to be dyed or finished in Canada)—										
Total imports ...	616,419	194,938	4,921,659	5,808,510	3,917,642	1,834,304	5,132,410	2,157,075	3,607,217	1,750,047
Of which from										
United Kingd'm	603,425	190,462	4,757,529	5,418,919	3,783,880	1,719,411	4,839,382	1,938,349	2,907,874	1,337,866

TABLE IX.—British India

British Woollen Exports to India and Burmah

	1913			1920		1921		1922		1923	
	1000 lin. yards	1000 sq. yards	%	1000 sq. yards	%	1000 sq. yards	%	1000 sq. yards	%	1000 sq. yards	%
Woollen tissues ...	11,357	15,143	10·6	6,426	3·4	1,255	1·6	1,232	1·0	3,343	2·28
Worsted tissues ...	5,077	6,346	8·1	5,191	6·7	751	1·8	1,007	1·6	1,601	2·5
Total ...	16,434	21,489	9·7	11,617	4·6	2,006	1·7	2,239	1·2	4,944	2·35

Imports into India—Wool Manufactures, Piece Goods (1,000 yards)

	March 1913—1914	1920	1921	1922	1923
From United Kingdom ...	18,612	9,527	2,444	1,524	3,347
„ Germany	4,871	—	178	323	790
„ France	2,234	158	227	242	664
„ Austria-Hungary	260	—	—	—	—
„ Japan	2	876	183	311	520
„ Netherlands	295	134	32	33	82
Total Imports	27,329	10,829	3,132	2,779	6,486
Percentage British ...	67	88	78	55	52

For the period 1913–14 the fiscal year has been taken. The other columns give the figures for the respective calendar years.

APPENDIX A

STATEMENT SHOWING THE DUTIES LEVIABLE ON THE FOLLOWING TISSUES ON IMPORTATION INTO THE UNDERMENTIONED COUNTRIES.

CANADA

Cotton—Grey cotton fabrics and fabrics of flax, unbleached, not otherwise provided for—

British Pref. Tariff	12½% ad valorem.
General	25% ,,
Intermediate	20¼% ,,

White cotton fabrics and fabrics of flax, bleached, not otherwise provided for, tailors' hollands of linen and towelling of linen or cotton in the web, coloured or not—

British Pref. Tariff	15% ad valorem.
General	25% ,,
Intermediate	20¼% ,,

Fabrics of cotton or flax, printed, dyed or coloured, not otherwise provided for—

British Pref. Tariff	22½% ad valorem.
General	32½% ,,
Intermediate	25½% ,,

Cotton duck, grey or white, weighing over 8 ounces per sq. yard—

British Pref. Tariff	15% ad valorem.
General	20% ,,
Intermediate	17½% ,,

Manufactures of cotton, hemp or flax or of which cotton, hemp or flax is the component material of chief value, not otherwise provided for—

British Pref. Tariff	25% ad valorem.
General	35% ,,
Intermediate	27% ,,

Wool—Womens' and childrens' dress goods, coat linings, Italian cloths, alpacas, orleans, cashmeres, henriettas, serges, buntings, nuns' cloth, bengalines, whip cords, twills, plain or jacquards of similar fabrics, composed wholly or in part of wool, worsted, the hair of the camel, alpaca, goat or like animal, not exceeding in weight 6 ounces to the sq. yard, when imported in the grey or unfinished state for the purpose of being dyed or finished in Canada under regulations prescribed by the Minister of Customs—

British Pref. Tariff	15% ad valorem.
General	25% ,,
Intermediate	18·125% ,,

Fabrics, manufactures, weaving apparel and ready-made clothing, composed wholly or in part of wool, worsted, the hair of the goat or other like animal, not otherwise provided for, cloths, doeskins, cassimeres, tweeds, coatings, over-coatings and felt cloth, not otherwise provided for—

British Pref. Tariff	27½% ad valorem.
General	35% ,,
Intermediate	29·75% ,,

Wool and Cotton—Flannels, plain, not fancy; fabrics of wool or of wool and cotton, commonly described and sold as lustres, mohair, alpaca, and Italian linings—

British Pref. Tariff	20% ad valorem.
General	35% ,,
Intermediate	27% ,,

Artificial Silk and Cotton, or Wool—Artificial silk fabrics or artificial silk fabrics produced from a form of cellulose, obtained by chemical processes, or of which artificial silk or artificial fibre silk is the component material of chief value, not otherwise provided for—

British Pref. Tariff	17½% ad valorem.
General	35% ,,
Intermediate	32½% ,,

Manufactures of artificial silk or of artificial fibre silk produced from a form of cellulose, obtained by chemical processes, or of which artificial silk or artificial fibre silk is the component part of chief value—

British Pref. Tariff	30% ad valorem.
General	37½% ,,
Intermediate	35% ,,

General Notes—(1) Tissues of artificial silk and wool or cotton are dutiable as above, according to which material predominates in value.

(2) A reduction of 10% of the duty is allowed on goods subject to a rate of duty in excess of 15% ad valorem under the British Preferential Tariff on condition of direct shipment.

(3) A "sales" tax of 5% of the f.o.b. value plus amount of duty payable is levied on all importations by the following—

Users and retailers, unlicensed manufacturers, wholesalers and producers, licensed wholesalers, manufacturers and producers for their own use, and manufacturers of exempt goods.

INDIA

Silk piece goods	30% ad valorem.
Cotton piece goods	11% ,,
Woollen yarns, knitting wools and other manufactures of wool, including felt	15% ,,

Cotton and Woollen mixed tissues are not specially mentioned but would probably be included under the following heading—

All other sorts of yarns and textile fabrics not specially mentioned	15% ad valorem.
Artificial Silk and Cotton or Wool fabrics are not specially mentioned but would apparently also be dutiable under the previous heading	15% ,,
Flax, hemp and jute manufactures	15% ,,

SOUTH AFRICA

Piece goods made of *cotton*, hair or *wool*, or *mixtures thereof*—

British Pref. Tariff	12% ad valorem.
General	15% ,,

Fabrics of silk or *imitation silk* and those including silk or imitation silk, fabrics of textile materials not covered by the previous heading—

British Pref. Tariff	17% ad valorem.
General	20% ,,

AUSTRALIA

The following classifications are given in the Tariff Guide—

Cotton fabrics	Several headings are quoted below.
Wool fabrics	No. 105 F.
Wool and cotton fabrics	No. 105 F.
Artificial silk and wool fabrics	No. 105 F.
,, ,, cotton fabrics	No. 105 D.

Cotton—Cotton, linen and other piece goods, not elsewhere included, oil baize not containing wool—

British Pref. Tariff ... ... Free.
General ... ... 15% ad valorem.

Cotton piece goods, knitted, in tubular form—

(1) For the manufacture of goods other than apparel, as prescribed by Departmental bye-laws—

British Pref. Tariff ... ... Free.
General ... ... 15% ad valorem.

(2) Other—

British Pref. Tariff ... ... 20% ad valorem.
General ... ... 35% „

Piece goods, not elsewhere included, other than of wool or silk, suitable for human apparel or to be worn in connection with the human body, having on one or both sides a teased, treated, combed, fluffed or raised nap or surface in imitation of or resembling flannel in feel or appearance—

British Pref. Tariff ... ... Free.
General ... ... 15% ad valorem.

No. 105 (*D*)—Silk or containing silk, or having silk worked thereon, except piece goods enumerated in sub-item (F)—

British Pref. Tariff ... ... 15% ad valorem.
General ... ... 20% „

No. 105 (*F*)—Piece goods of wool or those containing wool, not elsewhere included—

British Pref. Tariff ... ... 30% ad valorem.
General ... ... 45% „

NEW ZEALAND

Cotton—Textile piece goods of cotton, linen, jute, hessian, hemp, other vegetable fibre or combinations of these materials with one another—

(1) Having thereon or therein patterns, devices, or designs which indicate that they are to be cut up—

British Pref. Tariff ... ... 20% ad valorem.
General ... ... 35% „

(2) So woven or marked as to indicate that they are to be cut up—

British Pref. Tariff ... ... 20% ad valorem.
General ... ... 35% „

(3) Not elsewhere included (including muslins of such qualities and patterns, as may be approved by the Minister), not being tucked, sewn or otherwise similarly worked—

British Pref. Tariff ... ... Free.
General ... ... 10% ad valorem.

Note—Textile piece goods included under the above heading, hemmed or whipped in lieu of a selvedge, shall not be deemed to be sewn or similarly worked.

Wool—Textile piece goods, including piece goods of wool or containing wool, not elsewhere included—

British Pref. Tariff ... ... 20% ad valorem.
General ... ... 35% „

Wool and Cotton—Union textiles, not elsewhere included, in the piece, the invoice price of which does not exceed that specified by the Minister when cut up and made into shirts, pyjamas or underclothing, under such conditions and regulations as the Minister may prescribe—

British Pref. Tariff ... ... Free.
General ... ... 10% ad valorem.

Note—Until otherwise notified by Ministers' Order, published in the *Gazette*, the invoice price above referred to shall be deemed to be 1/3d. per yard, and the conditions and regulations shall be those which were applicable under the Tariff of 1907 to union textiles, not otherwise enumerated, in the piece, the invoice price of which did not exceed 6d. per yard.

Artificial Silk and Cotton Fabrics—Textile piece goods, not elsewhere included, composed of silk, imitation silk (other than mercerised cotton), artificial silk, or of combinations of these with one another, or with any other material except wool or hair—

(1) Having thereon or therein patterns, devices or designs which indicate that they are to be cut up—

British Pref. Tariff	20% ad valorem.
General	35% ,,

(2) So woven or marked as to indicate that they are to be cut up—

British Pref. Tariff	20% ad valorem.
General	35% ,,

(3) Not elsewhere included, not being tucked, sewn or otherwise similarly worked—

British Pref. Tariff	10% ad valorem.
General	15% ,,

Artificial Silk and Wool Fabrics—Dutiable as woollen tissues.

General Note—A primage tax of 1% ad valorem is also levied.

APPENDIX B

SUPPLEMENTARY STATEMENT TO SHOW IMPORT DUTIES ON FABRICS ENTERING BRITISH DOMINIONS AND NOT COVERED BY PRINCIPAL STATEMENT.

CANADA

Stair linen, diaper of cotton or linen, uncoloured damask of linen or cotton in the piece, including uncoloured table cloth or napkins of linen or cotton—

British Pref. Tariff	20% ad valorem.
Intermediate	24¾% ,,
General	30% ,,

Jute and jute butts, jute cloth or jute canvas, as taken from the loom, not coloured, cropped, mangled, pressed, calendered, nor finished in any way, free.

Jute cloth or jute canvas uncoloured, not further finished than cropped, bleached, mangled or calendered—

British Pref. Tariff	7½% ad valorem.
General and Intermediate	10% ,,

Sail canvas of hemp or flax, when to be used for boat's and ship's sails	5% ad valorem.

Oiled silk and oiled cloth, and tape or other textile, india-rubbered, flocked or coated, not otherwise provided for—

British Pref. Tariff	20% ad valorem.
Intermediate	24¾% ,,
General	30% ,,

Felt, pressed, of all kinds, not filled or covered by or with any woven fabric—

British Pref. Tariff	15% ad valorem.
Intermediate	20¼% ,,
General	25% ,,

Prunella cloth of wool; bolting cloth not made up—

British Pref. Tariff	Free.
General	,,
Intermediate	,,

Manufactures of jute, not otherwise provided for—

British Pref. Tariff	15% ad valorem.
General	25% ,,
Intermediate	22½% ,,

Velvets, velveteens, silk velvets and plush (not over 24 ins. in width)—

British Pref. Tariff	17½% ad valorem.
General	20% ,,
Intermediate	35% ,,

Silk fabrics, not specially mentioned (not over 26 ins. in width)—

British Pref. Tariff	17½% ad valorem.
General	35% ,,
Intermediate	20% ,,

Plush and silk fabrics, not otherwise provided for—

British Pref. Tariff	17½% ad valorem.
Intermediate	29¼% ,,
General	35% ,,

Manufactures of silk or of which silk is the component part of chief value, not otherwise provided for—

British Pref. Tariff	30% ad valorem.
Intermediate	30% ,,
General	37½% ,,

Special reduced rates of duty are granted to cloth of specified kinds, when imported by manufacturers of certain products as prescribed by the Tariff. The notes on the general statement are applicable to the above.

NEW ZEALAND

Brattice cloth of jute or hessian—

British Pref. Tariff	Free.
General	10% ad valorem.

Oiled silk in the piece—

British Pref. Tariff	Free.
General	10% ad valorem.

Tailors' trimmings, viz., haircloth, plain or coloured imitation haircloth—

British Pref. Tariff	Free.
General	—

Waterproof material in the piece, having within or upon it a coating of india-rubber—

British Pref. Tariff	Free.
General	10% ad valorem.

Leather cloth and oil baize, plain or fancy, in the piece—

British Pref. Tariff	Free.
General	10% ad valorem.

Felt piece goods, not elsewhere included, not including felted textiles—

British Pref. Tariff	Free.
General	10% ad valorem.

All articles not elsewhere included, made of textile, felt, or other piece goods, or of any combination of the same, wholly or partly made up or manufactured, and not being apparel or clothing either wholly or partly made up—

British Pref. Tariff	20% ad valorem.
General	35% ,,

Headings exist in the tariff covering certain textile goods imported by manufacturers of certain products. A number of made-up articles are also specified by name in the tariff.

AUSTRALIA

Cotton and linen piece goods defined for cutting up for the manufacture of hemmed or hemstitched handkerchiefs, serviettes, table cloths, towels or window blinds, as prescribed by Departmental bye-laws—

British Pref. Tariff	5% ad valorem.
General	20% ,,

Velvets, velveteens, plushes, sealettes and cloths imitating furs, astrakhans, Italians containing wool, tucked linens or cottons—

British Pref. Tariff	15% ad valorem.
General	20% ,,

Haircloth and cloth of hair or hair and wool combined for lining apparel—

British Pref. Tariff	Free.
General	10% ad valorem.

Waterproofed cloth, prepared with rubber, oil or celluloid—

(1) Woollen or containing wool—

British Pref. Tariff	30% ad valorem.
General	45% ,,

(2) Silk or containing silk, but not containing wool—

British Pref. Tariff	20% ,,
General	30% ,,

(3) Leather cloth—

British Pref. Tariff	5% ,,
General	15% ,,

(4) Not elsewhere included—

British Pref. Tariff	15% ,,
General	25% ,,

Piece goods dutiable at a higher rate than that payable under this sub-item, imported for the manufacture of waterproofed piece goods, as prescribed by Departmental bye-laws—

British Pref. Tariff	10% ad valorem.
General	25% ,,

Canvas and duck, waterproofed by treatment with any substance—

British Pref. Tariff	15% ad valorem.
General	25% ,,

Canvas and duck, not elsewhere included—

British Pref. Tariff	Free.
General	15% ad valorem.

Special headings exist for materials for certain definite purposes, as also for made-up and partly made-up articles.

Customs Tariffs for Foreign Countries and the United States may be found on reference to the Board of Trade *Journal* for 27th December 1923 and 12th October 1922 respectively.

Discussion

The Chairman, in calling for discussion, said that they had listened to a most admirable address, and personally he would like to congratulate Mr. Hitchcock on his wonderful facility for figures. There were two ways of dealing with figures—one intelligent and the other not. Mr. Hitchcock had analysed in a masterly way the figures relating to our vast export trade in textiles. The speaker had been in textiles all his life, but he had learned that day for the first time the relative position which textiles bore to the other trades of this country. With regard to the question of preference he was prepared to believe that all in that room shared very much the same view. It was necessary to unite the Colonies to the Old Country if they were to get on at all. He had been all his life a Free Trader, but those of them who had travelled realised that there were limitations to Free Trade. He agreed with what Mr. Hitchcock had said about the necessity for intelligence. He did not care what textile industry was taken as an example, it was existing in this country as a result of brains. Take jute. For the last thirty years he had heard nothing but that Dundee had had its day and was going to be wiped out. Nevertheless, it managed to maintain its position and that was due to brains. With regard to Russia, again he was in agreement with Mr. Hitchcock. There was no money in Russia. The only point on which he found occasion to disagree with Mr. Hitchcock was with regard to what he had said about the Board of Trade. If he found that the Board of Trade did not submit figures in the way in which they should be submitted, it was probably the traders themselves and not the department which were to blame. He was confident as a result of his own experience of communications with the Board of Trade that if the manufacturers wished to have the figures put in a certain form and submitted their plan to the Board of Trade they would receive every consideration.

Captain S. E. J. Brady said that at the Board of Trade some difficulty was experienced in obtaining figures from the manufacturers. Probably the fact was that the manufacturers, after their wartime experience, were sick to death of filling up forms. But the disadvantage was apparent. Only recently three of the leading people in the woollen trade had realised suddenly that there were no statistics available for the woollen trade. These suggestions for a new statistical basis must come from the trade itself, and so far as he was aware no suggestions had been received at all. He was pleased to find that Bradford had taken the initiative in discussing the question of classification, and he instanced certain errors in classification hitherto existing, as, for instance, the inclusion of worsted under woollen tissues. If the merchants cared to approach the Board of Trade and say which type of statistics they preferred, and what headings there should be, he was certain that the Board of Trade would give them every consideration and would welcome any suggestion.

The President (Mr. John Emsley, J.P.) said that he must declare himself strongly against any policy which would have the effect of raising the cost of production, because with every such increased cost there would be a smaller chance of selling goods in foreign countries than there was at the present time. Britain had built up her reputation upon honesty in dealing and excellence of product, and what she had already done she could do again. In this country they had gone through a crisis not equalled in any other country nor in any other period of history. They had experienced a great boom and a great slump. They had allowed the Government to regulate the procedure of their business, to tell them what to buy stuff at and what to sell it at, and the effects of this recent history were still being felt. They were still in the slough of despond, but they were gradually emerging once more into the sunshine. He spoke as a manufacturer, and what he would like Mr. Brady to do at the Board of Trade would be to say that it was imperative that returns should be made at least once a quarter by everybody that was in the trade, not under their names, but under numbers. This would not be secured by voluntary effort; it needed compulsion. If the Board of Trade demanded these returns the returns would be made. Every manufacturer, if they were demanded of him, would furnish all the figures required, and in that way a correct analysis of the trade of this country would be obtained. The worst section of the industry, on the wool side of it, had been men's wear. Mr. Hitchcock had stated that afternoon that there were no surpluses of material after the war had finished. But the fact was that as soon as signs of revival appeared the Government was able to bring out stocks from some quarter or other and undersell them again. He had been delighted to hear Mr. Hitchcock on the general subject of his paper. The exportation of our manufactured articles was the lifeblood of this country. We could not live in this country by producing only what we ourselves consumed. If we could not export the stuff we made here, then our operations could not be maintained. Recently at Bradford a delegation from a Continental Chamber of Commerce was received, and the thing was talked over fairly and squarely. One of the members of that delegation said, "Your salvation is in your wonderful system of exportation. We cannot get an organisation together such as you have got." It had been said that America had cut us out. Certainly America had had the ball at her feet. When we in this country were engaged up to the hilt making clothing for the soldiers we were not in a position to keep our export trade open. The Americans and the Japanese might have had it all their own way, but the fact was that they wanted to get rich too quickly and they did not deliver quality. We were now getting back our trade through honest reputation. We were an exporting country and we should maintain our exports. Gradually we were getting back again to the old position, regaining our export trade; we had already regained the bulk of it, and we should still increase it. What we wanted in this country was a purchasing power among our own people and then trade would boom again. He wished to thank Mr. Hitchcock for his paper. It had brought to a conclusion a series of meetings unique in the history of the textile industry. The meeting had been held in the midst of an unprecedented Exhibition of imperial products, and among other things they had tried to show their overseas friends the vastness of the textile industry of this country. They must have felt in that Conference how interdependent one industry was upon another. They could not expect, for instance, their worsted industry to flourish if the engineering industry, the mining industry, the shipping industry were not prosperous also. We had to see the relative value of each one to the other. We had also to see that wages were relative to the services performed. He thought that the people in protected trades must come to see that every time they demanded shorter hours and more money for what they did they were penalising the men who were in trades not protected. There were questions needing very serious study and problems still awaiting solution, but to the extent that they were carefully thought out and the right policy acted upon, the industries would not only maintain their position in this country but would go up by leaps and bounds. He believed that the quality of products would improve. There were some wonderful brains in the service of industry in this country. When we started the war we were in some respects at the bottom of the poll; when we finished we were leading, and that lead would still be maintained. The Americans were going to take the money market away from us, but the Americans never managed it. It had been suggested that the pre-eminence in shipping would pass from Britain, but this, like other dire predictions, had been falsified. He begged those to whom he was speaking not to lose heart. Those concerned in the textile industries were going to try and raise them to the status of a profession, and the granting of the Charter to the Institute, which could not be long delayed, would make membership of the Institute carry the hall-mark of competence. Industry on its various sides was helping to make this the most civilised country in the world, understanding by civilisation not the making of money but the opportunity given to every citizen to develop a full and free and happy life.

Colonel McConnel, in endorsing the sentiments expressed by the President, said that it was one of the highest tributes to the Textile Institute that it had been able to inaugurate such a series of conferences, and of all the papers he had heard Mr. Hitchcock's had had the merit of putting before them figures and facts, generally considered extremely dry, in a most charming and attractive way, and they were very much indebted to him. The different problems which faced them were indeed tremendous. The President had hinted at the question of Free Trade versus Protection, a question which they carefully eliminated as a rule from their discussions. His own views on that question were quite well defined, but he would not trouble the meeting with them; he would only say that he thought the great policy which they ought to press forward was that of peace in the world. The lack of peace was the real secret of our troubles. In the cotton trade, for example, they were suffering more than in most other trades, chiefly because of the turmoil and uncertainty in the eastern and far eastern and other countries where cotton fabrics were so greatly used. With regard to India, he would like to hear what Mr. Hitchcock had to say on the great triangular trade argument. But if the world could only be got to be more peaceful and friendly, a solution of their difficulties would be in sight. With regard to the Colonies and Overseas Dominions, he felt that the Empire Exhibition in general, and the work that the Textile Institute had done in it in particular, must be of the greatest importance in this domain. The Textile Institute was not a local organisation; it embraced all our constituent nations and Colonies, in fact all parts of our great Empire, and everywhere within its influence it created the spirit of mutual helpfulness for which it stood.

Mr. Hitchcock, in replying on the discussion, said that he had no quarrel with Mr. Brady, but he would like to point out that the manufacturers of Bradford or anywhere else were not the people to give the necessary information with regard to the export trade. The Board of Trade had got to get rid of the idea that merchanting was carried on by manufacturers. He knew the difficulties of the Board of Trade, but he also knew the difficulties of the trade itself. More consultation was required between the people whose actual business it was to consider these particular problems. With regard to the President's remarks, the speaker fully agreed with him that anything which increased cost and therefore restricted consumption was bad for industry. For his own part he was not afraid of talking about Free Trade and Protection, because these were real issues in business to-day. The more they kept away from them in discussion the less useful the discussion became. It might well be argued that in our textile trade we had a capital of 350 millions sterling, and that if we diminished our exports because some other countries were manipulating tariffs we should lose to that extent the earning power of that invested capital. Therefore he thought the actual realities of the matter had best be faced. A remark had been made about surplus Government stocks. He could assure them that on the ground of quality and fineness those surplus stocks which were put on the market did not hurt them very much. One speaker had mentioned the question of the triangular trade with India. There were various kinds of reasons for lessened business from India, partly political, partly due to custom, but if the exports of India were examined it would be found that the triangular trade argument did not hold. Up to a certain point it was correct, but India must be regarded as below par, at any rate so far as the textile trade was concerned. He thanked the audience again for the kind attention which had been paid to his disjointed remarks.

A vote of thanks was accorded by acclamation.

Mr. J. D. Athey, General Secretary of the Textile Institute, said that he wished to acknowledge on behalf of the Council and officials of the Textile Institute, and on behalf of the General Committee which had had the arrangement of the Empire Conference, the debt they owed to all who had assisted in the promotion of this event. He would like also to add that no individual had done more than the Chairman of that afternoon, Mr. Wigglesworth, in helping forward the plans.

Mr. Wigglesworth testified to the pleasure it had given him to help the Institute forward. This meeting had been the first direct link between London and the producing districts in the North, and it had given him great satisfaction to have taken any part in the forging of that link.

The President expressed the thanks of the meeting to Mr. Wigglesworth for his conduct of the chair that afternoon, and said that although the audience had not been as large as might have been wished, the account of the proceedings would reach a much wider circle through the printed word.

This closed the Conference.

CONVERSAZIONE

On the evening of Thursday, 12th June, the Master, Wardens, and Court of Assistants of the Worshipful Company of Clothworkers entertained the members of the Institute and visitors to the Empire Textile Conference at a conversazione. Colonel Owen Willmer White, the Master, received the guests at eight o'clock in one of the Louis Seize drawing rooms, after which the company adjourned to the famous Livery Hall. An excellent musical programme was provided and opportunity was afforded to inspect the Company's gold and silver plate, including that presented by the famous diarist, Samuel Pepys, one time Master of the Company. At an interval in the musical programme, Mr. P. J. Neate, immediate Past Master of the Clothworkers' Company and a Vice-Chairman of the London Section of the Institute, read a most interesting paper on the history and work of the Company. After recounting its ancient powers and "governance" over all engaged in "art or mystery or mysteries whatsoever using the said art or mystery of cloth workers," he referred to the breaking down of the Guild system and pointed out that the Clothworkers' Company, in the last fifty years, was the only one of the twelve great City Companies to carry out the original idea of their foundations in that it followed the textile trade to Yorkshire, where its efforts to promote the welfare of the industry were so happily reflected in the great work of the Textile Department of Leeds University, which department the Company inaugurated and endowed.

The President of the Textile Institute, Mr. John Emsley, J.P., thanked the Company for their most kind hospitality, and the very pleasant evening terminated with the passing of a hearty vote of thanks to the hosts. About 350 ladies and gentlemen were in attendance as guests.

COMMUNICATIONS

To the Editor

Sir,—On page P245 of your July issue I am recorded as having inquired of Mr. Shimmin* how his figures compared with 1917 figures. What I really asked was how they compared with 1907 Census of Production figures. Will you kindly make the necessary correction in the bound report, as 1917 is, for obvious reasons, a valueless year to take for comparisons of this sort. I have now looked these figures up. Mr. Shimmin gives number of insured workers for 17 centres as 178,600. The *Labour Gazette* for July 1924 states that the estimated number of insured workers in July 1923 in the woollen and worsted industries of Great Britain and Northern Ireland was 273,330.

The Census of Production (1907) table is as follows—

	Under 18 Years of Age	Over 18 Years of Age	Total
England and Wales—			
Wage earners	51,056	172,345	223,401
Salaried persons	673	7,621	8,294
Total	51,729	179,966	231,695
Scotland—			
Wage earners	5,117	21,603	26,720
Salaried persons	109	1,036	1,145
Total	5,226	22,639	27,865
Ireland—			
Wage earners	924	3,333	4,257
Salaried persons	6	198	204
Total	930	3,531	4,461
United Kingdom—			
Wage earners	57,097	197,281	254,378
Salaried persons	788	8,855	9,643
Total	57,885	206,136	264,021

Although the Irish Free State is not included in the 1923 figures, it can be assumed to be comparatively small in view of the 1907 figures. We therefore have the following estimates—

1907 ... 264,021 workers (including salaried persons).
1923 ... 273,330 insured persons.

The Census of Production to be taken next year will be of further assistance in this connection.

Yours faithfully,

(*Signed*) S. E. J. BRADY.

Board of Trade,
Westminster, S.W.1,
31st July 1924.

* "Export Trade and Employment in the Woollen and Worsted Industry," by A. N. Shimmin, M.A.

To the Editor

Dear Sir,—I should like to point out an error on page P403 of the August Journal. In reporting my remarks after the conclusion of Mr. Elton's paper, you say, "Outside of India, Australia, on account of her climate, is the largest silk-rearing population in the British Empire." Please note that this should be the "largest silk-wearing population."

Yours faithfully,

London, 2nd September 1924. (Signed) B. LEWORTHY.

SURVEY OF THE TEXTILE FIBRES OF THE EMPIRE COLONIAL EXHIBITS AT WEMBLEY (iii.)

FIBRE EXHIBITS OF EAST AFRICA

The Sudan—This court, which has been included in the East African Pavilion, has a well arranged exhibit of cotton, including Egyptian, American, African-American and Native varieties. The methods of cultivation are illustrated and living cotton plants, bearing opened and partly opened bolls, add interest. Specimens of Lancashire yarns and fabrics made from Sudan cotton are also presented and may be contrasted with native-worked products. Mr. J. N. Cameron, of the Department of Agriculture, is very enthusiastic about the future prospects of cotton cultivation and is not afraid to predict, if the present tendency of Egyptian growers to forsake Sakellarides for Zagora and other inferior varieties continues, that Lancashire will have to look to the Sudan for her requirements of the finest Egyptian cotton. Perhaps the most important work in the history of cotton growing in the Sudan, and illustrated at Wembley, is the building of the great dam at Makwar, 170 miles south of Khartoum, which it is hoped to complete in time for the irrigation of the 1925–26 cotton crop. By that time, in the region between the Blue Nile and the White Nile, called the Gezira, there should be some 300,000 acres under cultivation, which, allowing for rotation and fallow years, would mean 100,000 acres of cotton every year, of which there are planted already 20,000 acres. Irrigation is at present provided by pumps and the results being obtained give splendid promise for the future of the area as a cotton producer. Only the best strains of Sakellarides, carefully selected by the Department and the Sudan Plantations Syndicate, are used in the Gezira, and the growing, which is undertaken on land owned by natives, is carefully superintended. Cultivation is carried out on a partnership system between the native owners, the Government (which arranges for the water supply and the allotment of land), and the Sudan Plantations Syndicate which undertakes the ploughing and ridging of the soil, supervises the cultivation, and markets the cotton on the natives' behalf. Although the initial yearly area of cotton aimed at in the Gezira is 100,000 acres, the dam actually commands 3,000,000 acres, which gives some idea of the potential cotton growing area in this district. The deltas of the Baraka and the Gash, at Tokar and Kassala respectively, are also important producers of Egyptian (Sakel) cotton. Tokar, in the Red Sea Province, grows 50,000 acres, yielding up to 207,000 kantars* seed-cotton, of a very fine spinning quality. An auction for the crop is held at Tokar under Government supervision, and all seed must be obtained through the Department of Agriculture. Kassala, which has suffered in the past through lack of transport facilities, has recently been linked up to Port Sudan through Thamiam by the railway, and there is an early possibility of a cotton area twice that of Tokar in the Gash delta. The cotton grown and the conditions of cultivation are similar to those of Tokar, except that there is no auction in the district.

* 1 Kantar=100 rotls (1 rotl=·99 lbs.).

For the future the Syndicate has undertaken the marketing and the crop will probably be shipped direct to Liverpool. At both Tokar and Kassala the area cultivated annually depends on the extent of the floods.

American cotton grown in the Northern Sudan is confined to certain small areas along the Nile bank north of Khartoum, chief among which are the Dongola and Berber Provinces. Lack of humidity in these districts renders them unsuitable for Egyptian cottons, and two varieties of American—Webber and what might be called Nyasaland-American—are the chief crops. Last year the total output was about 84,000 kantars (seed), the greater part of which was the Nyasaland type.

In the Central Sudan, where the rainfall is higher, rain-grown cotton is already past the experimental stage, the figures for the last two years on the Blue Nile being—1922–23, 4,500 kantars (seed); 1923–24, 33,000 kantars (seed). For the last quoted crop only 500 sacks of seed were distributed; for the present season there has been an issue of 3,500 sacks. Further south still, where the rainfall is heavier and more assured, in the Nuba mountains, the Upper Nile and Bahral Ghazel Provinces, the cultivation of rain-grown cotton has been successfully introduced among the Dinka, Nuer and Nuba (mountain) tribes. Although too much must not be expected of this experiment at first, there are indications which point to its success. There are already in the Sudan ginning plants at Suakim, Wadmedani, Port Sudan and Zeidab, while others are in the course of erection at Atbara and in the Gezira. The cotton exported last year amounted to 35,218,400 lbs., valued at £2,026,820.

Nyasaland—Photographs of cotton and sisal cultivation, together with samples of seed and ginned cotton, and prepared fibre form the textile interest in this section. Cotton is at present of primary interest, for it must not be forgotten that the variety "Nyasaland Upland" is one of the most successful African-American cottons yet evolved, as both Uganda and the Sudan have since decided. It has a staple of 1⅛ in. to 1¼ in. and usually fetches anything from 2d. to 2½d. a lb. more than American Fully Middling on the Liverpool market. Most of the cotton is grown by Europeans, as the price fluctuations bewilder and discourage the natives, but efforts are now being made to encourage the latter to take up cotton cultivation. Ratooning is forbidden by Government regulation, but in certain districts on the Lower River the date for uprooting and destroying the plants is postponed in order to allow the planters to take a second crop. In all districts, however, cotton is freshly planted every year. In 1923 the Empire Cotton Growing Corporation established Mr. Sampson with a small staff in the Protectorate to further the work of seed selection and the study of cotton pests, chief among which is the red boll-worm. Sisal cultivation was started by the British Central Africa Company, and since 1922 three other plantations have been devoted to this crop. Mauritius hemp has also been tried but proved a failure.

The following table shows roughly the development of these industries, the discrepancies between acreage and exports being due to the holding over of crops during seasons when bad prices obtained. The acreage table only takes account of land under European cultivation.

Year	Cotton		Other Fibres	
	Exports in lbs.	Acreage	Exports in lbs.	Acreage
1907	403,486	8,659	—	327
1912	3,237,555	23,755	140,692	837
1917	866,510	28,372	342,215	988
1922	2,227,674	26,545	1,129,476	2,716
1923	2,182,537	—	1,673,762	—

Tanganyika Territory—This country, formerly German East Africa, is represented at the Exhibition by Major G. G. Anderson. Specimens of sisal and native grown cotton, which are the crops of textile interest, are displayed in the section. Sisal was introduced by the Germans in 1893, when 1,000 bulbils were imported from Florida. What few of these survived the voyage, a very small proportion of the shipment, were sufficient to start the whole industry, and the same stock was later responsible for the great plantations in the Kenya Colony. Sisal is the chief export of Tanganyika to-day, 12,845 tons, worth £367,228, being exported last year, and its cultivation is almost altogether in the hands of European planters. A problem which is receiving attention at present is the treatment of land on which sisal growing has ceased for the time being and which is often allowed to remain fallow. Cotton is sometimes grown as an intermediate crop with young sisal, and it seems likely that this practice will gain ground. Up to the present, however, cotton, which is the fourth most valuable export, has been chiefly grown by natives in the districts Mwanza, Morogoro, the Rufiji Valley, Kilwa and Lindi. As the conditions vary considerably throughout these areas, it has been found impossible to lay down hard and fast rules for all districts regarding the dates for pulling and burning old plants after the harvest, but ratooning is generally prohibited. The Agricultural Officers distribute high-class seed free to native growers, superintend the sowing and cultivation, and conduct auction markets at which the crop is sold. The grower obtains a fair price and is paid in cash for his cotton on the same day that he brings it in, circumstances which have the best tendency to encourage his industry. Last year 1,469 tons were exported, which is an increase of 400% on the 1913 figure, and more than double that of 1922. What cotton has been produced in the past by Europeans has chiefly been grown by Greek planters, who favoured a poor variety of old stock, Uganda-Upland, and certain unsuitable Egyptian strains. There is fortunately a present tendency on the part of these growers to co-operate a little better with the Agricultural Department, and it is hoped that eventually they will take up the cultivation of improved and suitable strains under scientific conditions. Other fibres grown in Tanganyika are Ambari or Deccan hemp and Sunn hemp, both of which give better results with the light rainfall than a jute-yielding plant also known in the Territory.

Uganda—Thanks to Mr. T. D. Maitland, the Government botanist, who represents the Department of Agriculture at Wembley, the exhibit of fibres in the Uganda Court is second to none in the whole Exhibition. Some twenty different varieties are shown, all of which are indigenous to the country, with the exception of *Agavé sisalana* (sisal), *Fourcroya gigantea* (Mauritius hemp), and *Musa textilis* (Manila hemp) among the leaf fibres, and flax in the bast fibre group. All these four exotic plants thrive very well under the climate conditions which obtain over the greater part of the Protectorate, and if machinery for decorticating and scutching were available, a considerable export trade in these fibres might be quickly realised. All the specimens in the Court are hand prepared but present a sufficiently good appearance as far as cleanliness, colour, lustre, and strength are concerned to indicate that very satisfactory fibres for commercial purposes could be produced in Uganda. Several varieties of Hibiscus flourish, some of which (e.g. *Hibiscus rostellatus*, Guill et Perr) possess very soft and lustrous qualities which are not unlike those of flax. The *Sida urens*, Linn., is also comparable to flax, and fibre from certain varieties of both Hibiscus and Sida could be used in the manufacture of very fine fabrics. Other kinds of Hibiscus, such as *H. diversiifolius* and *H. cannabinus*, which partake more of the nature of Indian hemp, are used by natives in the manufacture of coarse sack cloth, ropes, cordage and fishing nets. Recent experiments of the Agricultural Department tend to prove that a finer fibre can be produced from these types when the plants are cut down and a "ratoon" crop taken. Other fibres of interest are the *Sesbania*, which, owing to its durability when subjected to long immersion in water, is used principally for the making of drag ropes and fishing nets; the *Musa ensete*, or Kitembe fibre, which is equal to Manila in strength but is unfortunately a non-suckering plant and therefore unable to compete with Manila in productivity; and Raphia, which is prepared from the epidermis and cuticle of the young leaves of the Raphia Palm and used as a tying material. Flax must still be regarded as an experimental crop and the samples which have reached this country up to the present have obviously had their value decreased by the primitive methods used in their preparation. The specimens displayed were grown on the Kakumiro Plantation in the Mubende District.

Cotton growing in Uganda has increased very quickly during the last few years and now ranks as the chief industry, an output of 35,218,400 lbs., worth £2,026,820, being recorded last year. Several varieties of seed, which the Department of Agriculture distributes free to the native growers, are in use, the most popular, apparently, being Webber and Nyasaland-American. A series of Uganda cottons grown on the experimental farm at Serere and samples of the ordinary crop from the Busoga District were valued in March this year by a standard based on April American Futures, being worth 16·50d. The ordinary crop was valued at 18·50d. and described as "bright and good colour. Staple full $1\frac{1}{8}$ in.," while the experimental crops from Sunflower No. 4, Nyasaland No. 21, and Webber, were returned as being worth 19·50d., 19·00d. and 19·25d. respectively. The native growers co-operate well with the Department of Agriculture in the endeavour to grow pure strains of cotton and combat insect pests, and the outlook for the industry is increasingly good. Uganda has provided all the cotton which is being used in the demonstrations of spinning processes in the Cotton Exhibit in the Palace of Industry.

Zanzibar—In this Court may be seen specimens of *Ananassa sativa*, known locally as pine-apple fibre, and baobab fibre, from which the natives make fishing twines. There is also an exhibit of coir yarns and fabrics, the latter made in the State prisons, where coir weaving is one of the chief industries. Coir is not exported in any great quantity, the total for last year being only 216 cwts., but a far greater amount is used in the country and much more would be available for export if any demand arose. This seems unlikely at present, although there is talk of coir being used as a substitute for horse-hair and also for the manufacture of bristles for brushes. Kapok is grown but not exported. Generally speaking, the cultivation of textile fibres plays a very small part in the industrial life of Zanzibar and perhaps would always be subservient to the growing of cloves, of which spice Zanzibar holds a world monopoly.

Kenya—In this Court there is a good show of both sisal and flax fibres. Sisal was originally introduced into the Colony from German East Africa (now Tanganyika Territory) in 1907, when bulbils were imported and planted at Punda Milia and Gazi. The following year the Germans put a prohibitive export duty on bulbils and suckers, probably to prevent the industry flourishing in British territory, but the Punda Milia plantation was well established and was able, soon after, to supply all the plants needed to start other plantations. In 1912, 2,500 cwts. of sisal were exported, and this export steadily increased until 1919, when 126,937 cwts. were recorded. Since then the drop in value from the controlled price of £99 per ton to from £36 to £46 per ton has had the effect of reducing the output, but planters are gradually getting back to pre-war costing and are making the crop pay at the lower prices. The practical use of the vegetable waste occasioned by the decortication of the leaves has not yet been exploited, but it is known that sisal juice contains saccharine and that alcohol could be made from it. East African sisal is better in quality than Mexican and is worth from £2 to £6 more a ton.

Altitudes of 6,000–8,000 feet are well suited to flax in Kenya, but the present tendency is to grow it at 7,500 feet and over only, where the fibre produced by dew retting is of excellent quality and wilt disease is almost unknown. All the operations of cultivating, sowing, reaping and scutching are carried on much in the same way as in Ireland, but there is no stream water retting. Apparently the temperature of the rivers is too low for the retting bacteria to carry out fermentation properly. Experiments with hot-water retting are now being carried out in the Colony and it is hoped by the use of this method, if successful, to improve the uniformity of the product and reduce the cost of its production.

Mauritius—A few years ago it was thought that Mauritius would eventually deserve serious consideration as a contributor to the world's supplies of textile fibres. *Fourcroya madagascariensis* and *F. gigantea,* which takes its trade name from that of the island, were cultivated on a large scale, and the fibre exported in 1913 amounted to as much as 57,334 cwts. Since the war, however, fibre cultivation has been almost entirely abandoned in favour of sugar, which is now the chief agricultural crop. In the Mauritius Court at Wembley, some good samples of hemp are shown, but it is obvious that the islanders have lost interest in what was once a most important product. In 1816 there were 4,600 acres of cotton in Mauritius, but it is doubtful if any is grown to-day. Experiments were made with Sea Island in 1905 and 1911, but the endeavour to introduce this crop came to naught. Several reasons for these failures were given, such as the unsuitability of the climate for young plants and the prevalence of insect pests and snails, but the real reason probably was that the whole energies of the agricultural population were being directed to the development of the sugar industry and that the cotton experiments were unwelcome.

SOUTH AFRICA: FIBRE PRODUCTION

The Union of South Africa has a most interesting exhibit of wools and mohair, with Capt. A. G. Michaelian, the principal sheep and wool expert of the Union, in charge. Outside the Pavilion, in an enclosure, are specimens of living Angora goats and Merino sheep, while inside, a wide range of wool samples, chiefly from last year's clip, illustrates the effect of the three main types of grazing land on the Merino fleeces they produce. The karroo, a semi-arid area with a somewhat low carrying capacity, is best suited to the production of strong wools, 60's–64's, as sheep bearing this quality are best able to resist the climatic conditions of the high altitudes. In the mixed-veld, or karroo and grass region, and the grass-veld, sheep for the finer types of wool are bred, the Bedford and Albany districts producing the highest spinning qualities. An excellent range of Cape tops, together with length analysis charts supplied by the Bradford Conditioning House, is displayed, while the results after each process of scouring and combing of S.A. wools, made plain by percentage yield charts dealing with each quality, are amply illustrated. Bales of wool, drawn at random from recent consignments shipped to London, help to justify Capt. Michaelian's conviction that the grading of Cape wools no longer deserves the opprobrium of past years. Farmers are yielding to the persuasion of the Government and employ skilled appraisers, who take charge of the shearing from start to finish and prevent mixing or adulteration. The formation of Wool Growers' Associations is also making much headway, while the efforts of the Sheep Division of the Department of Agriculture, which employs a number of itinerant wool experts, helps greatly to improve the education of the producer.

The late General Botha had a high opinion of the Union's prospects as a sheep-breeding country, and it was at his instigation that the Sheep Division was inaugurated, under General Enslin. Shortly after its foundation, it was decided to secure the services of an expert sheep breeder from New South Wales to act as chief adviser, and Mr. Charles Mallinson in due course accepted the Government's invitation. To him, in no small measure, is due the thanks of the South African sheep breeding community, for it was his advice, gained by some thirty odd years' experience of the industry in Australia and a first-hand knowledge of Bradford manufacturing conditions in addition, that started that development of wool growing in South Africa which has so altered the outlook for the worlds' supply. Since that time the Sheep Division has continued its far-sighted policy. The staff has been greatly augmented, chiefly by students, who are sent out to study Australian methods at the Technical College, Sydney, and on the most progressive sheep stations in N.S.W., and who return to act as travelling experts among the sheep farmers of the Union. The outlook for the future is promising and it is expert opinion which forecasts that the present Merino census of 28,000,000 should easily be doubled in the next twenty years. In the meantime grading and packing will receive more careful attention and, as the crop is almost entirely pure Merino, South African production promises to rank very high among the contributions to the wool requirements of this country.

The Union also produces about 75% of the world's total supply of mohair, which is considerably more than the Empire's requirements. Indeed, owing to the unstable prices which mohair has realised in recent years, there is a tendency among goat breeders to turn their attention to sheep farming with its more certain reward. Last year the total shipments of mohair from South Africa amounted to 26,000,000 lbs. (approx.), of which England took barely one-tenth. The industry originated with the importation, in 1838, of one ewe goat from Turkey with her ram lamb, and it was as a result of successful crossing of the latter with carefully selected white "boer," or native, ewes that the first experimenters were encouraged to continue their efforts to produce Angora types. Since then, although at long intervals, there have been several infusions of new Angora blood, and now although the best Turkish qualities of mohair are still superior to the South African, the quality of the latter is rapidly improving. A series of samples illustrating the manufacturing qualities of mohair from the top to the finished fabric are on view in the South African Pavilion and, as stated above, there is a pen of live goats attached to the exhibit.

The various cotton growing districts of the Union, chief among which are Natal and Zululand, the Rustenburg area and the Eastern Transvaal, are represented at Wembley by a central exhibit in the South African Pavilion. Various samples of seed-cotton are shown, including some Sea Island with which experiments are now being conducted, and a variety of American Upland which has proved very successful. The following table, which was compiled from the South African Department of Agriculture's statistics, illustrates how the average grade of cotton has improved in recent years.

Comparison of Grade	1922–23		1921–22		1920–21	
	Bales	%	Bales	%	Bales	%
$1\frac{1}{4}$ in. and above	216	4	—	—	—	—
$1\frac{3}{16}$,, ,,	1,096	$20\frac{1}{2}$	6	$\frac{1}{2}$	70	$3\frac{1}{2}$
$1\frac{1}{8}$,, ,,	2,308	$43\frac{1}{4}$	447	26	604	25
$1\frac{1}{16}$,, ,,	754	$14\frac{1}{4}$	228	13	680	29
1 ,, ,,	942	$17\frac{1}{2}$	1,014	59	970	41
$\frac{15}{16}$,, ,,	26	$\frac{1}{2}$	24	$1\frac{1}{2}$	39	$1\frac{1}{2}$
	5,342	100	1,719	100	2,363	100

N.B.—(i.) Small bales are reckoned as half bales.
(ii.) In 1922–23 there were two bales of Sea Island grown.

Last year a total crop of 6,044 running bales was recorded and it is expected that this number will be improved to 7,000 bales of 500 lbs. each during the present year. All cotton for export is graded by Government experts and the Department of Agriculture is actively encouraging the production of types suitable for Lancashire mills.

Southern Rhodesia—It was surprising to learn that the newly established Colony of Southern Rhodesia had 30,000 acres at present under cotton and was actively planning to increase that area. Mr. H. W. Taylor, who is the representative of the Agricultural Department at the Exhibition, has arranged an impressive exhibit of seed and ginned cotton, which compares very favourably with the displays of many of our more important cotton-growing colonies. Only one variety is encouraged, the Improved Bantock (staple $1\frac{1}{8}$ in.–$1\frac{1}{16}$ in.), which has proved itself not only suited to the varying conditions of the country but a very profitable crop. Most of the present cotton area enjoys comfortable proximity to the one railway, and it is reasonable to suppose that the future expansion of the industry depends to a great extent on the improvement of communications. All cotton grown in the territory is ginned at Salisbury, in plant owned and operated by Major A. O. Cooper, who deserves credit for the practical assistance he afforded the new industry at a time when the erection of a ginnery seemed a very speculative enterprise. Mr. Taylor was emphatically against any sweeping legislation which would prohibit ratoon crops, and explained that in certain of his areas cotton could not be profitably grown as an annual and should be allowed a second growth to assure the farmer an adequate return. All seed cotton is controlled by the authorities and the country is fairly free from pests, the cotton stainer and certain minor varieties of boll-worm causing the only apprehension in this direction. Yields are generally very good and up to 1,600 lbs. per acre have recently been picked over wide areas, 1,200 lbs. per acre being a common average. The Department of Agriculture has inaugurated a cotton station at Gatooma this year, and intends to keep up the standard of the present variety of cotton, at the same time experimenting with other types to find the most suitable for the country. Southern Rhodesian growers are not subsidised to produce cotton, but cheap labour is plentiful and the crop pays when sold in the open market.

(*To be concluded.*)

NOTES AND NOTICES

London Section Dinner

Attention is again drawn to this function of the London Section of the Institute. The dinner is for all members of the Institute, whether attached to the London Section or not and for their friends, which includes ladies. The date fixed is Friday, 10th October, and the dinner will be served at the Connaught Rooms, Kingsway, W.C.2. Tickets are 12s. 6d. each and members who will be in London on the date in question and desire to attend are asked to communicate immediately with the London Section Secretary at the Textile Institute, 38 Bloomsbury Square, W.C.1, stating number of tickets required, so that accommodation may be reserved.

Fellowships and Scholarships

The British Research Association for the Woollen and Worsted Industries announces the following awards for the year 1924-25—Research Fellowships have been granted to Mr. Robert Burgess, B.Sc., of Nottingham, to enable him to continue his research at the University College, Nottingham, on the bacteriology and mycology of wool; and to Mr. J. E. Nichols, B.Sc., of Edinburgh, to conduct research at the Animal Breeding Research Department of the University of Edinburgh on the relationships between the wool fibres of various breeds of sheep. An Advanced Scholarship has been granted to Mr. H. Maldwyn Williams, tenable at the Scottish Woollen Technical College, Galashiels.

The University of Leeds

The coming of age of the University of Leeds and the jubilee of its parent foundation, the Yorkshire College, are to be celebrated in fitting manner during the week commencing Monday, 15th December next. A preliminary draft of the programme of what is described as Celebration Week has been issued, and the Textile Institute has been invited to appoint one or two delegates. At a meeting of the Council of the Institute on the 17th September, it was decided to ask the President (Mr. John Emsley, J.P.) and the Chairman of Council (Mr. John Crompton, M.Sc.Tech.) to represent the Institute. The programme already referred to shows that extensive arrangements have been made for special receptions and meetings on each day of the week. The Court Dinner will be held at the Town Hall on the Monday evening. On the Tuesday evening there will be an official reception of delegates, congratulatory addresses, and conferment of Honorary Degrees on certain persons who have given distinguished service to the Yorkshire College and the University of Leeds, whilst in the evening there will be a presentation of a portrait to Sir Michael Sadler. There will be special lectures, and on Thursday, 18th December, there will be a visit on the part of the Lord Mayor of Leeds, members of the Council, and other representatives of the city. On the Friday, 19th December, there will be a visit by County and County Borough Councils of Yorkshire, and Education Committees, whilst the Old Students' Association will hold their Annual Dinner in the evening.

Empire Textile Conference

It is now hoped that the separate Official Report of the proceedings of the above-named Conference will be available during next month. So far as the Institute is concerned, the printed matter is complete, but delay has arisen in regard to the section covering the joint proceedings with the Faraday Society. We understand, however, that the printing of the Faraday Society's record is now well forward, and that the availability of the section, which will be added to the Institute's record and published in one complete volume, is not likely to be much further delayed.

Membership of the Textile Institute

At last meeting of the Council, the following were elected to membership—Harry G. Leigh, B.Sc., F.C.S., 46 Brent View Road, West Hendon, London, N.W.9 (assistant research chemist); Eldred F. Hitchcock, Messrs. Eldred Hitchcock & Partners, Ltd., 108a Cannon Street, London E.C. (wool and textile merchant and banker); Horace Hall, c/o Messrs. Henry Bond & Co. Ltd., 2 Hall Street, Manchester (cotton manufacturer); A. N. Goodbrand, 19 Victoria Street, Manchester (mechanical engineer); Ernest W. Tetley, Upwood House, Morton Banks, nr. Keighley (Head of Department of Textile Industries, Keighley Technical School); Frank Moc, Czecho-Slovakia (cotton spinner); and Professor Emil Heuser, Teltow-Seehof Bie, Berlin, Germany (Director of the Research Institute, Berlin).

Next Year's Institute Conference

At the September meeting of the Council of the Institute, the question of the *locale* of the 1925 Conference was discussed. To some extent, Conference arrangements for next year will depend upon circumstances connected with probable reconstruction of the organisation in view of the possibility of the securing of a Royal Charter of Incorporation. The application for Royal Charter is proceeding, and, notwithstanding apparent delay, the Council has been assured that everything possible has been done to expedite matters. The draft petition and Charter have already been submitted, and certain amendments suggested and agreed upon. Meantime the Institute is proceeding with its usual programme—hence the early consideration of next year's Conference arrangements. Two suggestions came before the Council—one for a visit to textile centres in France, and another that Glasgow might form a useful and convenient centre for a visit. The meeting favoured the latter suggestion, and Whitsun week was mentioned as a desirable time. Inquiries are to be pursued, and the whole matter will in due course receive further consideration.

Notices: Institute Meetings

Tuesday, 7th October — *Manchester*—2-0 p.m. Meeting of Publications Committee, at Institute.

Wednesday, 15th October — *Manchester*—2-45 p.m. Meeting of Institute Council, at Institute.

Lancashire Section

Friday, 10th October — *Manchester*—12-45 p.m. (Luncheon); 1-15 p.m., Address, "Overseas Markets," by Sir Edwin Stockton.

London Section

Monday, 6th October — *London*—5.45 p.m. Public Lecture on "Misdescription in the Textile Trades," by A. E. Garrett, B.Sc., F.C.S., at the Clothworkers' Hall, Mincing Lane, E.C.3.

Thursday, 16th October — *London*—5-45 p.m., Informal Lecture, "Follow-up Discussion to Public Lecture," by A. E. Garrett, B.Sc., F.C.S., at the Institute premises, 38 Bloomsbury Square, W.C.1.

Thursday, 30th October — *London*—7-0 p.m. Informal Lecture, "Fabrics Knitted from Artificial Silk," by R. Boettcher, at the Institute premises, 38 Bloomsbury Square, W.C.1.

Other Organisations—Notices of Meetings

Oldham Technical Association and Old Students' Union—

Saturday, 7th October — Lecture on "The Blending of Cotton," by B. Robinson, Esq., at 7-0 p.m., in the Municipal Technical School, Union Street.

Saturday, 25th October — Lecture on "Some Recent Experiments with Cutting Tools," by I. Hey, Esq., Hyde, at 7.0 p.m., in the Municipal Technical School, Union Street.

Burnley Textile Society—

Wednesday, 1st October	Lecture on "Export Trade and Some of Its Problems," by Sir Edwin Stockton, at 7.30 p.m., at Municipal College, Burnley.
Tuesday, 21st October	Lecture on "Faults in Cotton Yarns" (Illustrated by Lantern), by J. H. Dawson, Esq., Brierfield, at 7.30 p.m., in the Municipal College, Burnley.

Halifax Textile Society—

Wednesday, 15th October	"Gleanings from Balliol Conference," at the Imperial Café, Halifax.
Wednesday, 29th October	Lecture on "South American Wools," by H. Kenningham, Esq., Bradford, at the Imperial Café, Halifax.

Leicester Textile Society—

Friday, 10th October	Lecture on "The Problem of the World's Cotton Supply," by J. A. Todd, Esq., M.A., B.L., Liverpool, at 7-30 p.m., at the Rechabite Hall, Dover Street.
Friday, 31st October	Lecture on "Manufacture of Hosiery Needles," by Lawrence Lees, Redditch, at 7-30 p.m., at the Rechabite Hall, Dover Street.

Blackburn Textile Society—

Friday, 24th October	Lecture on "The Development of the East African Colonies and their value to Lancashire Trade" by Sir Sydney Henn, M.P. at 7.30 p.m., in the Assembly Hall, Public Halls, Northgate.

REVIEWS

The Journal of the Municipal College of Technology. Vol. II. (119 pp.). College of Technology, Manchester, 1924.

This volume is a record of investigations undertaken by members of the College during the period 1916–1922. Since, however, nearly all these investigations have been previously published in various journals, they are here recorded in abstract form only. The volume is therefore more valuable as an indication of the activities of the College than as a work of reference. The various papers included deal with mechanical and sanitary engineering, applied chemistry, textile industries and mathematics.

Investigations which are of interest to textile workers relate to the physical and chemical properties of cellulosic materials, the scouring, bleaching and dyeing of cotton yarns and fabrics, and the preparation and properties of oxidised cellulose. Other investigations relate to the preparation and constitution of dyestuffs and dyestuff intermediates. Animal fibres are not dealt with and those sections on mathematics and engineering do not refer to textile problems. It is interesting to note that the volume is printed in the Department of Printing and Photographic Technology of the College, but it is suggested that numbering of the papers and the inclusion of a full table of contents would be helpful to readers.

A. J. H.

Corrigenda

Professor Fr. Tobler informs us that the series of books on Bast Fibres, of which Schilling's "Faserstoffe des Pflanzenreiches" (see P281) is Vol. III., is issued by him personally, and not by the Sorau Research Institute for Bast Fibres; he is, however, the director of this Institute.

Professor P. Krais explains that his share in the production of the little Textil-Literatur Verzeichnis (P418) was merely to arrange material supplied by German booksellers on the occasion of the recent Dresden Textile Exhibition. The fact that the list of foreign books was so short is partly because catalogues from abroad are not regularly received in Germany.

Aniline and its Derivatives. By P. H. Groggins. B. S. Chapman & Hall, Ltd., London, 1924 (pp. vii. + 256, with 33 illustrations and diagrams. Price 18/– net.)

The so-called chemical engineer and the question of his training have been the subject of considerable discussion of late, so that the appearance of a book primarily intended for the student of chemical engineering, although of value also to the chemist or engineer already engaged in a works, is a matter of immediate interest.

The title "Aniline and Its Derivatives" is scarcely adequate to indicate the valuable and interesting nature of the contents, for the technique in the production of aniline has been utilised to introduce the reader to the business side of plant chemistry, and to present the application of the principles of chemical engineering as illustrated in a well-organised works. Consequently, a more detailed account of the contents is desirable.

The discovery of aniline and its significance to the development of the dye industry are dealt with in a brief introduction, and the nature of the reaction in the reduction of nitrobenzene with iron and a very limited quantity of hydrochloric acid is then discussed. This is followed by a practical outline of the manufacture and purification of aniline by this method from the point of view of equipment, feeding the charge, reduction, distillation and rectification of the crude product, whilst a chapter is devoted to a comparison of the efficiency and cost of the various processes available for separating aniline from the reducer charge. Ferrous chloride as reducing agent is next considered, and is followed by a description of the preparation of iron borings in the plant, together with operating tests for the various grades. The manufacture of nitrobenzene is outlined, together with a critical discussion of nitration acids and the nitration efficiencies of various types of machines. As the author truly remarks, "Production without profit attracts neither men nor money," so a chapter is devoted to a review of the factors affecting costs in production, the analysis of the cost sheet, sources of loss and the chemical budget, this being followed by a chapter dealing with the thermal factors in the reduction of nitrobenzene and the rectification of aniline. The prominence given to the question of aniline poisoning conveys a valuable warning, for not only does aniline exert an immediate poisonous action on the blood, but continued inhalation of the vapour has a much more insidious action, leading to malignant tumours of the bladder. The physical constants of aniline are next reviewed, the conclusion being drawn that the freezing point affords the best criterion of purity, whilst details for the examination and determination of the purity of commercial samples of aniline and nitrobenzene are given, together with tables of general chemical and physical data. Various other patented methods for the manufacture of aniline are described, but it is doubtful whether these could compete with the method of reduction using finely divided iron borings and ferrous chloride as a catalyst, with the exception of the continuous process in which steam, hydrogen and nitrobenzene vapour are blown over a suitable catalyst, such as nickel, at a temperature below the boiling point of nitrobenzene.

In turning to the derivatives of aniline, the author has not merely given details for their preparation, but as far as possible actually tested manufacturing operations are quoted, together with an indication of the commercial importance and fields of application of the various products. Derivatives dealt with in this manner are aniline hydrochloride; sulphanilic acid; diphenylamine, methyl- and ethylaniline, dimethyl- and dimethylaniline, ethylbenzylaniline, with notes on autoclave operations, and design and construction of autoclaves; acetanilide, *p*-nitroacetanilide, *p*-nitroaniline and *p*-phenylenediamine; quinone and hydroquinone; aminoazobenzene; Direct Fast Black EW; phenylglycine and indigotin. This section concludes with a description of the preparation of a number of derivatives used as accelerators in rubber manufacture, such as aniline sulphate, thiocarbanilide, *p*-nitrosodimethyl- and diethylaniline, quinoline, formanilide, diphenyl- and triphenylguanidine. Finally, the technical nature of the work is emphasised by a chapter dealing with the action of acids and alkalis on metals used in chemical operations.

It is, of course, American practice which is described throughout, but the critical manner in which the matter is dealt with from the commercial standpoint, coupled with the fact that the author has been assisted by numerous technical associates in the preparation of certain sections of the contents, makes this book a valuable addition to technical works on aromatic organic chemistry and one which can be recommended to all interested in the subject. F. M. R.

GENERAL ITEMS AND REPORTS

Investigations into the Nature of British Pedigree Wools

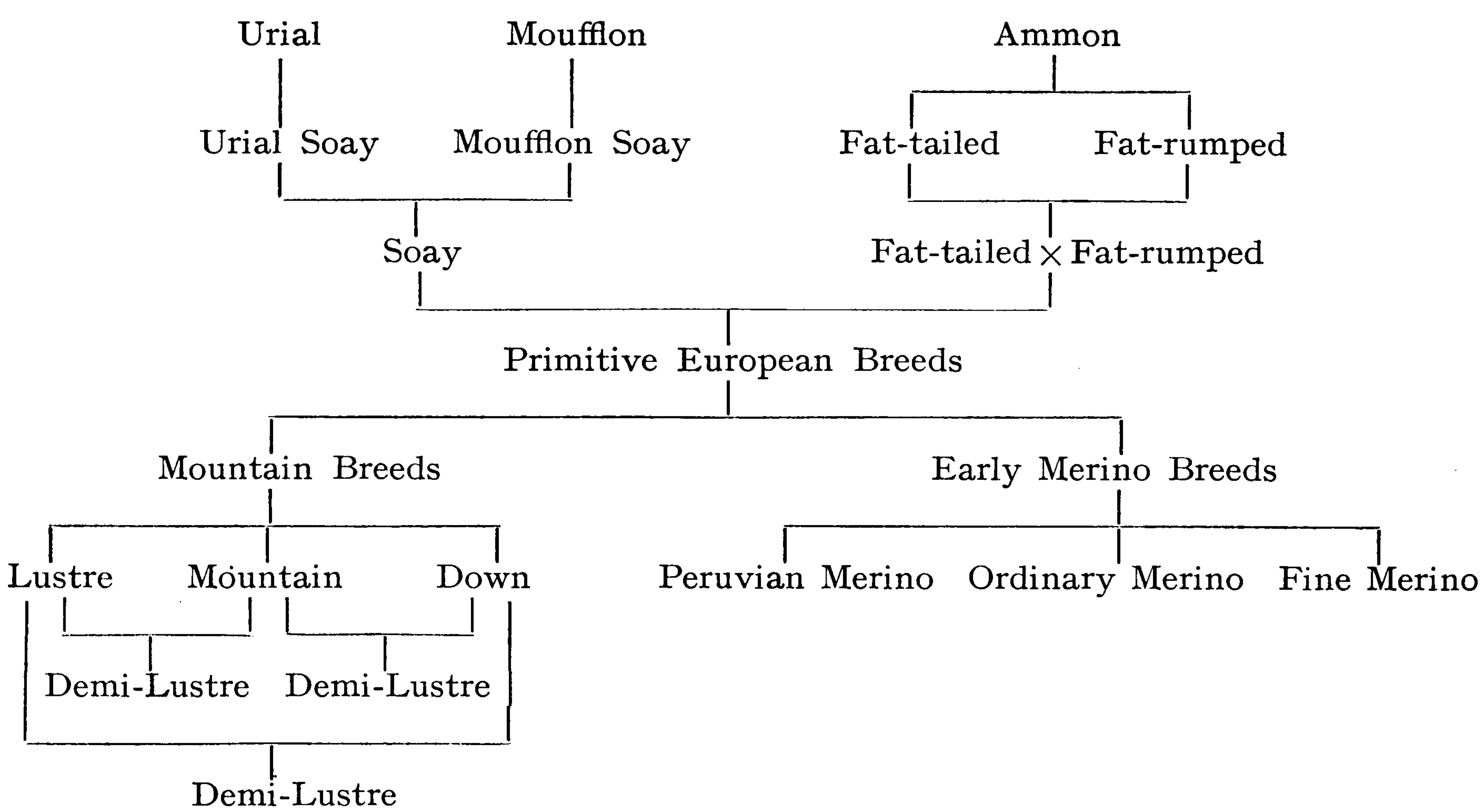
(*Continued from page* P424)

The Royal Agricultural Society's Show at Leicester in July afforded an opportunity to place before sheep breeders, merchants &c. the preliminary results of these investigations. An exhibition shed was placed at the disposal of the Textile Department, where a well-arranged display was set out by Professor Barker and his staff. The exhibit was planned on an easily comprehended scheme, and save in one or two minor details, could have been followed easily without demonstration, but in general, visitors, who numbered some thousands during the five days of the show, were conducted in small parties along the exhibit benches, either by Professor Barker himself or by one of his assistants. Thus a description of the exhibit will resolve itself into a record of the investigation so far as it has been carried to date.

The enumeration, origin and classification of the twenty-seven breeds of pedigree sheep whose wool has formed the basis of the investigations, was first set out for inspection. There are some thirty types of British sheep accepted as distinct breeds by authorities on the subject. Strictly speaking, certain of these breeds should be spoken of as crosses, but in view of the fact that such crosses present certain combinations of characters not present in either parent breed, and, further, breed true, the time has come when they should be accepted as distinct breeds—just as the stabilised cross between the Lincoln and the Merino in Australasia is now recognised as a distinct breed under the name "Corriedale." Thus the twenty-seven breeds referred to in the following text may all be taken as pedigree breeds of a reasonably fixed type.

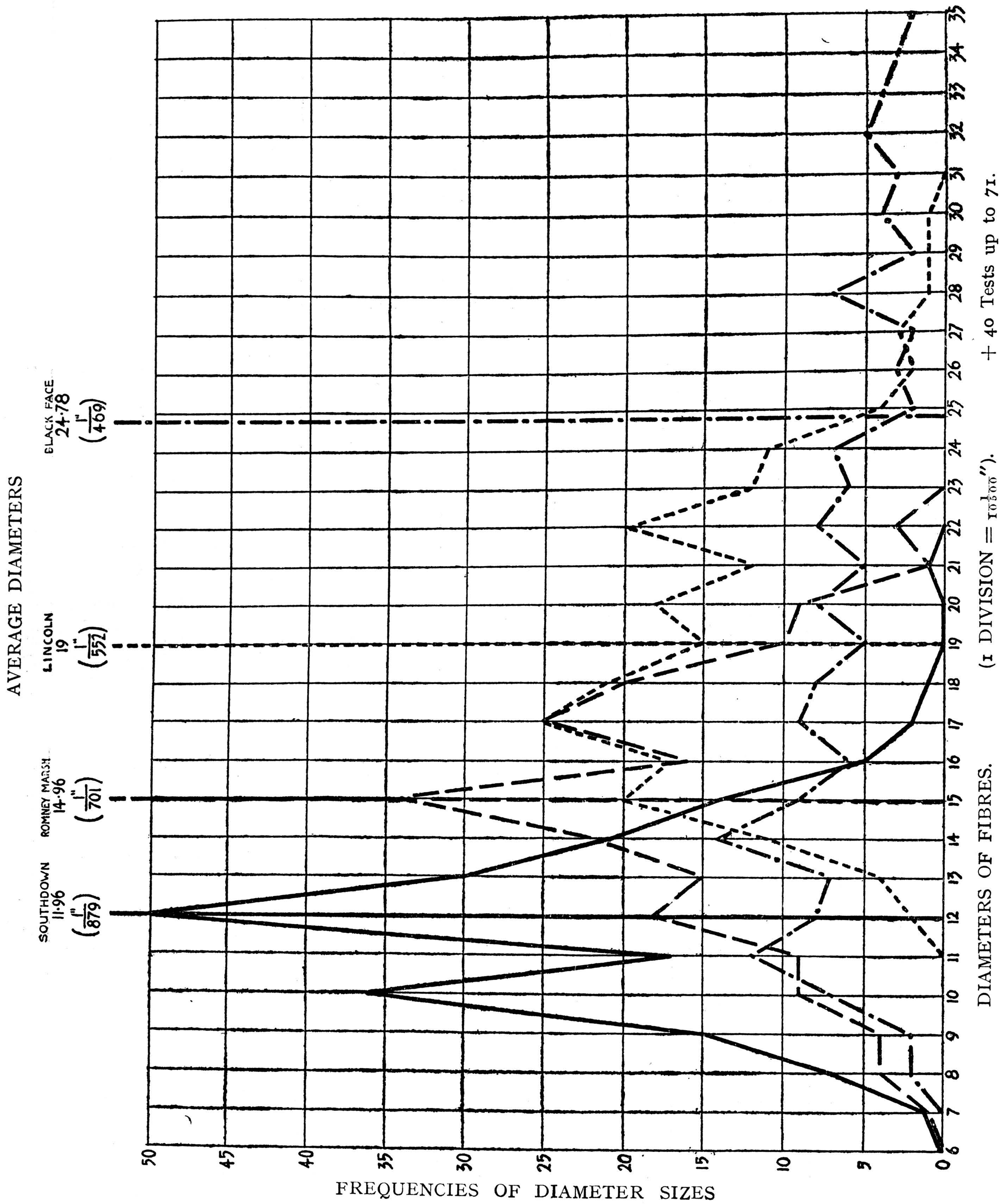
Authorities differ as to how they should be graphed. Following the line of evolution traced out by Professor J. Cossar Ewart, of Edinburgh University, and taking wool as a basis for grouping, Graph II. may be constructed. This graph was prominently displayed and illustrated by good photographs of the sheep mentioned. Though later discoveries may modify this scheme of evolution, and though as recently as 1913 other investigators, such as H. J. Elwes,* did not apparently know of Professor Ewart's theory of the origin of our domestic sheep, yet it is obvious that much weight attaches to Professor Ewart's scheme, since it is the outcome of much research and careful thought.

GRAPH II.—EVOLUTION OF THE DOMESTIC SHEEP.



* Guide to the Primitive Breeds of Sheep and Their Crosses on Exhibition at the Royal Agricultural Society's Show, Bristol, 1913, p. 23.

For further ease of comparison, the wools handled were divided into four classes—Mountain Wools, Lustre Wools, Demi-Lustre Wools and Down Wools. Display cards were on view with "staple" samples from the fleeces of representative mountain, lustre, demi-lustre and down breeds. The following table is a summary of useful particulars, compiled from a series of lists prepared from these investigations and published in the *Journal of Textile Science*, to which previous reference has been made (p. P423), and Graph III., kindly lent by Prof. Barker, presents diameter frequencies of four representative wools on the "frequency curve" basis.



Graph III.—DIAMETER FREQUENCIES (200) OF FOUR REPRESENTATIVE WOOLS

The weights and measurements of the fully-woolled representative skins given in the table are to be taken as approximate only. The fibre measurements are to be regarded, it is thought rightly, as of great importance, and taken class by class, the wools are arranged in order of average diameter. In each case 200 fibres were measured to arrive at the averages and to ensure representative results. It was pointed out that the relation between diameter and length in these fibres is not so consistent as in the case of merino wools. While dealing with these results,

Breeds	Flock Totals (where available)	Weight of Fleece	Yield of Scoured[3] Wool +16% Moisture	Proportion Top : Noil	Skins (Fully Woolled)				Fibre Measurements			
					Weight		Size		Average Diameter	Average Length	Average Waves per In.	Percentage of Black Fibre
							Length	Width				
		Lbs.			Lbs.	ozs.	Inches	Inches	Inches	Inches	Inches	%
MOUNTAIN BREEDS—												
Blackface	—	5 G.	92*	6 : 1	—		—	—	1/469	11·22	—	14
Herdwick	29,921	4 G.	87*	4 : 1	4	7	59	42	1/525	7·62	—	30
Welsh (White)	6,150	2½W.	80	9 : 1	4	3	49	37	1/592	3·67	4·6	0
Lonk	—	4 W.	67	9·3 : 1	5	8	55	38	1/620	6·72	3·65	12
Swaledale Dales... ...	—	3 G.	75*	4·3 : 1	5	12	62	42	1/675	7·70	—	18
Exmoor Horn[1]	—	8 G.	84*	17·7 : 1	6	7	49	45	1/692	3·81	6·95	0
Welsh (Black)	752	2½W.	70	5·6 : 1	2	8	44	36	1/749	4·02	5·45	96
LUSTRE BREEDS—												
Lincoln	43,848	10½W.	90	19·5 : 1	11	8	49	47	1/552	8·05	2·30	0‡
Devon Longwool ...	—	11 G.	94*	10 : 1	7	12	58	48	1/582	9·10	1·77	0
South Devon	—	—	78	12·3 : 1	—		—	—	1/594	10·95	3·55	—
Leicester	12,000[2]	9½W.	—	—	11	12	68	46	1/614	12·02	2·05	0
Dartmoor	5,000	7½ W.	76	12·5 : 1	10	4	60	40	1/642	11·15	1·75	1
Cotswold	—	10 W.	90	10 : 1	15	12	68	45	1/646	10·75	2·27	0
Wensleydale	2,874	8 W.	—	—	—		—	—	1/647	12·70	2·42	10
Border Leicester ...	—	8½W.	—	—	6	2	56	45	1/712	7·85	3·3	0
DEMI-LUSTRE BREEDS—												
Cheviot	—	7½G.	84*	11 : 1	6	7	49	41	1/681	4·70	5·80	2
Romney Marsh or Kent	29,460	6½W.	80	10·5 : 1	7	8	57	47	1/701	6·30	4·65	0‡
Half-bred Leicester ...	—	7 W.	76	16·8 : 1	11	2	60	46	1/703	6·10	4·80	1
Kerry Hill	—	6½W.	76	11·6 : 1	7	0	51	46	1/714	3·82	4·2	0
DOWN BREEDS—												
Dorest Down	33,500	5½–6 W.	76	14·3 : 1	6	8	58	45	1/651	2·90	6·0	0
Dorset Horn	47,452	6 W.	79	18·5 : 1	6	2	54	36	1/658	3·17	5·8	0‡
Oxford Down	33,550	7 W.	66	15·5 : 1	7	4	57	50	1/700	4·03	6·4	10
Suffolk Down	44,363	6 W.	55½†	11·2 : 1	5	4	53	45	1/723	3·95	7·1	8
Hampshire	120,363	7½G.	71*	13·3 : 1	—		—	—	1/737	3·70	7·6	7
Ryeland	—	7 W.	60	—	6	0	48	41	1/741	4·40	5·75	—
Shropshire	7,423	7 W.	78	12·5 : 1	5	12	50	40	1/817	2·50	6·1	3
Southdown	51,114[2]	6 W.	70	7·5 : 1	3	12	44	38	1/879	3·67	9·6	0

[1] May be ranked as Demi-lustre Wool. [2] Ewes only. [3] Lightly scoured. * Evidently Washed Wool. † Evidently Greasy Wool.
‡ Very clear of black fibres.

it is interesting to refer to Professor Barker's recently published article on "Wools and Wool Fibre Testing,"† in which average diameter figures were given for 56's Southdown and 36's Lincoln in comparison with 80's merino. The average figures then given of the British wools agreeing closely with those now arrived at and appearing in the table.

The woolled skins were displayed on the walls of the showroom, and were labelled to indicate their sorting qualities. The series of twenty-seven, arranged in the order given in the list of particulars above, enabled visitors to compare readily class by class or skin by skin. Below each skin was a photograph of a typical sheep of the breed, in one or two cases of the actual animal whose skin was on view. Below, on a sloping bench, were arranged the cloths woven on the scheme laid down in Graph I. (p. P424), so that beneath each skin were laid out five woollen cloths and five worsted cloths, two of each type being dyed. Each sample was labelled with a statement of the manner of preparation, viz., woollen cloth, scoured and dyed, or worsted cloth, milled and undyed &c. The ease with which not only could cloth with cloth of the same wool, but cloth with cloth of differing wools, be examined was admirable, as ample space, an essential for useful exhibition, was available. In addition, yarn for hosiery purposes prepared from each kind of wool was displayed beside the cloths, and finally an example of the hosiery yarn knitted into fabric was on view.

Opposite to the array of skins, yarns, and cloths were assembled the tabulated results, some of which have been given above, graphs of other results, and, lastly, the report of the Silk and Cotton Research Association's investigations referred to on page P424. Some of the results were not absolutely complete, as certain processes with one or two of the wools were still being carried out, but in the final section of this report it is hoped to publish all particulars as well as some of the suggestions arising from the assembled data. One chart in particular will be examined here, and the rest held over for the final instalment. Cloths from each wool were woven of 37 in. loom width; these, after milling, exhibited shrinkage in varying degrees. The percentage shrinkage figures for the various wools used were graphed to a large scale, and formed a striking exhibit, the more so as they demonstrated scientifically ascertained facts to be in contradiction to popular opinion. It is not possible to reproduce the actual diagram, but the data upon which it was based are as follows—

Breed	Percentage Shrinkage		Breed	Percentage Shrinkage	
	Woollen Cloth	Worsted Cloth		Woollen Cloth	Worsted Cloth
Blackface	21·6	23·0	Border Leicester ...	—	—
Herdwick	25·7	27·7	Cheviot	25·7	32·4
Welsh (White)	27·7	31·0	Romney Marsh or Kent	28·4	42·6
Lonk	21·6	26·4	Half-bred Leicester ...	30·4	36·5
Swaledale Dales ...	21·6	28·4	Kerry Hill	25·7	29·8
Exmoor Horn	25·7	39·2	Dorset Down	24·3	33·1
Welsh (Black)	27·0	29·8	Dorset Horn	27·7	42·6
Lincoln	27·7	34·5	Oxford Down	25·7	29·1
Devon Long Wool ...	27·7	27·7	Suffolk Down	27·7	32·4
South Devon	—	—	Ryeland	—	—
Leicester	—	—	Hampshire	22·3	34·5
Dartmoor	26·1	18·9	Shropshire	25·0	36·5
Cotswold	27·7	31·1	Southdown	24·3	33·1
Wensleydale	—	—			

These figures show that in all cases save two woollen cloths have shrunk less than worsted cloth, and that in the two exceptions, one was a case of equal shrinkage and one a reversal of the general result.

(*To be concluded.*)

† *J. Text. Inst.*, 1924, **15**, T53-T60.

Competition in Industrial Designs

The Royal Society of Arts has made a commendable effort to revive and extend its interest in relation to the Industrial Arts, and some time ago appointed several committees, consisting mainly of manufacturers, to deal with Architectural Decoration, Textiles, Furniture, Book Production, and Pottery and Glass. A strong central committee was formed under the chairmanship of Sir Frank Warner, K.B.E. These committees were unanimously of opinion that the best means of bringing to light young designers of promise was to hold an annual competition open to two classes of competitors—(*a*) Students in British Schools of Art, and (*b*) all British subjects. It was further decided to conduct exhibitions of the products of the competitions.

About a year ago, the various committees appealed for funds. Over £1,000 was subscribed, almost entirely by manufacturers, in order to provide scholarships and prizes for the 1924 competitions. The results have recently been published and the report of the 1924 competition shows that in relation to textiles there were eight sections or groups. The number of candidates who entered in all sections of the competition was 553, and of these 344 were students of Schools of Art and 209 were non-students. The total number of designs submitted was 1,408 and the textile section was easily the most productive with 538. The report contains many interesting observations and the results of the adjudication may be briefly stated as follows—

(1) Designs for Carpets and Rugs; Moquettes; Floor Coverings (Linoleums and Floor Cloths)—Designs in this section were comparatively few in number and have no special merit. No prize awarded.

(2) Tapestries; Damasks; Brocades and Figured Velvets for Furniture and Decoration—Prize of £10 10s. awarded to Eric E. Taylor (School of Arts and Crafts, Battersea Polytechnic) for a design of a tapestry panel. Prizes of £5 5s. each awarded to Miss Doris Duckworth (City School of Art, Liverpool) for a damask tablecloth; and Miss Rebecca Viney (School of Art, Farnham) for general merit.

(3) Printed Fabrics for Hangings and Furniture—Prize of £10 10s. awarded to Miss Eleanor Joan Palmer (Municipal School of Art, Manchester) for cretonne hanging; and £5 5s. to James Hanson (School of Art, Technical College, Blackburn) for cushion square.

(4) Printed Fabrics for Dress; Dress Brocades and Fancy Dress Fabrics; Handkerchiefs; and Narrow Goods—Prize of £10 10s. and Owen Jones Bronze Medal awarded to Miss Elizabeth Wilson-Haffenden (Croydon School of Art) for design for printed dress fabric.

Many of the designs in this section, it is stated, show a moderate average of technical knowledge and of facility in execution.

(5) Lace; Lace Curtains; Embroidery and Openwork—Prize of £10 10s. each to Mrs. Ella Hodgett (School of Art, Glossop) for lace bedspread; and to Miss Gladys Ruth Adams for embroidered blouse; £5 5s. each also to Miss Daisy Rogers Stedman (Nottingham) and Miss Jane Kirkbride (Storey Institute, Lancaster).

The report states that in regard to the designs for printed dress fabrics, the purpose for which the material is to be used should be kept more constantly in mind when the design is being made. In one case only was direct evidence given that the idea of dress was conceived before the pattern was made, and a prize of £5 5s. was awarded to the designer, Miss Kate Muriel Gee.

In regard to woven dress fabrics, it is stated that although some of the designs are satisfactory from a weaving point of view, the *motifs* are very uninteresting and the colour generally muddy and dull.

Referring to designs for handkerchiefs, tie silks and mufflers, the adjudicators state that this part of the competition has been distinctly bad, the technical qualities being poor and the artistic qualities very poor.

The report adds—"There seems to be but little indication in the work submitted that students are made familiar with the trend of fashion. This is a most important factor in designing any dress fabric, as, after all, tradition is the outcome of a series of fashions, and fashion has at the present time a great influence on the type of design necessary. The judges feel strongly that this first competition should be dealt with very seriously, for the regrettable gulf which has opened between art and manufacture must be bridged without delay if this country is to regain her pre-eminence in commerce."

Scheme of Pensions for Workpeople

At the annual meeting of shareholders in the Tootal Broadhurst Lee Company, Ltd., at Manchester on the 26th August, Mr. Kenneth Lee, Chairman of Directors, announced that the company's pensions scheme was now ready and only required the formal sanction of the authorities. The scheme, he stated, was both voluntary and contributory. It divided itself into two parts—provision to enable employees of 25 years of age and upwards to provide for old age, and allocation of the lump sum already set aside in 1919 and 1920 towards providing pensions for employees who already had a number of years' service to their credit, after reaching 25 years of age. Those who joined and contributed $2\frac{1}{4}\%$, or even a lesser amount of their salary, would have a like amount added by the company, with a proviso that the company's contribution would be limited to $2\frac{1}{4}\%$ on a salary or wage of £250 a year; in other words, the company would not pay more than £5 12s. 6d. a year towards an employee's fund, even though his earnings exceeded £250. The actuary estimated that an employee joining at 25 and contributing $2\frac{1}{4}\%$ of his or her annual earnings, assuming them to be £150, would have at 65 a fund which would give a man a pension of £71 and a woman a pension of £64, the difference arising from the fact that a man had a worse "life-table" than a woman. There were provisions enabling an employee to contribute a larger percentage of his salary than $2\frac{1}{4}$, and also provisions concerning the guaranteeing of interest by the company on the sum invested. Other provisions applied to retirement at an earlier age than 65, or death, if it occurred before pension age.

The Cotton Research Board, Egypt: Third Annual Report, 1922*

Following an introduction concerned mainly with internal arrangements, this report is submitted in five parts. Parts IV. and V. are summaries of current publications relating to cotton by the Egyptian Government and by other publishers respectively, and are not considered here.

Part I.—Special Questions Considered by the Board

The Pink Boll-Worm in Egypt in 1922—This subject was the choice of the Cotton Research Board for a communication to the International Cotton Conference, Rio Janeiro 1922, and the paper was prepared by the Board's senior entomologist, Mr. C. B. Williams. The boll-worm in Egypt damages yearly 15% of the crop. Larvæ are first found at the beginning of June. These complete their life cycle during the summer, but those found in the autumn spin a cocoon between two cotton seeds, in which they pass the winter. It is from these autumn larvæ that the following year's infestation comes. For this reason, a law has been passed compelling growers to pull up all standing cotton by the end of November. During the October picking, however, much infected lint is collected and sent to the ginneries. Infected bolls also get knocked on to the ground and trampled in. A further source of infection is the cotton sticks, bearing bolls, which are taken to the villages to be used as fuel. Control of the larvæ in the picked cotton is secured at the ginnery, where the seed must be kept at 57° to 60° C. for a sufficient time to kill all the worms. To prevent infection from unginned cotton, it has been made illegal to delay ginning after 30th April. Control of the larvæ remaining in the fields and villages has not yet proved possible. Compulsory collection of all bolls left after the crop has been removed has been suggested, together with destruction of all fuel in the villages not burnt by the end of April. The last source of infection—bolls under the ground—may eventually be reduced by altered agricultural processes during the winter.

* Published by the Government Press, Cairo, 1924. Price P.T. 15

Occurrence of Cotton Worm (*Prodenia litura*) *in* 1922.—This pest was reported from Lower and Middle Egypt, the period of maximum attack being 15th June-7th July. No appreciable damage was done, but the attack was more severe than in the previous year. In many cases the source of infection appeared to be adjacent fields of berseem (Egyptian clover), so the control measures recommended include cessation of berseem irrigation in May and immediate cutting of infected fields.

Estimation of the 1922 *Crop*.—The estimate of the total crop is arrived at by multiplying the average yield by the area under cotton. In 1922, cultivators were forbidden to have more than one-third of tleir land under cotton, but there were many contraventions of the law, so that the area reported as being under cotton was considerably smaller than the actual area. Discovery of this fact rendered necessary a revision of the original final estimate.

Forecasting the Cotton Crop.—A sub-committee appointed by the Board recommends that a scheme for forecasting should start with a flower count from 1st June to 15th August, followed by an examination of open bolls from August to October. From the latter a good figure for the total possible crop could be obtained, and allowance made for damage by insects and other causes.

Part II.—Experimental Work on Cotton, 1922

Botanical Section—In 1922, 269 pure line families were grown. Certain 1921 families were tested for purity by comparing the length of the seed "halo" in the parent with that in the offspring. Accounts are given of the propagation of selected strains. Small experimental plots of Sea Island cotton have been grown, but with little success. Hybridisation work with Sakel cotton has been continued. It was found during the course of this work that crossing was most successful if flowers were emasculated at night and pollinated with fresh pollen on the following morning, instead of at once.

Catch nets were placed under selected plants. These nets were brushed daily, and the sweepings examined. Counts were made of the buds, bolls and sympodia shed. An account of the results obtained is to be published in the next Report.

Daily height measurements and flowering counts were made for 46 plants. On comparing these with temperature records, it is seen that agreement is fairly good between the minimum temperatures and the growth curve. On five occasions in the early part of the season a high maximum was followed by a decrease in growth rate. The flower production can best be correlated with the growth 35 days previously, but the agreement is not very close. Daily fluctuations in flowering curves showed a marked concordance between the Ashmûni and Assîli plots; the Sakel curve starts very slowly owing to heavy shedding, but continues to rise until about 15th August. Ashmûni and Assîli reach their maximum about 15th July.

The presence of lenticels is noted, one on each side of the insertion of each lateral root. After an irrigation, the internal tissue of these organs swells up and exudes through the bursting surrounding tissue.

Other topics dealt with in this section include the effect of heat on cotton-seed, and the effect of soaking cotton-seed in water. Among diseases, sore-shin and cotton-wilt are mentioned, and the results of three naphthalene test experiments for alleviating sore-shin are given, and the conclusions arrived at are stated. The causes and circumstances relating to cotton-wilt received careful and detailed study, and the results are summarised without any statement as to the discovery of successful means of combating this disease.

Agronomic Section—Field tests of certain commercial varieities of cotton were made; Assîli, Casulli, Nubâri, "310," Pilion, Sakel—were tested for germination, earliness, yield of seed cotton, ginning out-turn and commercial value. Assuming that the relative prices of these varieties remain as they were for the previous year's crop, the value per feddân works out at—

Pilion	200	dollars per feddân.
Assîli	188	,, ,, ,,
Nubâri	183	,, ,, ,,
Casulli	182	,, ,, ,,
Sakel	172	,, ,, ,,
"310"	171	,, ,, ,,

(1 dollar=4/2; 1 feddân=5,024 sq. yds.)

For 1922, therefore, the fine cottons, Sakel and "310," were the most unremunerative, but it is hoped that with a return to more normal conditions the present tendency to abandon these types will cease. Field tests of selected strains were also carried out at five experiment stations.

Entomological Section—The pink boll-worm has formed the chief subject of experiment, and this section of the report deals almost exclusively with this pest. Tables are given showing the weekly amount of attack of green bolls in each province. In five localities all the open bolls were taken weekly from one qirât ($\frac{1}{24}$ acre). Results show that damage by boll-worm and state of the crop both vary considerably within small areas, so that to obtain a correct estimate of boll-worm attack many small samples are necessary.

A definite relation has been found to exist between the percentage of damaged bolls and the amount of damaged cotton produced by them, and it is hoped that more rapid and accurate methods of forecasting the loss by pink boll-worm will soon be possible. A greater survival of the worm is found nearer the surface and in dry crops than at greater depths and in wet crops. Thus, berseem planted after cotton would cause more reduction in survival than would wheat.

The results of the heat treatment showed a distinct improvement, the number of samples received containing live worms having sensibly diminished. The ginneries sent 24,218 samples of treated seed for testing. Of these, 278 did not germinate, 709 germinated badly, and 317 contained living worms. Legal action was taken against 35 ginneries for contravention of the law.

Chemical Section—The *sharâqi* period is considered in this section, and more particularly in regard to soil temperature and to partial sterilisation of Egyptian soils. *Sharâqi* is the term applied to land left without water from May to July. when the Nile is low. With the spread of irrigation in Egypt, there has grown up the practice of keeping the land moist throughout the year, the *sharâqi* period being abandoned. It has been suggested that the elimination of this period has been responsible for the decline in the yield of cotton. A study has been made of the temperature of the soil during the *sharâqi* period, and of the possibilities of partial soil sterilisation at these temperatures.

Continuous records were kept of the temperature at surface level and 5, 10, 15, 20, 25 and 30 cms. below. It was found that from May to August the surface soil was for 476 hours above 55° C., and the soil 5 cms. below was occasionally above this temperature. So, from a temperature point of view, the factor in the soil detrimental to plant growth is likely to be completely suppressed to a depth of five centimetres. The suppression may take place temporarily for a further 15 centimetres, and is at its maximum in July and August. It does not appear that the detrimental factor in Egyptian soils is the presence of protozoa, since these are found to be present as cysts, capable of withstanding high temperature. But though the soil protozoa were not suppressed, it appears probable that a partial sterilisation of the soil occurs during the *sharâqi* period, and that some factor detrimental to nitrate production is destroyed. It is suggested that the effect of the *sharâqi* period should be fully utilised by thorough tillage of the soil, and that maize sowing be postponed until about 21st August, so that the *sharâqi* period is not curtailed.

Part III.—Programme of Experimental Work for 1923

Cotton breeding work on "pure lines" has been continued and bulk selection proceeded on methods already adopted. Further field trial tests are forecast, while growth and flowering curves are to be drawn up. All this and more work laid down for 1923 is, of course, now actually accomplished, and it is hoped that a more up-to-date publication of the Annual Report of the Board can be secured. The production under consideration, as were its predecessors, is well carried out and of considerable size, but it should be possible to produce it earlier than eighteen months or so after the year's end. R. W. M.

Flax Growing in Ulster—Use of Pedigree Seed*

At the annual meeting of the Flax Mill Owners' Association held recently an important discussion took place regarding seed selection and the use of pedigree seed as a means of reviving and improving the flax and linen industry. Recent

Belfast News-Letter, 25th August 1924

visits to flax plots and inspection of growing flax crops by a deputation from the Department of Argiculture have demonstrated the increased yield and general return of product by the use of pure line pedigree seed. The results are such that the Flax Mill Owners' Association is convinced that the only way to bring about a large increase in flax production in Ireland is to devise means to procure a sufficient quantity of pedigree seed for the requirements of flax growers. It was felt that the Government of Northern Ireland would before long undertake a big scheme of flax seed selection.

Meanwhile the Association approved of the following resolution—"That as the selection of pure line flax seed has now been demonstrated beyond any doubt to be the only certain method of permanently reviving, improving, and maintaining the flax growing industry in Ireland, we urge on the Northern Ministry of Argiculture the absolute necessity of devising and putting into operation with the least possible delay a scheme to procure by some means a supply of pure line flax seed sufficient for the requirements of Northern Ireland, if flax growing is to be maintained or increased; and we would impress on the Government that unless assistance of this nature be granted, a continuation of inferior crops produced from commercial seeds will tend to reduce very much the present small acreage under flax, even with the comparatively high flax prices now ruling. As experience has shown that our climate is in most seasons unsuitable for saving seed for sowing purposes on a large scale satisfactorily, we suggest that arrangements should be made in some suitable countries within the Empire to grow and save sufficient pure line seed for the requirements of the growers in Northern Ireland." F. B.

THE CONSTITUENTS OF THE WAX OF EGYPTIAN SAKELLARIDIS COTTON

By Robert George Fargher, D.Sc., and Lucy Higginbotham, M.Sc.
(The British Cotton Industry Research Association.)

Abstract

The examination of the constituents of the wax of cotton has been extended to Egyptian Sakellaridis cotton. It is shown that most of the component alcohols, acids, esters and hydrocarbons are very similar to, and many of them actually identical with, those of American cotton. The conclusion may therefore be drawn that Egyptian cotton will behave like American cotton in scouring, as far as the wax is concerned, and that any conclusions drawn from experiments on the removal of wax from American cotton may justifiably be applied to Egyptian cotton.

I.—INTRODUCTION AND SUMMARY

Though extraction with organic solvents forms a convenient method of comparing the amounts of material of a waxy nature present in different varieties of cotton, it fails to differentiate fat from wax, and only partly differentiates wax from resin, and it has been found[1] that the extracts obtained with the solvents normally employed for the elimination of fat or wax from natural products contain, in addition to fat and wax, a proportion of resin which varies with the solvent employed. In the case of American cotton[2,5,6] this material is exceedingly heterogeneous, comprising fats and the corresponding fatty acids, waxes and their component alcohols and acids, hydrocarbons, sterols, a sterol glucoside, and resin acids, esters and resinols, the principal constituents being a group of wax alcohols of which the chief are gossypyl and montanyl alcohols. It was therefore anticipated that the wax of Egyptian cotton would prove to be equally complex, more especially as Knecht[7] had already shown that it contained palmitic and stearic acids, probably present both as free acids and as glycerides, cerotic acid, melissic acid, one or more phytosterols and several hydrocarbons, including hentriacontane and dotriacontane. Knecht's failure to isolate normal wax alcohols in sufficient amount to permit their identification suggested, however, that the wax of Egyptian cotton differed from that of American, the former being characterised, apparently, by the presence of a considerable proportion of sterols and hydrocarbons, whilst the most important constituents of the latter were normal wax alcohols. This was not without practical significance, as earlier work on the scouring of American cotton[4] had indicated that sterols were less readily removed than normal fatty alcohols, whilst the omission of paraffin hydrocarbons from size mixings has been strongly recommended by many observers, owing to the difficulty experienced in their removal during bleaching.

Analysis of the wax of Egyptian Sakellaridis cotton showed, however, that its properties are very similar to those of the waxes of the two American cottons which have been examined in detail, as will be seen from the following table—

	American Cottons		Egyptian Cotton
	Upland	Mississippi Delta	Sakel
Melting point ...	77° C.	76·5° C.	80°C.
Density (15° C.) ...	0·985	0·976	0·990
Acid value ...	27	29	28
Saponification value ...	65	57	70
Acetyl value ...	64	84	83
Iodine value ...	19	27	20
Unsaponifiable matter ...	62%	68%	57%
Acetyl value of unsaponifiable matter ...	133	124	115

It seemed probable, therefore, that the wax of Egyptian cotton would prove to be very similar to that of American, though, of course, the actual components might differ, and the present investigation was initiated in order to determine whether this was so.

The material employed was obtained by extracting an Egyptian Sakellaridis cotton in the form of card sliver with chloroform, the cotton being identical with that used in the earlier comparative extraction experiments. The extract, examined by the methods employed in the earlier work, was found to contain the following substances—

Alcohols

Gossypyl alcohol ($C_{30}H_{62}O$) as the principal alcohol, and smaller amounts of montanyl alcohol ($C_{28}H_{58}O$), ceryl alcohol ($C_{26}H_{54}O$), an alcohol $C_{32}H_{66}O$, a *glycol* $C_{30}H_{62}O_2$ (?), and glycerol. A *phytosterol*, $C_{29}H_{50}O$, as such and as the corresponding *glucoside*, and small amounts of amyrin and unidentified amorphous resinols.

Free Acids

Saturated acids—palmitic and stearic acids, together with smaller amounts of carnaübic acid ($C_{24}H_{48}O_2$), montanic acid ($C_{28}H_{56}O_2$), and an acid $C_{34}H_{68}O_2$, and traces of an acid resembling *iso*-behenic acid ($C_{22}H_{44}O_2$). Unsaturated acids—oleic acid, probably an acid $C_{20}H_{38}O_2$, very small amounts of doubly unsaturated acids, and also amorphous resin acids.

Combined Acids

Saturated acids—palmitic, stearic, carnaübic, montanic, and gossypic acids with traces of acids resembling lignoceric acid ($C_{24}H_{48}O_2$), and melissic acid ($C_{30}H_{60}O_2$). The unsaturated acids occurring as esters consisted of a similar mixture to those occurring in a free state. Palmitic, stearic, and oleic acids appear to occur principally as glycerides, and carnaübic, montanic and gossypic acids as wax esters.

Hydrocarbons

A crystalline hydrocarbon resembling triacontane and an indefinite mixture of unsaturated liquid hydrocarbons; the latter could not be freed completely from resinous material which did not react with phthalic anhydride in pyridine solution.

It is evident, therefore, that the waxes of American and Egyptian Sakellaridis cottons are not only similar in composition, but in their actual components, the differences being confined principally to the replacement of sitosterol and sitosterol glucoside by a *phytosterol* $C_{29}H_{50}O$ and the corresponding *glucoside*, and the presence of a greater proportion of wax esters. Few of the substances isolated need therefore be discussed.

The *sterol* $C_{29}H_{50}O$ closely resembles sitosterol in its melting point and those of its derivatives, and in its specific rotation, and the resemblance persists in the corresponding glucosides and their tetra-acetates. The formula $C_{29}H_{50}O$ is supported, however, not only by analysis of the sterol and its *dibromoacetate*, but by the saponification values of the *acetate* and *benzoate*, whilst the properties of the dibromoacetate show that it is not contaminated with stigmasterol.

The properties of the acids isolated from the wax suggest that two series are present, the first consisting of carnaübic, montanic and gossypic acids and the acid $C_{34}H_{68}O_2$, and the second, present only in very small amount, of acids resembling closely *iso*-behenic,[9] lignoceric,[8] and melissic acids. The melting points of the acids and their methyl esters are compared in the following table—

Series I.	M.p. of Acid	M.p. of Methyl Ester	Series II.	M.p. of Acid	M.p. of Methyl Ester
Carnaübic acid— $C_{24}H_{48}O_2$ ...	72°-73° C.	55°-56° C.	*iso*-Behenic acid— $C_{22}H_{44}O_2$ ...	75° C.	54·5° C.
Montanic acid— $C_{28}H_{56}O_2$ ...	84° C.	67·5° C.	Lignoceric acid— $C_{24}H_{48}O_2$ ...	81° C.	56°-57° C.
Gossypic acid— $C_{30}H_{60}O_2$ ...	86·5° C.	69·5° C.	Melissic acid— $C_{30}H_{60}O_2$ ...	91° C.	74·5° C.
Acid—$C_{34}H_{68}O_2$ ...	90°-91° C.	75°-76° C.			

Although the wax esters are probably as complex a mixture as the corresponding acids and alcohols, it has been found possible to isolate fractions consisting essentially of *gossypyl carnaübate, gossypyl gossypate* and *montanyl montanate.* Here again there is a decided resemblance to American cotton, *gossypyl carnaübate* being in all probability the principal wax ester in both.

II.—GENERAL CONCLUSIONS

Detailed examination of the waxes of American and Egyptian cotton has shown that the material usually designated "cotton wax" is in reality a mixture of fats, waxes and resins. The substances which may be grouped as fat include glycerides of palmitic, stearic and oleic acids, and probably unsaturated acids $C_{16}H_{30}O_2$ and $C_{20}H_{38}O_2$, together with the corresponding free acids. Those which may be grouped as wax include alcohols with an even number of carbon atoms, varying in complexity from ceryl alcohol ($C_{26}H_{54}O$) to an alcohol $C_{34}H_{70}O$, of which gossypyl alcohol is the chief; higher fatty acids, principally carnaübic acid, though one or other of the cottons has yielded acids with an even number of carbon atoms from *iso*-behenic acid ($C_{22}H_{44}O_2$) to an acid $C_{34}H_{68}O_2$; and wax esters (true waxes), of which gossypyl carnaübate is probably the chief, though gossypyl gossypate and montanyl montanate have also been isolated. In addition, American cotton contains sitosterol and sitosterol glucoside, and Egyptian cotton a sterol $C_{29}H_{50}O$ and the corresponding glucoside, whilst both contain a small proportion of solid and liquid hydrocarbons. Of the substances which may be classed as resins, only two have been obtained crystalline—

amyrin and lupeol—but there are also present amorphous resin acids, esters and alcohols.

The pronounced similarity of the waxes of American and Egyptian cottons enables the conclusion to be drawn that they will behave similarly in the scouring process, so that results obtained with American cotton will be equally applicable to Egyptian cotton, so far as the wax is concerned. The behaviour of the former has already been examined,[4] and the conclusion drawn that it was removed initially by a process of emulsification, the emulsified material then undergoing partial saponification. It was pointed out that the relatively high proportion of free acids in the wax was therefore of importance, more particularly if they were acids of high detergent and emulsifying powers, as they would then influence considerably the formation and stability of the emulsions. The detailed examinations show that all three waxes contain about 16 per cent. of free acids, of which the greater proportion consists of palmitic, stearic and oleic acids, all three forming soaps of high detergent and emulsifying power, whilst the higher fatty acids, which are known to form soaps difficultly soluble even in boiling water, and with low detergent and emulsifying powers, are present to a much smaller extent. The resin acids, though more easily removed than the higher fatty acids on account of the ready solubility of their soaps, have probably a relatively low detergent power.

The identity and mode of combination of the combined acids are also of importance, and the examinations have shown that palmitic, stearic and oleic acids are present principally as fats, which are relatively easily saponified, whilst the higher fatty acids are present as wax esters which are unlikely to be saponified under normal scouring conditions.

The behaviour of the unsaponifiable substances, principally wax alcohols, has been dealt with in the communication already mentioned.

III.—EXPERIMENTAL

The material used in the investigation was obtained by the extraction of 270 lbs. of Egyptian Sakellaridis cotton, 1921 crop, by continuous percolation with chloroform for a period of 16 hours, and consisted of 330 grams of a light brown wax, which still contained about 12 per cent. of solvent. The properties of the material completely freed from solvent were as follow—

Melting point	68°-75° C.	Acetyl value	97
Density	1·001	Iodine value, Hübl	23
Acid value	32	Iodine value, Hanus	36·5
Saponification value	67	Unsaponifiable matter	53%

A test portion (30 grams) was mixed with two-thirds of its weight of purified sawdust, and extracted successively for eight hours with light petroleum, ether, benzene, chloroform and alcohol. Light petroleum dissolved 85%, ether 8%, benzene 3%, chloroform 2%, and alcohol 1% of the whole, a total of 99%. The remainder of the crude wax was therefore mixed with sawdust, and submitted to exhaustive extraction with light petroleum, ether, benzene and chloroform, in this order, yielding 227 grams of material soluble in light petroleum, 17 grams soluble in ether, 3·5 grams soluble in benzene, and 1·8 grams soluble in chloroform, the whole accounting for 96 per cent. of the crude wax employed. The light petroleum extract was sub-divided into portions readily and sparingly soluble in the solvent, the former amounting to 143 grams and the latter to 84 grams. The fractions were then examined as described in the following sections, the components of each being shown in the accompanying diagram, where the figures in brackets are percentages of the crude wax.

- **Crude chloroform extract**
  - **Light petroleum extract (85%)**
    - **I. Sparingly soluble portion (31%)**
      - *Alcohols* (23%). Ceryl, montanyl, gossypyl, an alcohol $C_{32}H_{66}O$, and a glycol $C_{30}H_{62}O_2$ (?).
      - *Free acids* (2%). Montanic acid and an acid $C_{34}H_{68}O_2$.
      - *Combined acids.* Carnaübic, montanic, and melissic acids.
    - **II. Readily soluble (54%), divided by means of alcohol into**
      - **IIa. Soluble in cold alcohol (40%)**
        - *Alcohols* (10%). Glycerol, a phytosterol, $C_{29}H_{50}O$, amyrin, and amorphous resinols.
        - *Free acids* (17%). Palmitic, stearic, oleic, carnaübic, *iso*-behenic, and amorphous resin acids.
        - *Combined acids* (6%). Palmitic, stearic, oleic, acid $C_{20}H_{38}O_2$, and lignoceric acid.
        - Unsaturated liquid hydrocarbons.
      - **IIb. Insoluble in cold alcohol (12%)**
        - Gossypyl carnaübate.
        - Montanic acid, free and combined.
        - C_{28} and C_{30} alcohols.
        - Triacontane.
      - **IIc. Insoluble in boiling alcohol (2%)**
        - Amorphous resin esters.
  - **III.—Ether Extract (8%)** — Phytosterolin, $C_{35}H_{60}O_6$ (6%). Gossypyl gossypate (2%).
  - **IV.—Benzene extract (2%)** — Wax esters, principally montanyl montanate.
  - **V.—Chloroform extract (1%)** — Phytosterolin, $C_{35}H_{60}O_6$.

Light Petroleum Extract. Readily Soluble Portion (II).

This consisted of 143 grams of soft, dark brown, waxy material, from which it proved impossible to remove the free acids by extraction of the ethereal solution with alkalis, owing to the formation of persistent emulsions. It was therefore boiled with a litre of alcohol, and separated into three fractions—

A. Soluble in cold alcohol (100 grams) (IIa.).
B. Soluble in hot alcohol, but sparingly so in cold (32 grams) (IIb.).
C. Insoluble in boiling alcohol (5 grams) (IIc.).

Portion Soluble in Cold Alcohol (A, *above*)—

After removal of the alcohol there remained a dark brown viscid syrup, which showed no signs of crystallisation. It was therefore dissolved in ether, and the ethereal solution extracted repeatedly, first with a 5% solution of sodium carbonate and water alternately, and then with a 5% solution of sodium hydroxide and water alternately. The alkaline extracts were acidified, the precipitated material re-dissolved in ether, and the extraction repeated. The portion dissolved by sodium carbonate amounted to 42 grams of dark brown semi-solid acids (D), whilst that dissolved by sodium hydroxide consisted of 0·2 gram of a brown phenolic varnish which failed to crystallise even after acetylation or benzoylation.

The material remaining after removal of the free acids still showed no signs of crystallisation, and proved to be partly saponifiable. (Found. saponification value=54.) It was saponified by boiling for several hours with a 5% solution of potassium hydroxide in alcohol, the alcohol evaporated, and the residue mixed with water and extracted with ether (extract=E). The alkaline solution was then acidified, the acids originally present as esters taken up into ether (extract=F), and the residual faintly acid solution (G) examined for the presence of glycerol.

Identification of Free Acids (Extract D, *above)*—

The crude free acids were esterified by boiling with methyl alcohol containing sulphuric acid. The resulting solution, on cooling, deposited a small amount of solid esters, mixed with resinous matter, which was removed by filtration (solid=H). The filtrate was mixed with water, the oil which formed extracted by means of ether, and the ethereal extract shaken repeatedly with dilute alkali to remove traces of non-esterified acids. It was then dried by means of anhydrous potassium carbonate, and evaporated, leaving 34 grams of pale brown oil which was distilled at 8 mm. pressure, the following fractions being collected—

(1) B.p. 165°-185° C., mainly at 175° C., 15·7 grams.
(2) B.p. 185°-205° C., 8·5 grams.
(3) B.p. 205°-230° C., 1·3 grams.
(4) B.p. above 230° C., 6·5 grams.

A small residue of red, sticky resin remained, which decomposed on heating even at 1 mm. pressure.

The solid methyl esters (H, above) were freed from traces of resin by means of methyl alcohol, in which the resin was practically insoluble. They were then crystallised repeatedly from the same solvent, yielding eventually a felted mass of minute needles, m.p. 55°-56° C. (Found, M.W. by saponification=385; $C_{25}H_{50}O_2$ requires 382·5.) The corresponding acid separated from glacial acetic acid in minute leaflets, m.p. 72°-72·5° C., and was identified as carnaübic acid. (Found, M.W.=365; $C_{24}H_{48}O_2$ requires 368·5.)

The methyl esters boiling at 165°-185° C. *at* 8 *mm.* consisted of a colourless oil, from which 12 grams of mixed acids were obtained. (Found, mean M.W.=262; iodine value, 40; m.p. 44°-47° C.) These were separated by means of the lead salts into saturated and unsaturated portions. The saturated acids (7·4 grams) were divided into two fractions by crystallisation from 75% alcohol, the properties indicating that they consisted of a mixture of palmitic and stearic acids, the former preponderating. Found, fraction 1, m.p. 54°-55° C., mean M.W. 269; fraction 2, m.p. 54°-56° C., mean M.W.= 262; $C_{16}H_{32}O_2$ requires M.W. 256, and $C_{28}H_{36}O_2$, 284.) The unsaturated acids were distilled at 16 mm. pressure, the greater portion boiling between 230° and 240° C., and the residue between 240° and 260° C. The fraction of lower boiling point solidified at 14°-13° C., melted completely at 16°-17° C., and consisted essentially of oleic acid. (Found, M.W.=277; iodine value, 88; $C_{18}H_{34}O_2$ requires M.W. 282; iodine value, 90.) The small residue of higher boiling point appeared to be a mixture of unsaturated acids $C_{18}H_{34}O_2$ and $C_{20}H_{38}O_2$, the iodine value indicating that a small amount of a doubly unsaturated acid was also present. (Found, mean M.W.=298; iodine value, 95.)

The methyl esters boiling at 185°-205° C. *at* 8 *mm.* consisted of a pale yellow oil, which was saponified and divided into saturated and unsaturated portions as in the previous instance. The saturated acids, after crystallisation from dilute alcohol melted at 55°-57° C., and appeared to consist chiefly of stearic acid. (Found, M.W.=279; $C_{18}H_{36}O_2$ requires 284.) The unsaturated acids, which formed about two-thirds of the whole, were distilled at 17 mm. pressure, and collected in two fractions boiling respectively at 229°-234° C. and 234°-240° C. Analysis indicated that they were essentially a mixture of acids $C_{18}H_{34}O_2$ and $C_{20}H_{38}O_2$, but that there was also a small proportion of a doubly unsaturated acid present. (Found, fraction b.p. 229°-234° C., mean M.W.=288; iodine value, 101; fraction b.p. 234°-240° C., mean M.W.=298; iodine value, 102.)

The small fraction of *methyl esters boiling between* 205° C. *and* 230° C. *at* 8 *mm.* partly solidified on keeping. The solid portion was separated by trituration with a little methyl alcohol, and consisted of glistening leaflets melting constantly at 54·5° C. after several crystallisations from methyl alcohol. (Found, M.W.=358; $C_{23}H_{46}O_2$ requires 354·5.) The corresponding acid separated from glacial acetic acid as a felted mass of glistening needles melting at 73·5°-74° C. (Found, M.W.=337; $C_{22}H_{44}O_2$ requires 340·5.) The acid may therefore be identical with the *iso*-behenic acid described by Meyer, Brod and Soyka,[9] which melted at 75° C., and yielded a methyl ester melting at 54° C.

The methyl esters boiling above 230° C. *at* 8 *mm.* consisted of light brown resinous material, from which a mixture of resin acids was obtained which dissolved readily in all the usual organic solvents and in aqueous alkalis, but could not be crystallised. (Found, mean M.W.=547, iodine value 55.)

Identification of Acids Present as Esters (*Extract* F., p. T424)—

These acids amounted to 14 grams, and were separated like the free acids, yielding a small amount of a solid methyl ester sparingly soluble in methyl alcohol, and a mixture of liquid esters, b.p. 180°-210° C./8 mm.

The *liquid esters* gave a mixture of acids which melted at 35°-37° C. (Found, mean M.W. 282; iodine value 76.) These were divided into saturated and unsaturated components by means of the lead salts. The saturated acids consisted of a mixture of palmitic and stearic acids. (Found, m.p. 52°-52·5° C.; mean M.W.=273; $C_{16}H_{32}O_2$ requires 256, $C_{18}H_{36}O_2$ requires 284.) The unsaturated acids boiled between 220° and 240° C. at 15 mm., and appeared to consist principally of oleic acid. (Found, mean M.W.=279; iodine value, 106; $C_{18}H_{34}O_2$ requires M.W.=282; iodine value, 90.) The high iodine value suggests the presence of a small proportion of a doubly unsaturated acid.

The *solid ester* was saponified and the recovered acid crystallised repeatedly from glacial acetic acid and ethyl acetate alternately, and then converted again into the methyl ester, which separated from methyl alcohol as a felted mass of minute needles melting at 56°-57° C. (Found, M.W.=385·5; $C_{25}H_{50}O_2$ requires 382·5.) The acid recovered from this crystallised from ethyl acetate in radiating clusters of needles melting at 80°-81° C. (Found, M.W.=372; $C_{24}H_{48}O_2$ requires 368·5.) The melting points and properties of the acid and its methyl ester agree with those given by Kreiling[8] for lignoceric acid, but the amount was too small to allow more definite identification.

Identification of Glycerol (G., p. T424)—

The faintly acid solution remaining after the isolation of the combined acids was evaporated to a volume of 200 cc., carefully neutralised with sodium carbonate, and evaporated to dryness under diminished pressure at as low a temperature as possible, crops of sodium chloride being removed from time to time. The residue was extracted with a mixture of equal parts of alcohol and ether, evaporation of which left about half a gram of viscous liquid. This gave a strong odour of acrolein on heating with sodium hydrogen sulphate, the distillate reducing an ammoniacal solution of silver nitrate and giving a silver mirror. The aqueous solution gave the borax-phenolphthalein reaction for glycerol, and, after oxidation with bromine water, the colour reactions of dihydroxyacetone described by Denigès.[3]

Examination of the Unsaponifiable Portion (*Extract* E, p. T424)—. This consisted of 41 grams of soft resinous material which was heated with 25 grams of phthalic anhydride and 50 cc. of pyridine for four hours on the water bath. The product was then mixed with water and extracted with ether, the pyridine removed by means of dilute hydrochloric acid, and the ethereal solution shaken with a 4% solution of sodium hydroxide and water alternately until nothing more was removed. In this way the alcohols were obtained as hydrogen phthalates soluble in aqueous alkalis, whilst the hydrocarbons remained in the ethereal solution.

Identification of the Alcohols—The alkaline solution containing the hydrogen phthalates and phthalic acid was acidified, and the resulting precipitate saponified with an alcoholic solution of potassium hydroxide, yielding eventually 18 grams of a brown resin. This was dissolved in 250 cc. of ethyl acetate, decolourised with charcoal, and allowed to stand, when a small quantity of crystals, melting at 76°-78° C., and consisting essentially of a mixture of wax alcohols, gradually separated. The filtrate from this was then evaporated to about 50 cc., and kept in the ice chest for several days, yielding 8 grams more of crystalline material, which separated from methyl alcohol in long glistening plates, m.p. 136° C., and gave the usual phytosterol coloration with chloroform, acetic anhydride and sulphuric acid. Further purification by crystallisation as the acetate or the benzoate failed to alter the melting point of the alcohol, which is a new *phytosterol*, $C_{29}H_{50}O$, with very similar properties to sitosterol. (Found, C=83·9, H=12·4; $C_{29}H_{50}O$ requires C=84·0, H=12·2%.) The *acetate* crystallised from alcohol in minute needles, m.p. 124·5°-125·5° C. (Found, CH_3CO=9·45%, M.W.=453; $C_{31}H_{52}O_2$ requires CH_3CO=9·4%; M.W.=456), and when treated by the method of Windaus and Hawth,[11] yielded a *dibromide* which separated from alcohol as a white amorphous powder, m.p. 125°-126° C. (Found, Br=26·0%; $C_{31}H_{50}O_2Br_2$ requires 26·0%.) The bromination showed that stigmasterol was absent. The *benzoate* was repeatedly crystallised from ethyl acetate, and formed glistening plates, m.p. 145°-146° C. (Found, C_6H_5CO=20·15%; M.W.=516·5; $C_{36}H_{54}O_2$ requires C_6H_5CO=20·1%; M.W.=519.) The solution which remained after separation of the phytosterol, $C_{29}H_{50}O$, left a resinous mass on evaporation from which no further crystalline material could be obtained. On acetylation, however, it gave a crystalline acetate which melted indefinitely at 200°-206° C., even after several crystallisations from ethyl acetate. (Found, CH_3CO=9·3%; M.W.=462; $C_{32}H_{52}O_2$ requires CH_3CO=9·2%; M.W.=468.) The recovered alcohol crystallised from alcohol in long silky needles which melted at 177°-178° C., and the melting point was not depressed by admixture with a specimen of mixed α- and β-amyrins melting at the same temperature. It gave a magenta colouration with chloroform, acetic anhydride, and sulphuric acid, and probably consisted of a mixture of α- and β-amyrins, the amount, however, being too small to allow separation of the components. The remaining acetates failed to give any crystalline material, and formed a hard varnish which was not examined further.

Examination of the Hydrocarbons—The ethereal solution containing the hydrocarbons (p. T426) was again treated with phthalic anhydride in pyridine solution to ensure complete removal of alcohols. The yellow liquid (14 grams) which remained gave no indication of constant boiling point, and was therefore divided into four fractions by distillation at 7 mm. pressure. The characteristics of these are shown in the following table, and it will be seen that all four fractions were contaminated with substances containing oxygen, probably, from the colour reactions with chloroform and sulphuric acid, belonging to the so-called "resenes." The amount of material available precluded further examination.

B.p. at 7 mm. Pressure	Appearance	Analyses			Colour Reaction	
		Iodine Value	C (%)	H (%)	Chloroform Layer	Sulphuric Acid Layer
180°-200° C., 1·5 grams	Yellow liquid	37	85·1	12·9	Yellow ...	Orange
200°-220° C., 2·5 grams	Yellow liquid	39	85·8	12·8	Yellow ...	Orange to brown
220°-270° C., 2·5 grams	Light brown, viscous liquid	52	85·2	12·3	Brown ...	Red
270°-300° C., 3·5 grams	Very viscous brown liquid	73	84·9	12·3	Deep brown	Dark red

Portion Sparingly Soluble in Alcohol (B, p. T423)—

This consisted of a felted mass of minute needles, melting at 67° C., which dissolved sparingly in alcohol, ethyl acetate, acetone, or light petroleum, but more readily in benzene. (Found, acid value=7; saponification value=66·5.) Analysis showed that it consisted principally of an ester, or mixture of esters, but fractional crystallisation from a number of solvents failed to yield any pure component. By means of cold chloroform, however, it could be divided into two portions.

The sparingly soluble portion melted at 72°-74° C., but was still contaminated with small amounts of free acids. (Found, acid value=6; saponification value=73.) It was therefore dissolved in alcohol, exactly neutralised with an alcoholic solution of potassium hydroxide, evaporated to dryness, mixed with sand, and extracted with light petroleum in a hot Soxhlet apparatus. The material so obtained was an ester which, after several crystallisations from light petroleum and ethyl acetate alternately, formed rosettes of needles, m.p. 75°-76° C. (Found, in material dried at 100° C. *in vacuo*, C=81·8, H=14·0; saponification value 68; $C_{54}H_{108}O_2$ requires C=82·2, H=13·8; saponification value=71.) The ester was saponified with an alcoholic solution of potassium hydroxide, most of the excess of alkali neutralised, the solution then evaporated to dryness, and the product mixed with a little sodium hydrogen carbonate and a quantity of purified sand, dried completely, and extracted with light petroleum in a "hot" Soxhlet apparatus. The extract melted at 84·5°-85° C. after crystallisation from light petroleum and ethyl acetate, and yielded an acetate which formed minute leaflets from alcohol or well-defined glistening leaflets from light petroleum, melting at 68·5°-69·5° C. (Found, M.W. by saponification=478; $C_{32}H_{64}O_2$ requires 481.) The alcohol recovered from the acetate melted at 85° C., and consisted essentially of *gossypyl alcohol.*

The acid from the soap which remained mixed with the sand in the extraction thimble crystallised from dilute alcohol or acetic acid in rosettes of minute needles, m.p. 71° C., and its methyl ester, after crystallisation from methyl alcohol, melted at 55° C. (Found, M.W. by saponification=385; $C_{25}H_{50}O_2$ requires 382·5.) The acid recovered from the methyl ester melted at 72° C., and was identified as carnaübic acid. (Found, M.W.=364; $C_{24}H_{48}O_2$ requires 368·5.) The *ester* therefore consisted essentially of *gossypyl carnaübate.*

The portion which dissolved freely in chloroform failed to give any pure component, and was therefore divided into free acids, combined acids, and unsaponifiable material in the manner described above. The crude free acids, m.p. 71°-73° C., were converted into the methyl esters, which were fractionally crystallised from a mixture of methyl alcohol and ethyl acetate, yielding eventually as least soluble constituent an ester, m.p. 66·5°-67° C., which on saponification gave an acid melting at 81°-82° C., probably *montanic acid.* (Found, M.W.=427; $C_{28}H_{56}O_2$ requires 425.) The amount of material available precluded the isolation of any other pure component, but the most readily soluble portion of the methyl esters melted at 54°-56° C., and yielded an acid melting at 70°-72° C. on saponification, so that carnaübic acid may also have been present. The crude combined acids melted completely at 67° C., sintering some degrees earlier, and as repeated crystallisation from different solvents failed to effect any separation, they were converted into the methyl esters, which were crystallised repeatedly from methyl alcohol and a mixture of methyl alcohol and ethyl acetate. An ester melting at 67°-67·5° C. was finally isolated which yielded montanic acid, m.p. 82°-83° C., on hydrolysis. (Found, M.W.=428; $C_{28}H_{56}O_2$ requires 425.) A pure product could not be obtained from the residual methyl esters, though the melting points and saponification values of the fractions indicated that carnaübic acid was probably the principal component. The unsaponifiable material melted completely at 77° C., softening some degrees earlier. It contained traces of a phytosterol, but analysis soon indicated that it consisted principally of a mixture of wax alcohols and hydrocarbons. It was therefore fused with potash lime, the hydrocarbons separated by extraction of the product with light petroleum. and the acids formed from the alcohols isolated in the usual manner. The hydrocarbons dissolved very sparingly in alcohol, but rather more readily in ethyl acetate, a portion being obtained after repeated crystallisation in the form of glistening leaflets melting at 64°-65° C., probably identical with *triacontane.* (Found, C=85·1, H=14·8%; $C_{30}H_{62}$ requires C=85·2, H=14·8%.) The acids recovered from the fusion separated from acetic acid as a mass of needles melting at 84° C. (Found, M.W.=442; $C_{30}H_{60}O_2$ requires 453; $C_{28}H_{56}O_2$ requires 425.) The original alcohols thus appeared to be a similar mixture to those encountered later, in all probability consisting principally of gossypyl and montanyl alcohols. The acids were not examined further.

Portion Insoluble in Hot Alcohol (C., p. T423)—

This fraction consisted wholly of amorphous resinous material which dissolved very readily in carbon tetrachloride, chloroform, or benzene, but sparingly in light petroleum, alcohol, ether, or ethyl acetate, and melted at 62°-64° C. Analysis indicated that it consisted essentially of a mixture of resin esters. (Found, acid value, 5; saponification value, 137; iodine value, 37; acetyl value, 20.)

Light Petroleum Extract. Sparingly Soluble Portion (I., p. T423)

This almost colourless crystalline material was collected in four fractions during the preliminary extraction of the crude wax. The amounts and properties of the fractions were—

Fraction 1—8·6 grams,	acid value, 12;	saponification value, 47.
,, 2—8·0 grams,	,, 11;	,, 39.
,, 3—58 grams,	,, 8;	,, 34.
,, 4—9·2 grams,	,, 12;	,, 41.

Though it was evident that the material contained a considerable proportion of esters, all attempts to separate these by fractional crystallisation failed. The fractions were therefore united, and separated into free acids, combined acids, and unsaponifiable material in the manner already described (p. T423). The unsaponifiable portion was further subdivided by fractionally extracting its mixture with sand with light petroleum, ether and benzene. There were therefore available for examination (1) free acids, (2) acids originally present as esters, (3) alcohols originally present in both free and combined form, subdivided according to their solubility in light petroleum, ether and benzene.

Examination of the Free Acids—

These were converted into the methyl esters, which were fractionally crystallised from light petroleum, yielding as least and most soluble components products melting at 75° C. and 67·5-68·5° C. respectively. The intermediate portion failed to give any fraction of constant melting point, though there were probably esters of other acids present.

The methyl ester melting at 75° C. yielded an acid which proved to be identical with the *acid* $C_{34}H_{68}O_2$ obtained from the wax of American cotton. (Found, m.p. 90° C.; M.W.=506; $C_{34}H_{68}O_2$ requires 509.)

The methyl ester with m.p. 67·5°-68·5° C. yielded an acid melting at 83° C., which consisted essentially of montanic acid. (Found, M.W.=429; $C_{28}H_{56}O_2$ requires 425.)

Examination of the Combined Acids—

The crude acids were found to contain a small amount of unsaponifiable material, and were therefore dissolved in alcohol, neutralised with potassium hydroxide, evaporated to dryness, mixed with sand, and the unsaponifiable matter removed by extraction with light petroleum. The regenerated acids then melted at 77°-83° C. (Found, mean M.W.=408), and were converted into the methyl esters. These were crystallised from light petroleum and divided into three fractions, from which, on repeated crystallisation from methyl alcohol, esters were obtained melting at 73° C., 67·5° C., and 55°-56° C.

The ester melting at 73° C., present only in very small amount, yielded an acid melting at 88°-89° C. (Found, M.W.=452; $C_{30}H_{60}O_2$ requires 453.) These figures are in agreement with those usually accepted for melissic acid.

The ester melting at 67°-67·5° C. yielded on saponification an acid melting at 81°-82° C., probably identical with montanic acid, (Found, M.W. of methyl ester=442; M.W. of acid=429. Methyl montanate requires 439, and montanic acid 425.)

The ester melting at 55°-56° C. yielded an acid identical with carnaübic acid. (Found, m.p. 72°-73° C., M.W.=371; $C_{24}H_{48}O_2$ requires 368·5.)

No indication was obtained of the presence of acids of higher molecular weight than melissic acid, or of lower molecular weight than carnaübic acid.

Examination of the Alcohols—

The three fractions of alcohols (see p. T429) were examined by the method already described,[6] the acetates being first divided by repeated crystallisation from alcohol into portions very sparingly and more readily soluble in that solvent, the former being then submitted separately to fractional crystallisation from light petroleum, and the latter united for further examination.

In this manner the portion of the original alcohols which dissolved in light petroleum yielded acetates melting at 72° C. (Found, mean M.W.=502; $C_{34}H_{68}O_2$ requiring 509); at 68°-69° C. (Found, mean M.W.=482; $C_{32}H_{64}O_2$ requiring 481); and at 64°-65° C. (Found, mean M.W.=427; $C_{28}H_{56}O_2$ requiring 425), together with residues soluble in alcohol. That which originally dissolved in ether yielded fractions melting at 71° C. (Found, mean M.W.=502); at 67°-68° C. (Found, mean M.W.=454; $C_{30}H_{60}O_2$ requiring 453); and at 64°-65° C. (Found, mean M.W.=418; $C_{28}H_{56}O_2$ requiring 425); together with material soluble in alcohol. The third fraction yielded acetates melting at 71°-72° C. (Found, mean M.W.=503); at 67·5°-69° C. (Found, mean M.W.=474); and at 66°-67° C. (Found, mean M.W.=449), and again a residue soluble in alcohol. The fractions of similar melting point and molecular weight were then united prior to further examination.

The acetates melting at 71°-72° C. were repeatedly crystallised from alcohol and light petroleum alternately, the greater part of the material eventually forming glistening leaflets, m.p. 72°-72·5° C. (Found, M.W.=505; $C_{34}H_{68}O_2$ requires 509.) The corresponding alcohol melted at 87°-87·5° C., yielded a benzoate, m.p. 69°-69·5° C. (Found, M.W.=568; $C_{39}H_{70}O_2$ requires 571), and, on fusion with potash lime, an acid, m.p. 88° C. (Found, M.W.=477; $C_{32}H_{64}O_2$ requires 481). The fraction consisted therefore essentially of the *alcohol* $C_{32}H_{66}O$ previously described.[6]

The acetates melting at 68°-69° C. formed the greater part of the original material. They were crystallised repeatedly from alcohol and melted eventually at 68·5°-69·5° C. (Found, M.W.=478; $C_{32}H_{64}O_2$ requires 481.) The corresponding alcohol melted at 84·5°-85° C., its benzoate at 65°-65·5° C., and the acid obtained on fusion with potash lime at 86° C. (Found, M.W.=450; $C_{30}H_{60}O_2$ requires 453), so that the fraction consisted essentially of *gossypyl alcohol.*

The acetates melting at 66°-68° C. were crystallised repeatedly from alcohol, the greater portion finally melting at 67°-67·5° C. (Found, M.W.=449; $C_{30}H_{60}O_2$ requires 453.) The alcohol recovered from the acetate melted at 83°-83·5° C., and yielded an acid, m.p. 83° C., on fusion with potash lime. (Found, M.W.=428; $C_{28}H_{56}O_2$ requires 425.) The fraction therefore consisted principally of *montanyl alcohol.*

The acetates melting at 64°-65° C., after repeated crystallisation from alcohol, yielded a product which melted constantly at 65° C. (Found, M.W.=429; $C_{28}H_{56}O_2$ requires 425.) The corresponding alcohol melted at 81·5°-82° C., and the benzoate at 60°-61° C. (Found, M.W.=487·5; $C_{33}H_{58}O_2$ requires 486·6.) The alcohol was therefore probably identical with ceryl alcohol.

The material separated by means of its solubility in alcohol from the mixed acetates dissolved readily in cold light petroleum, but more sparingly in alcohol, acetone, or acetic acid. It was crystallised repeatedly from alcohol, and the less soluble portion rejected, as it contained acetates of monohydric alcohols. The remainder was saponified, and the recovered alcohol crystallised repeatedly from light petroleum, ethyl acetate and benzene, when it melted at 92°-93° C., yielded an acetate, m.p. 59°-60° C. (Found, $CH_3CO=16{\cdot}0\%$), and a benzoate, m.p. 46°-48° C. (Found, $C_6H_5CO=31{\cdot}5\%$). These figures indicate the presence of a glycol, or mixture of glycols, of a similar character to those occurring in the wax of American cotton,[6] and are in agreement with those required by a *glycol*, $C_{30}H_{62}O_2$.

Ether Extract (III., p. T423)

The ether extract consisted of 17 grams of a white powder, of which 12·5 grams proved to be insoluble in ethyl acetate.

Isolation of the Glucoside of the Phytosterol $C_{29}H_{50}O$—The portion of the ether extract insoluble in ethyl acetate dissolved very sparingly in all the usual organic solvents with the exception of pyridine, and separated from a mixture of pyridine and alcohol as a mass of colourless microscopic needles. It darkened above 280° C., and melted from 295° to 300° C. On addition of a drop of sulphuric acid to the solution in a mixture of acetic anhydride and chloroform, a red colour developed, rapidly changing through blue to green. The *acetate* separated from alcohol in flat glistening needles, melting at 168°-169° C. (Found, $[\alpha]^{20}_{D}$, in chloroform solution= —21°.)

The component phytosterol and sugar were isolated by hydrolysis of the glucoside with hydrogen chloride in amyl alcohol. The former separated from a mixture of ethyl acetate and alcohol in flat needles, melting at 136° C., the mixture with the phytosterol $C_{29}H_{50}O$ (p.T 426) melting at the same temperature in the same bath. (Found, loss at 110° C., in a vacuum=3·4%; in dried material, C=83·9, H=12·3; $C_{29}H_{50}O$ requires C=84·0, H=12·1% $[\alpha]^{20}_{D}$, in chloroform solution= —33·8°.) The acetate separated from alcohol in small flat needles, melting at 125°-126° C. (Found, $CH_3CO=9{\cdot}3\%$, from which M.W. of phytosterol is 418; $C_{29}H_{50}O$ requires M.W. 414.) The sugar yielded an osazone separating from aniline in clusters of yellow needles, and melting at 210° C. Power and Salway[10] give the melting point of *d*-phenylglucosazone isolated from sitosterol glucoside as 212° C.

Portion Soluble in Ethyl Acetate—This material consisted of 4·5 grams of pale yellow crystalline solid, melting at 79° C., and sintering some degrees earlier. Analysis showed that it contained an ester, or mixture of esters, contaminated with a small proportion of free acids. (Found, acid value, 8; saponification value, 68.) It was therefore dissolved in alcohol, exactly neutralised with potassium hydroxide, evaporated to a small bulk, mixed with a little sodium hydrogen carbonate and a quantity of purified sand, dried completely, and extracted for several hours with boiling light petroleum in a Soxhlet apparatus. The extract was crystallised repeatedly from ethyl acetate and light petroleum alternately, and eventually the greater part of the material was obtained in the form of well-defined needles, melting at 86°-87° C. (Found, ester value, 63·6; $C_{60}H_{120}O_2$ requires 64·1.) In order to determine the constituent acid and alcohol, the *ester* was saponified by boiling for eight hours with excess of 0·5 *N*-alcoholic potassium hydroxide, and then most of the remaining alkali was neutralised, the solution evaporated to a low bulk, and the residue mixed with a small amount of sodium hydrogen carbonate and a quantity of extracted sand, dried completely, and extracted with light petroleum in a hot Soxhlet apparatus, which removed the alcoholic constituent of the ester and left the acids as salts mixed with the sand.

The *alcohol* melted at 84·5°-85° C. after repeated crystallisation from ethyl acetate and light petroleum alternately. It yielded an acetate, m.p. 68·5°-69·5° C. (Found, M.W., by saponification=484; $C_{32}H_{64}O_2$ requiring 481), a benzoate, m.p. 65° C., and on fusion with potash lime, an acid, m.p. 86° C., and therefore appeared to be gossypyl alcohol. The crude *acid* melted at 83°-84° C. (Found, M.W.=446; $C_{30}H_{60}O_2$ requires 453.) It was purified by conversion into the methyl ester, which separated from a mixture of methyl alcohol and ethyl acetate in minute glistening leaflets, m.p. 68°-69° C., and, on saponification, yielded an acid which crystallised from glacial acetic acid in minute needles, melting at 86° C. (Found, M.W.=456; $C_{30}H_{60}O_2$ requires 453.) The acid appeared therefore to be mainly *gossypic acid*, and the original *ester*, *gossypyl gossypate.*

Benzene Extract (IV., p. T423)

The benzene extract consisted of 3·5 grams of a dark brown wax, melting at 83°-85° C. (Found, acid value, 11; saponification value, 78.) Crystallisation from a mixture of alcohol and ethyl acetate showed that part of the material was sparingly soluble even in the boiling solvent. This part was separated and crystallised repeatedly from benzene, and then from ethyl acetate, in both of which it dissolved very sparingly in the cold. Eventually an *ester* was obtained which separated from ethyl acetate in clusters of minute needles, m.p. 86°-87° C. (Found, ester value=69; $C_{56}H_{112}O_2$ requires 68·6.) The constituent *alcohol* and *acid* were isolated in a similar manner to the constituents of gossypyl gossypate. The alcohol melted at 82·5°-83·5° C., and yielded an acetate melting at 67·5°-68·5° C. (Found, M.W., by saponification, 451; $C_{30}H_{60}O_2$ requires 453.) These figures suggest that it was montanyl alcohol, but fuller identification was precluded by the smallness of the amount available. The crude acid melted at 81·5°-82° C. (Found, M.W.=413), and yielded a methyl ester melting at 67°-67·5° C. after repeated crystallisation from methyl alcohol; the acid recovered from this separated from glacial acetic acid in minute needles, melting at 83°-83·5° C., and appeared to be montanic acid. (Found, M.W.=423; $C_{28}H_{56}O_2$ requires 425.)

These results indicate that the original ester consisted principally of *montanyl montanate*, but the amount of material available was too small to permit of more certain identification.

The material remaining after the isolation of the montanyl montanate was saponified, and separated into alcoholic and acidic components. The former melted at 84° C., and gave an acetate, m.p. 66·5°-67·5° C. (Found, mean M.W.=448); whilst the latter melted at 80°-82° C. (Found, mean M.W. =410), the mixture therefore resembling in composition the more sparingly soluble material.

Chloroform Extract (V., p. T423)

The chloroform extract consisted only of 1·8 grams of a grey powder, containing mainly the *phytosterolin* isolated from the ether extract. It was freed from small amounts of impurity by boiling repeatedly with ethyl acetate, and then crystallised from a mixture of pyridine and alcohol, forming a white microcrystalline powder which darkened rapidly above 285° C., and melted at 297° C. On addition of a drop of sulphuric acid to the solution in a mixture of acetic anhydride and chloroform, a rose colour developed which rapidly changed through blue to green. The acetate separated from alcohol containing a little ethyl acetate in needles, melting at 167·5°-168° C., the mixture with the acetate of the phytosterolin isolated from the ether extract melting at the same temperature in the same bath.

REFERENCES

1 Clifford, Higginbotham and Fargher, Shirley Inst. Mem., 1924, **3**, 31; J. Text. Inst., 1924, **15**, T.120-137.
2 Clifford and Probert, preceding Memoir.
3 Denigès, Compt. Rend., 1909, **148**, 172, 282, 570.
4 Fargher and Naylor, Shirley Inst. Mem., Series A, No. 7.
5 Fargher and Probert, Shirley Inst. Mem., 1923, **2**, 30; J. Text. Inst., 1923, **14**, T.49-65.
6 Fargher and Probert, Shirley Inst. Mem., 1924, **3**, 159-168; or J. Text. Inst., 1924, **15**, T.337-346.
7 Knecht and Allan, J. Soc. Dyers, 1911, **27**, 142.
8 Kreiling, Ber., 1888, **21**, 886.
9 Meyer, Brod and Soyka, Monatsh., 1913, **34**, 1123.
10 Power and Salway, J. Chem. Soc., 1913, **103**, 487.
11 Windaus and Hawth, Ber., 1907, **40**, 3681.

Shirley Institute
Didsbury

Received for publication, 11th April 1924.

THE MOISTURE RELATIONS OF COTTON

ii.—THE ABSORPTION AND DESORPTION OF WATER BY SODA-BOILED COTTON AT 25° C.

By ALEXANDER ROBERT URQUHART, B.Sc., A.I.C., and
ALEXANDER MITCHELL WILLIAMS, M.A., D.Sc.
(The British Cotton Industry Research Association.)

I.—INTRODUCTION

At the conclusion of Part i. of the study of the moisture relations of cotton[10] it was remarked that the experimental method there employed did not yield accurate results in the regions of very high or very low humidities. The aims of the present work are to establish complete absorption and desorption curves for one standard cotton, using a method which is trustworthy at all humidities, and to offer a possible explanation of the phenomenon of hysteresis.

Mention has already been made of the work of Trouton[9], who when investigating the absorption of water by flannel used a vacuum method capable of yielding accurate results. The flannel was contained in a bulb at the top of a barometer tube, and means were provided for admitting fixed amounts of water to the bulb. The pressure of the water in the flannel was given by the difference between the height of the mercury in the barometer tube and the true barometric height. The same type of apparatus was used in the investigation here described, but the barometer tube was replaced by a manometer, and the arrangements for the admission of water to the absorption bulb were so modified as to permit of the admission of any desired quantity of water, and not merely a multiple of some fixed quantity.

The material used throughout this investigation was soda-boiled cotton 85R, a description of which has already been given[10].

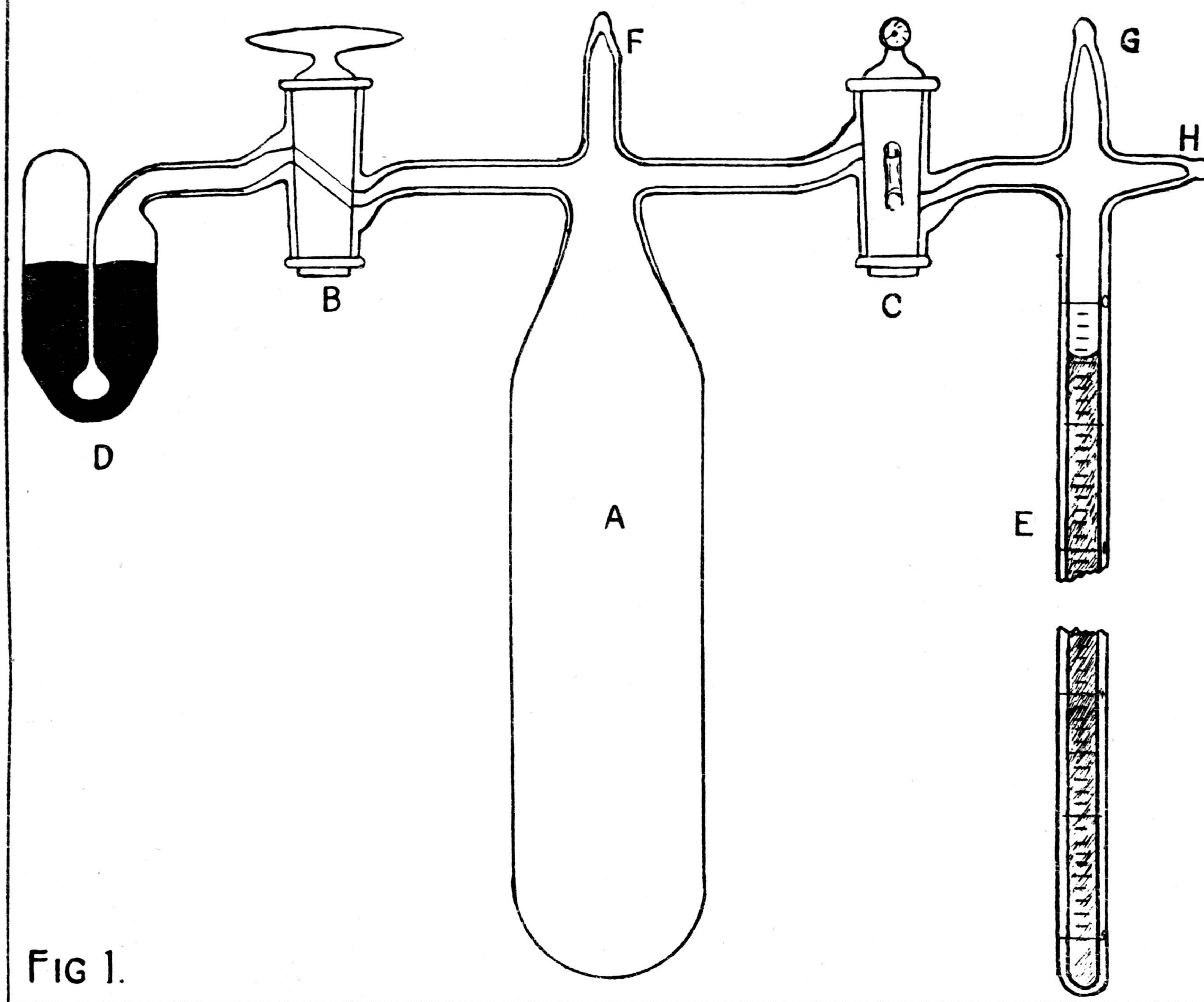


FIG 1.

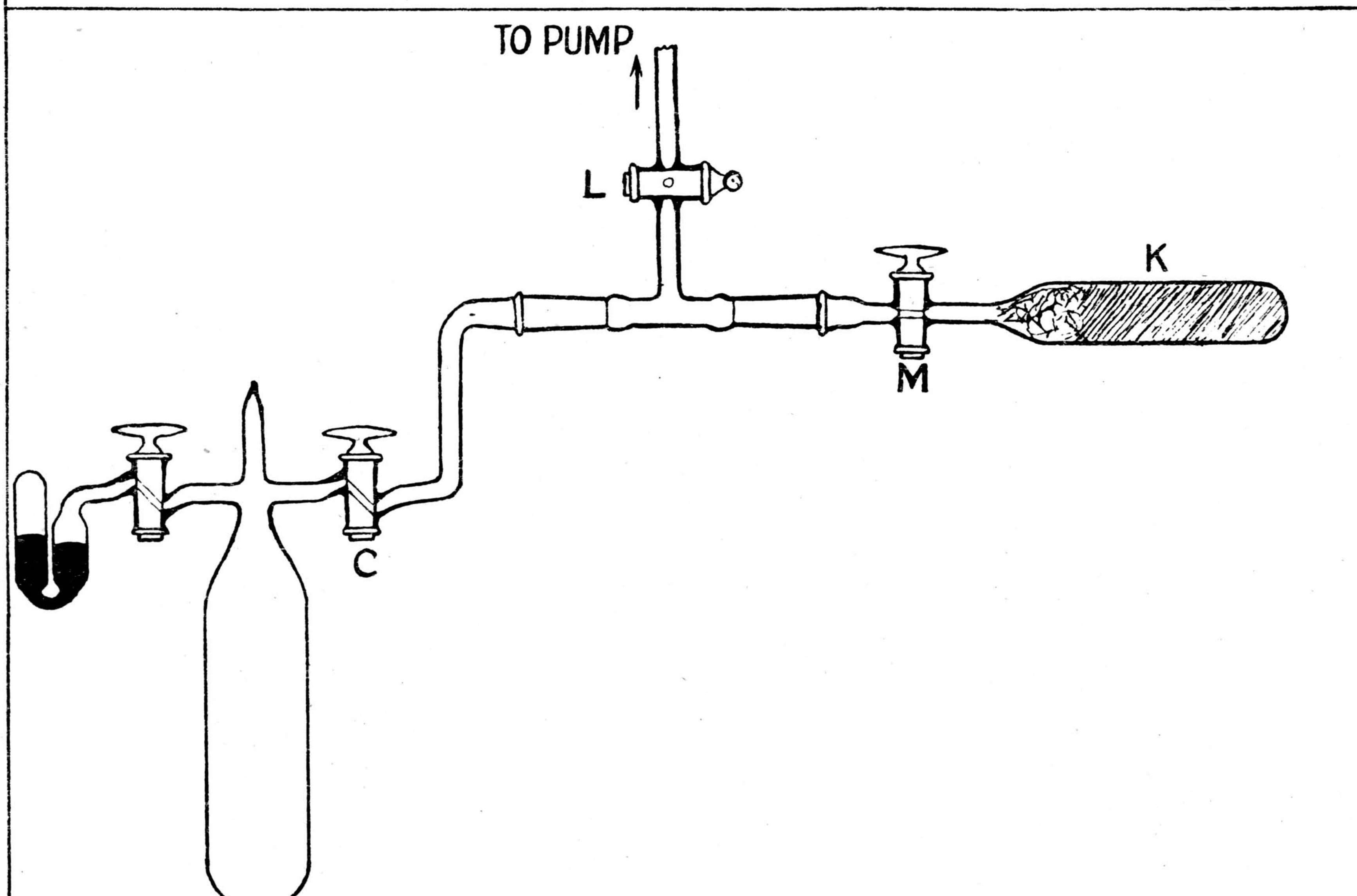


FIG. 2.

II.—EXPERIMENTAL METHODS

Preparation of the Apparatus

The apparatus is constructed entirely of glass, and consists of an absorption bulb A, Fig. 1, connected by means of taps B and C to a manometer D and a graduated tube E containing water. To prepare the apparatus, the bulb with its two side tubes and taps, C being temporarily sealed to a ground glass connection, was weighed, filled with about 10 grams of cotton by the tube F, and weighed again. The tube F was then sealed off, after which the apparatus was weighed with and without the sealed off portion. Connection to the pumping system was made by means of the ground glass joint, and the whole was evacuated to a pressure of 0·0008 mm. of mercury or less, the cotton bulb being immersed in boiling water during the evacuation. When the pressure of the system reached the above value, the apparatus was removed and weighed. The evacuation was then repeated, but a second weighing showed no difference from the first, indicating that one evacuation was sufficient to effect a complete drying of the material. From the various weights taken, the weight of dry cotton in the bulb was obtained, allowance being made for the weight of the expelled air by calculation from the known volume of the apparatus.

The taps and connections were lubricated with rubber grease, and before making any weighings, care was taken to remove all the grease from the ground glass joint. The weighings were made on a large balance capable of weighing three kilograms accurately to one milligram. The pumping system consisted of a "Cenco Hyvac" automatic oil pump, used in conjunction with a Töpler mercury pump, together with a McLeod gauge for the measurement of small pressures, and various phosphorus pentoxide tubes for the absorption of water.

The next step in the preparation of the apparatus was to seal the manometer D, together with a side tube (not shown on the diagram), to the tap B. The manometer had previously been filled with mercury and boiled out under reduced pressure in order to expel all the air from the longer limb. Evacuation of the manometer was effected through the side tube, the pump connection having been cut from the tap C for this purpose. When the evacuation was complete (the pressure being 0·0008 mm. or less) the tap B was opened so as to put the cotton bulb as well as the manometer in connection with the pump. The pressure was again brought down to 0·0008 mm., and in this way the small amount of air in the barrel of the tap B was removed. The side tube was then sealed off. In later forms of the apparatus the tap B was omitted, and the manometer was sealed to the bulb without a side tube from the beginning, and weighed and evacuated with the cotton. When this procedure was followed, however, it was necessary to allow the cotton to dry slowly, not applying heat until most of the water had been given off, otherwise the mercury in the manometer became contaminated with condensed water.

For the water tube E, a 5 cc. pipette, graduated in 20ths and easily readable to 200ths of a cubic centimetre, was calibrated and sealed at one end. Near the other end two side tubes were sealed on, and by means of these the pipette was joined on the one side to the tap C and on the other to the pumping system. Freshly boiled distilled water was poured in, and the pipette was sealed off at G. The water was then frozen in a mixture of solid carbon dioxide and alcohol (temperature, −78° C.) and evacuated. After a thorough evacuation, the pump was shut off by means of a tap, and the ice allowed to melt. In melting, a large volume of air was evolved, and was admitted to the pump by opening the tap for a moment. The water was then frozen again and the whole process repeated. After three or four repetitions no air was evolved on melting the ice, and the pressure had fallen to 0·001 mm. The apparatus was then sealed off at H.

Absorption of Water

The completed apparatus, as shown in Fig. 1, with the tap B open and the tap C closed, was totally immersed in a glass-sided thermostat controlled to 25 $\pm$ ·01° C., the taps being well covered with a very tough rubber grease to prevent leakage. After taking an initial reading of the mercury and water levels, the tap C was opened and the desired amount of water allowed to evaporate into the absorption bulb. The tap was then closed, and the new water level taken immediately. The pressure was read daily until all directional change had ceased. All the pressure measurements were made by means of a travelling microscope reading to 0·01 mm. On the attainment of equilibrium, a further quantity of water was admitted, and this procedure was continued until the cotton was saturated. The length of time required for the attainment of equilibrium varied from three or four days at low, to nine or ten days at high humidities. After a few days in the thermostat there was usually a certain amount of condensed water in the upper portion of the water tube. When the tap was opened, however, this water evaporated immediately, so that the readings of the water level taken just after the admission of water to the bulb were not in any way affected by this occurrence.

Desorption of Water

It was originally intended to remove the water from the cotton by immersing the water tube in carbon dioxide snow and opening the tap C. This method was actually used to obtain the first desorption figures at high humidities, but it was found to be too slow when the humidity was low or when it was desired to remove a large amount of water. Consequently, the apparatus shown in Fig. 2 was employed. The water tube was cut off, and in its place was sealed a connection to the pump, bent upwards so as to keep the open end out of the water when immersed in the thermostat. When the apparatus was connected to the pump and to the evacuated and weighed phosphorus pentoxide tube K as shown, the portion between the taps C, L and M was evacuated, the tap L closed, and C and M opened. When the desired amount of water had been removed from the cotton, taps C and M were closed, the tube K was removed from the pump and weighed, and the absorption apparatus was replaced in the thermostat. In this way the water was removed from the cotton in stages, pressure readings being taken as before, until the cotton had regained its initial dry state.

Calculation of Results

Knowing the volume of the water admitted to the cotton, the value of α, that is, the weight of water taken up by 1 gram of dry cotton, was readily obtained by dividing the corresponding weight by the weight of dry cotton. The readings of the mercury levels were corrected for the difference between the meniscus heights in the two limbs of the manometer, and the pressure so obtained was reduced to millimetres of mercury at 0° C., and corresponding with a value of g of 980·67 cm. per sec.^{2} Considerable difficulty was experienced in applying an adequate meniscus correction, so that eventually a manometer of internal diameter 13 mm. was used, at which size the corrections (as given by Kaye and Laby[6]) become almost negligible. For the saturation pressure at 25° C. the value 23·69 mm. (also given by Kaye and Laby) was chosen. The pressure actually observed when the cotton was saturated with water was 23·78 mm.; when the corrections mentioned above are applied this becomes 23·69 mm., identical with the value cited. Thus the value of p/P was obtained by dividing the corrected pressure by 23·69.

It is perhaps noteworthy that after water had been admitted to the cotton the pressure gradually *fell* to its equilibrium value, while after the removal of water from the cotton the pressure *rose* to its equilibrium value, indicating that the gain or loss is initially sustained by the outer layers of the material, and that the diffusion to or from the interior necessary to restore a proper balance is a more leisurely process than the absorption or desorption of water by these outer layers.

III.—EXPERIMENTAL RESULTS

The apparatus was set up in triplicate. With one apparatus (A) the complete cycle was traversed more than once, but as the results obtained in the second and subsequent cycles were identical with those obtained in the first, they are not specially indicated, though they are included, in the table and the curves (Figs. 3 and 4).

It is evident that the experimental method here employed yields considerably more accurate results than that formerly used. There are few points which lie off the smooth curve, and the agreement between the different experiments is all that could be desired. Where two identical results were obtained in different experiments only one is shown on Fig. 3 in order to avoid confusion, but both are recorded in Table I.

From the data given, a fairly accurate estimate of the moisture regain in a saturated atmosphere is obtainable. It will be observed that for $p/P=$ 0·999, $\alpha=0{\cdot}2242$, and for $p/P=1{\cdot}000$ the values of α were 0·2297, 0·2347 and 0·2362. As condensed water was observed in the absorption bulb with the last three values of α it is obvious that they are all higher than the true saturation value. Hence the saturation value lies between $\alpha=0{\cdot}2242$ and $\alpha=0{\cdot}2297$, the most probable figure being $\alpha=0{\cdot}226$. It is interesting to note here that the addition of water beyond the saturation point takes place at the constant saturation pressure.

Previous investigations[5, 8] on the hysteresis of cotton have shown the absorption curves meeting at the origin and at the saturation point. These meeting places, however, were merely assumed, and were not supported by any experimental evidence, the nearest determinations to them being some considerable distance away, where the curves were still quite distinct. The present work indicates that the hysteresis does not extend to zero humidity, but that the curves meet at $p/P=0{\cdot}018$, and that there is no apparent tendency for the loop to close at the saturation value.

Since the phenomenon of hysteresis was first observed by Van Bemmelen[2] a considerable amount of work has been done on the subject, more particularly with inorganic gels. A complete explanation of the phenomenon has yet to be found, but the hypothesis put forward by Zsigmondy[12] agrees

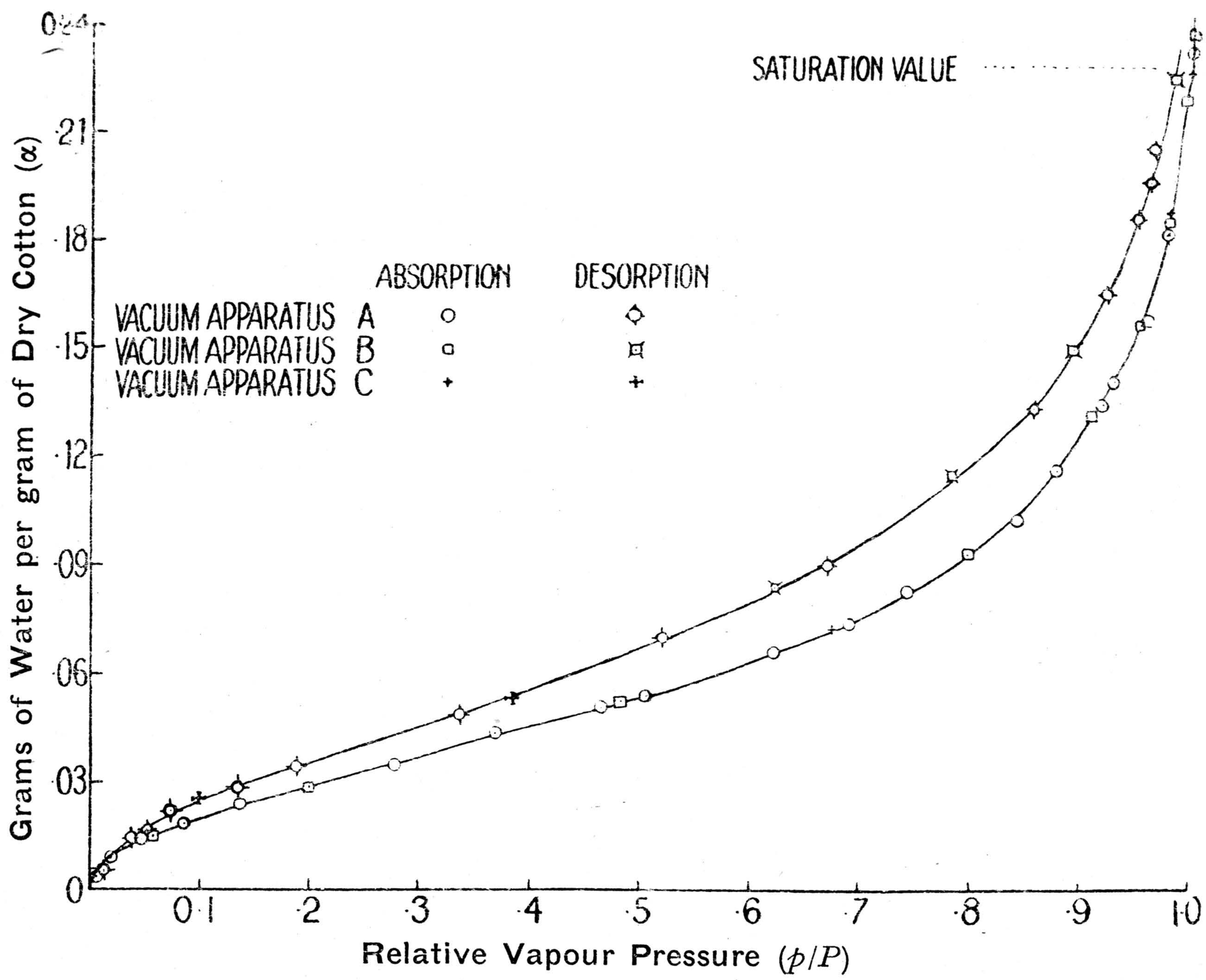


Fig. 3. Absorption and Desorption by Soda-boiled Cotton 85R, at 25°C.

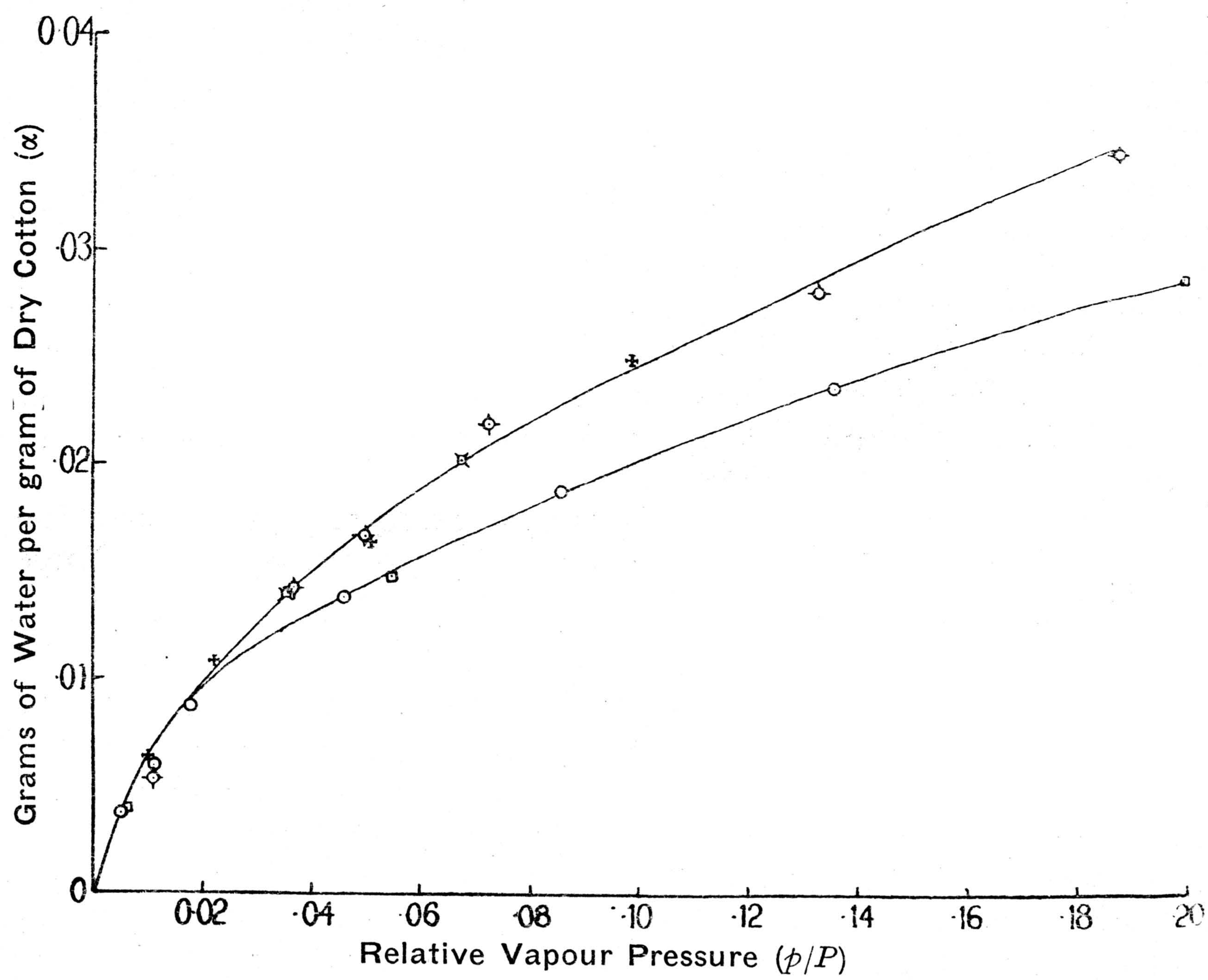


Fig 4. Large Scale plotting of Low Humidity Region from Fig. 3.

Table I.

Apparatus A — Weight of Dry Cotton, 10·236 grams

Absorption		Desorption	
p/P	α	*p/P*	α
0·005	0·0037	0·965	0·2033
0·011	0·0059	0·961	0·1940
0·018	0·0087	0·950	0·1838
0·046	0·0137	0·922	0·1633
0·086	0·0184	0·856	0·1317
0·136	0·0232	0·669	0·0895
0·279	0·0349	0·519	0·0692
0·370	0·0436	0·338	0·0482
0·464	0·0506	0·188	0·0340
0·505	0·0538	0·133	0·0276
0·621	0·0652	0·073	0·0217
0·689	0·0731	0·050	0·0165
0·742	0·0821	0·037	0·0142
0·796	0·0920	0·011	0·0053
0·842	0·1014	—	—
0·877	0·1156	—	—
0·920	0·1327	—	—
0·929	0·1394	—	—
0·960	0·1560	—	—
0·977	0·1804	—	—
1·000	*0·2297	—	—

Apparatus B — Weight of Dry Cotton, 10·370 grams

Absorption		Desorption	
p/P	α	*p/P*	α
0·006	0·0039	0·983	0·2225
0·055	0·0147	0·894	0·1484
0·200	0·0282	0·783	0·1141
0·483	0·0522	0·621	0·0837
0·798	0·0924	0·068	0·0200
0·918	0·1299	0·036	0·0140
0·954	0·1550	—	—
0·978	0·1829	—	—
0·995	0·2167	—	—
1·000	*0·2347	—	—

Apparatus C — Weight of Dry Cotton, 9·955 grams

Absorption		Desorption	
p/P	α	*p/P*	α
0·674	0·0720	0·385	0·0527
0·979	0·1854	0·099	0·0246
0·999	0·2242	0·051	0·0162
1·000	*0·2362	0·022	0·0108
—	—	0·010	0·0063

* Condensed water in absorption bulb.

fairly satisfactorily with the experimental facts. It is not proposed to discuss that hypothesis in detail here; it will be sufficient to offer a possible explanation of the hysteresis of cotton—an explanation based on that of Zsigmondy, but differing from it in some particulars.

Cotton may be regarded as a highly desiccated colloidal gel, consisting of an aggregate of minute particles or micelles held together by their mutual attractions. The spaces between the micelles will be of varying shapes and sizes, and may be regarded as a network of fine pores or capillaries. Owing to the fineness of the micelles, the surface area will be large in comparison with the volume, so that when cotton is exposed to water vapour the water molecules will be adsorbed on the micellar surfaces, the pressure exercised by the water molecules being less than saturation by virtue of the attraction between water molecule and cotton micelle. As the number of adsorbed molecules increases, the attraction per molecule will decrease, so that the pressure of the system will increase with increasing moisture content. Eventually, opposing water surfaces will unite to form a column of water in a capillary; the pressure at which this happens will depend on the diameter, the largest capillaries being the last to fill, and all being filled before or at saturation. If water is now removed from the material, the outer surfaces of the water columns will not disappear at the same point as they were formed, but the pores will gradually empty, beginning with the largest. When this process is going on, the pressure of the system will be controlled by the curvature of the water surfaces in the capillaries, in other words, by the diameter of the capillaries, so that desorption is quite distinct from absorption, and would be expected to follow a different curve connecting p/P with α. When the smallest of the capillaries have been emptied, however, further desorption results in the removal of the water adsorbed on the micellar surfaces, and so should take place reversibly.

The process as outlined above would lead to a curve similar to that experimentally obtained in this investigation, except that the hysteresis loop would close at or near the saturation value. In the above, however, only the intimate structure of cotton has been considered, neglecting the state of aggregation of the hairs. With cotton in bulk there may be another system of larger capillaries due to the spaces between the hairs. Hence, if to a quantity of cotton containing the saturation amount of water more water is added, these larger capillaries will become filled, and the subsequent emptying of them will cause a small reduction in pressure due to the curvature of the water surfaces in them, even while the cotton still contains more than the saturation amount of water. Thus it is evident the desorption curve will cut the $p/P=1$ ordinate at a value of α considerably in excess of the saturation value, the precise point depending on the closeness of packing of the hairs. Apart from the fact that the absorption and desorption curves show no tendency to join at the saturation point, no experimental evidence was obtained from the present investigation in support of the views expressed above. Evidence from other investigations, however, is not lacking. Thus Coward and Spencer[4] have shown that wet cotton retains about 50 per cent. of water after centrifuging, while some experiments of the authors on the rate of evaporation of water from cotton have shown that the water ceases to evaporate as from a plane surface when the moisture content is still considerably higher than the saturation value. Both of these results indicate that there is a point of some importance on the desorption curve corresponding to a value of α greater than the saturation value, and it is suggested here that that point may be the interception of the desorption curve with the ordinate $p/P=1$.

Coward and Spencer, however, have expressed the opinion that the 50 per cent. of water retained after centrifuging is not interstitial water, but is contained in the hairs themselves. On the other hand, Clegg and Harland[3] have published figures which indicate that in cotton the pore space is from 32 to 41 per cent. of the total volume. Even if the higher value be taken, the amount of water which could be accommodated in that space without swelling of the hair is only 31 per cent. by weight of the dry cotton. Incidentally it is interesting to note that the saturation value of the absorption from the vapour as found in this investigation (22·6 per cent.

of water) corresponds to a pore space of 36·5 per cent., a value which lies midway between the two extremes given by Clegg and Harland.

If the absorption and desorption processes take place as described, then the removal of water from cotton which has not been fully saturated ought to take place along a different desorption curve from that shown, as all the capillaries may not have been filled. This effect was not sought for in the present investigation, but it is interesting to note that Rakovski[8] obtained points lying between the curves when he removed water from an incompletely saturated material. Thus it is evident that the curves of Fig. 1 define an equilibrium area rather than form an equilibrium locus; so far as our present knowledge goes any point within that area may under suitable conditions represent a state of equilibrium between the moisture content of the cotton and the relative vapour pressure of the atmosphere.

It has been stated above that in desorption the pressure of the system is controlled by the curvature of the water surfaces in the capillaries, and hence the pressure at any point on the desorption curve depends on the diameter of the capillaries which are being emptied at that point. Thus by the use of known formulæ connecting vapour pressure and curvature it should be possible to obtain an estimate of the size of the capillaries. This could be done anywhere along the desorption curve, but probably it will be be most interesting to consider the point at which absorption and desorption curves meet in the low humidity region, as this point represents that stage in the desorption process where the smallest capillary has just been emptied, and only an adsorbed layer remains.

The formula which can be applied is that due ultimately to Kelvin,[7] as modified by Anderson,[1] namely—

$$r = \frac{2\sigma D_V}{D_L P \log P/p}$$

where r=radius of the meniscus of the water surface,

σ=surface tension.

D_V=vapour density over a plane surface,

D_L=liquid density,

P=vapour pressure over a plane surface,

p=vapour pressure over the meniscus of radius r.

It is customary to assume that the surface tension is the same as that of the liquid in bulk, whereas the real value in the case of a thin film upon an adsorbent is probably greater. Making the customary assumption, however, we find that—

$$r = 2{\cdot}54 \times 10^{-8} \text{ cm.}$$

which shows the diameter to be $5{\cdot}1 \times 10^{-8}$ cm., about one and a half times the diameter of a water molecule. This diameter represents the average distance between two opposing surfaces of adsorbed water in the smallest capillaries; twice the thickness of the adsorbed layer added to it will represent the corresponding distance between the micelles. As the thickness of the initially adsorbed layer may be taken as 4×10^{-8} cm.,[11] the diameter of the smallest pores (or the smallest distance between the micelles) is of the order 13×10^{-8}cm.

IV.—SUMMARY

(1) A method for the accurate determination of the moisture content of cotton at all humidities is described.

(2) A table and curves exhibiting the moisture relations of soda-boiled cotton at 25° C. are reproduced.

(3) Soda-boiled cotton is found to absorb 22·6 per cent. of water from a saturated atmosphere.

(4) It is shown that the hysteresis of cotton does not extend to zero humidity.

(5) A possible explanation of the phenomenon of hysteresis is put forward. This explanation involves a hypothesis with regard to the structure of cotton which is not inconsistent with botanical views.

(6) The diameter of the smallest pores in cotton is found to be of the order of 13×10^{-8} cm.

Abstract

A more trustworthy method than that previously employed,[10] and one applicable at all humidities, has been devised for determining the moisture content of soda-boiled cotton at 25° C. The results obtained again show that the curve connecting the moisture content with humidity of cotton which becomes wetter in the particular atmosphere (the absorption curve) lies lower than the curve for cotton which becomes drier (the desorption curve). Contrary to previous statements, however, these curves do not meet at zero humidity but at a point corresponding with 1·8% relative humidity. Nor do the curves meet at 100% R.H. An explanation of this phenomenon is offered which depends on a theory of the capillary structure of cotton not inconsistent with botanical views. The moisture content of an incompletely dried or incompletely saturated cotton at a particular humidity may lie on any point between the two curves At 100% R.H. the moisture content of soda-boiled cotton is 22·6 per cent.

REFERENCES

1 Anderson, Z. physikal. Chem., 1914, **88,** 191–228.

2 van Bemmelen, Z. anorg. Chem., 1896, **13,** 234; also "Die Absorption," p 233; Dresden, 1910.

3 Clegg and Harland, Shirley Inst. Mem., 1923, **2,** 356, or J. Text. Inst., 1923, **14,** T.492.

4 Coward and Spencer, J. Text. Inst., 1923, **14,** T.30.

5 Fuwa and Godbout, Text. World, 1923, **64,** 3023.

6 Kaye and Laby, "Physical and Chemical Constants"; London, 1919 (3rd edition).

7 Kelvin, Proc. Roy. Soc. Edin., 1870.

8 Rakovski, J. Russ. Phys. Chem. Soc., 1915, **47,** 18–21.

9 Trouton, Proc. Roy. Soc., 1906, **A77,** 292.

10 Urquhart and Williams, Shirley Inst. Mem., 1924, **3,** 49–58; or J. Text. Inst., 1924, **15,** T.138–148.

11 Williams, Proc. Roy. Soc., 1919, **A96,** 287.

12 Zsigmondy, "Kolloidchemie," 3rd edition, p.p. 226–227; Leipzig, 1920

Shirley Institute
Didsbury

Received for publication, 9th April 1924.

THE ELASTICITY AND TENSILE STRENGTH OF STARCH

By Sidney Maurice Neale, M.Sc.

(The British Cotton Industry Research Association.)

Abstract

The importance of starch in the sizing of cotton warps depends very largely on the tenacity with which it binds the hairs in the yarn together. Since it is very difficult to find a material to which starch paste does not adhere very firmly on drying, it is presumed that its value in sizing is mainly determined by the mechanical strength of the dried deposit of starch itself. Various pure starch pastes and mixtures containing the common sizing ingredients have therefore been evaporated to thin films on sheets of polished brass or ferrotype, and the tensile properties of these films have been studied by means of an apparatus which automatically drew their load—extension diagrams. The films were tested at 20° C. and at 34% and 66% relative humidities.

The results show that a starch film behaves very much like a ductile metal, such as copper, on loading and unloading, and that there is scarcely any difference between the elastic properties of maize, farina and sago. In dry air, the films are harder and more brittle than in moist air. Weaker films are obtained if the starch has been oxidised with hypochlorite, digested with diastophor, or prepared with acids or alkalis, and small quantities of soap in the mixing cause very considerable weakening. Glycerol, castor oil and tallow soften the films, but also weaken them if more than 5% is added, whilst a film with 4·6% of Japan wax was found to be brittle. Films containing these oils and fats are more or less white and translucent, whilst pure starch films are clear and transparent. The increasing opacity goes hand in hand with decrease in strength, especially for farina and tallow films.

INTRODUCTION

One of the functions of starch when used as a size for cotton warps is to act as an adhesive, binding together the constituent hairs of the yarn in a more effective manner than is achieved by the purely frictional clinging of the intertwined filaments. In the work now described an attempt has been made to measure the adhesive value of starch at two humidities and in the presence of various admixtures such as are commonly introduced into size.

The value of an adhesive material may consist either in the firmness with which it adheres to the surfaces it is destined to unite, or in its power of resisting rupture of its own substance. One or other of these factors may be of chief importance in any particular case, according as mechanical failures of joints occur mainly at the surface or in the body of the adhesive. If no definite information on these points is available, both sources of strength must be investigated. In the present work the internal mechanical strength of dried starch has been the sole subject of quantitative experiments, but it is thought that sufficient interest attaches to the question of surface adherence to justify the recording of some qualitative observations on the point. It is found, for instance, that starch paste dried on glass will tear the surface of the latter as drying nears completion; when dried on a glass plate coated with cotton wax, starch adheres so strongly to the wax that this is pulled as a polished surface from the glass, but no such effect occurs with paraffin wax. The adherence of starch paste to mercury and its non-adherence to ferrotype plate, aluminium coated with paraffin oil, or to polished brass have been noted in another paper.[13] Starch pastes containing soap will, however, stick well even to these. Though these observations are clearly incomplete, yet in view of the fact that it is difficult to find a surface to which starch will not stick, they suggest that the limitations to the adhesive value of starch used in sizing are determined by its mechanical strength, which has therefore been made the subject of the present experiments.

Previous Work on Similar Problems

Nelson[9] has investigated the effect of tensile stresses on films of drying oils, paints and varnishes, his results indicating that a higher rate of loading leads to smaller ultimate elongations but higher tensile strengths, and that moisture and heat soften the films and lead to greater extensibility but smaller tensile strength. The load-extension curves are nowhere straight, and may be represented by an equation of the form—$strain = constant \times (stress)^n$. $(n > 1)$. Films of common paints and varnishes also generally show a decrease in ultimate elongation, and a gain in tensile strength, as oxidation proceeds.

Mardles[8] has investigated the elasticity of organogels and films of cellulose acetate, both by direct tensile and by shearing tests. He concluded that the three kinds of strain are produced, namely, (i.) elastic deformation which instantly disappears on removal of the load; (ii.) reversible deformation, a function of time, which slowly disappears on removal of the load; and (iii.) viscous or plastic flow, which is irreversible, and is produced at a constant rate. In the shearing experiments he found that the effect of temperature on the rigidity of these gels is very large, and a much lower rigidity is obtained with a falling than with a rising temperature.

Bateman and Town,[1] working with strips of glue, found that the tensile strength increases steadily and rapidly with decreasing moisture content, while at very low humidities the glue was so brittle that tests could not be carried out.

The effect of alternating stresses on cellulose ester films was studied by Clement and Rivière,[2] who observed that with repeated loading the area between the curves connecting load with deformation became smaller until the strain was reversible, the modulus of elasticity becoming higher and the film more brittle.

EXPERIMENTAL

Material and Apparatus

The material available was a series of commercial samples of starch used in sizing, the same sample of each kind of starch being used throughout the work. Films were prepared as described by Farrow and Swan,[13] but drying was always carried out on sheets of polished brass or ferrotype. Test specimens consisting of strips of film 0·44 cm. wide and about 5 cm. long were cut by means of parallel razor blades, and the thickness was measured at half-centimetre intervals by a dial micrometer reading to one ten-thousandth of an inch. The strip under test was held in brass clamps with flat end faces, and the length between the clamps was measured by calipers. In some preliminary experiments the load was applied by weights placed on a scale pan and the extension measured either by direct microscopic observation or by means of an optical lever, telescope and scale. For the major portion of the work, an apparatus was used which drew automatically a load-extension diagram for each specimen (*cf.* Fig. 1). The test specimen A is held in the clamps B, B_1, and on extension tilts the optical lever C, which consists of a small mirror mounted on a three-legged stand which is set with two legs in a groove on the platform D, and the third resting on the plane upper surface of B_1. A converging beam of light from a collimator E is reflected by the small mirror, and focussed to a spot on a sheet of bromide paper fastened to the rotating drum F. The light iron bucket G, hanging from B by way of the spring H, is loaded by running in mercury from the uniform tube J, which contains a cylindrical iron weight K

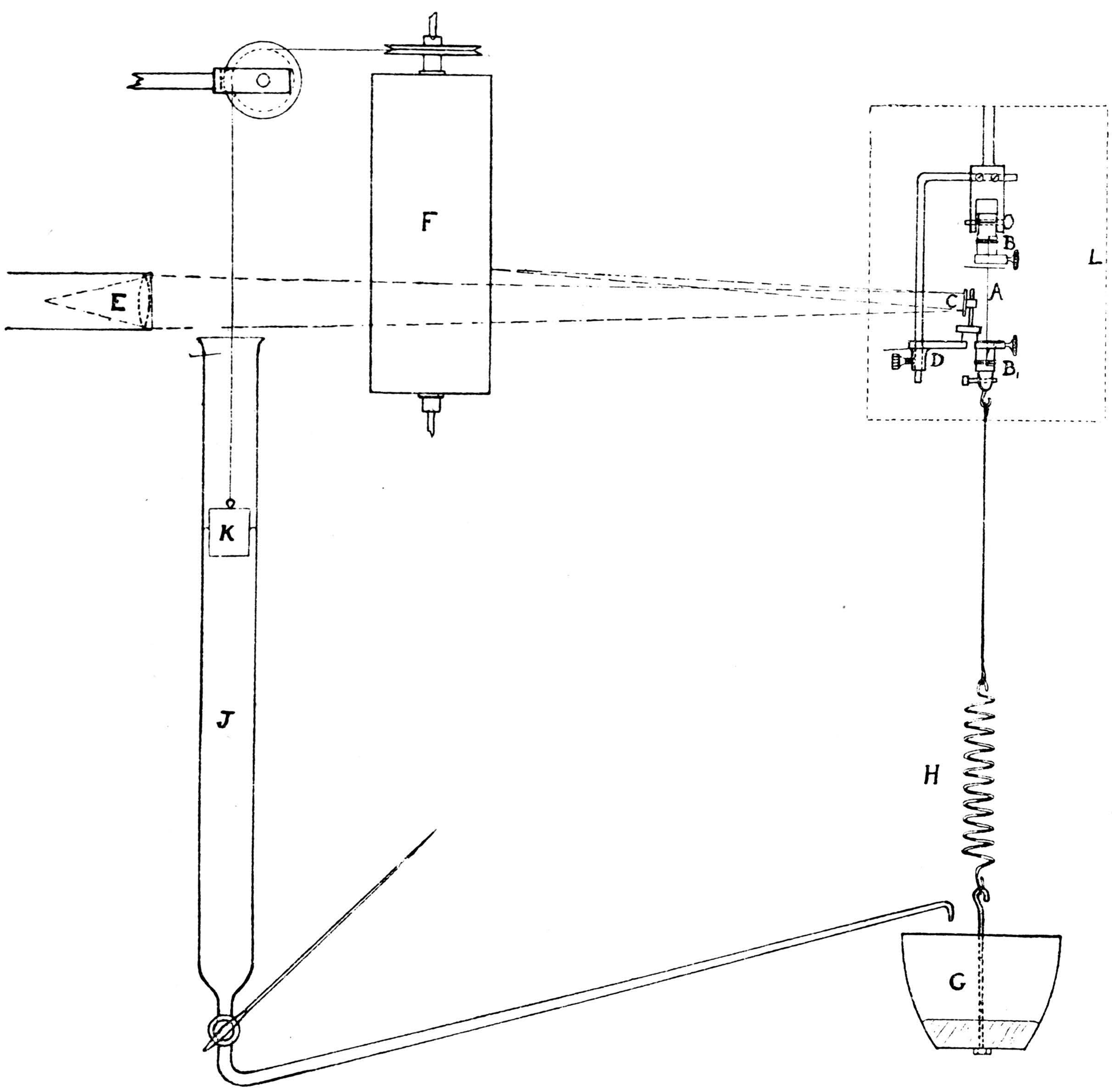


FIG. 1

floating freely. As the mercury level falls in J the drum F is rotated by means of a thread connecting it to K, and the amount of rotation is thus proportionate to the extra load on the specimen A. The extension of the film and consequent tilting of the optical lever cause the spot of light to move in a vertical direction, the result of the two motions being that a load extension diagram is impressed on the sensitive paper. When the film breaks, the movement of the spot is so rapid as to leave no trace on the paper. Another spot of light, flashing every second, is focussed near the bottom of the drum, and serves to give both a horizontal line and a measure of the rate of loading, the latter being adjusted so as to be roughly proportional to the thickness of the specimen. The test specimen, clamps and mirror are contained in an airtight glass-sided box L, which is maintained at 20° C. by an electric heater and thermoregulator. Through this box is circulated air of 34% relative humidity, obtained by passage through a saturated solution of magnesium chloride at 20° C. (vapour pressure, 5·8 mm.)[4], or of 66% relative humidity, using saturated ammonium nitrate solution (vapour pressure, 11·2 mm.)[10]. The humidities were checked by dew point measurements on the stream of air issuing from the box.

The apparatus is calibrated by observing the rotation of the drum caused by running out measured quantities of mercury from J, and by comparing vertical deflections of the spot of light with movements of B, directly observed with a travelling microscope.

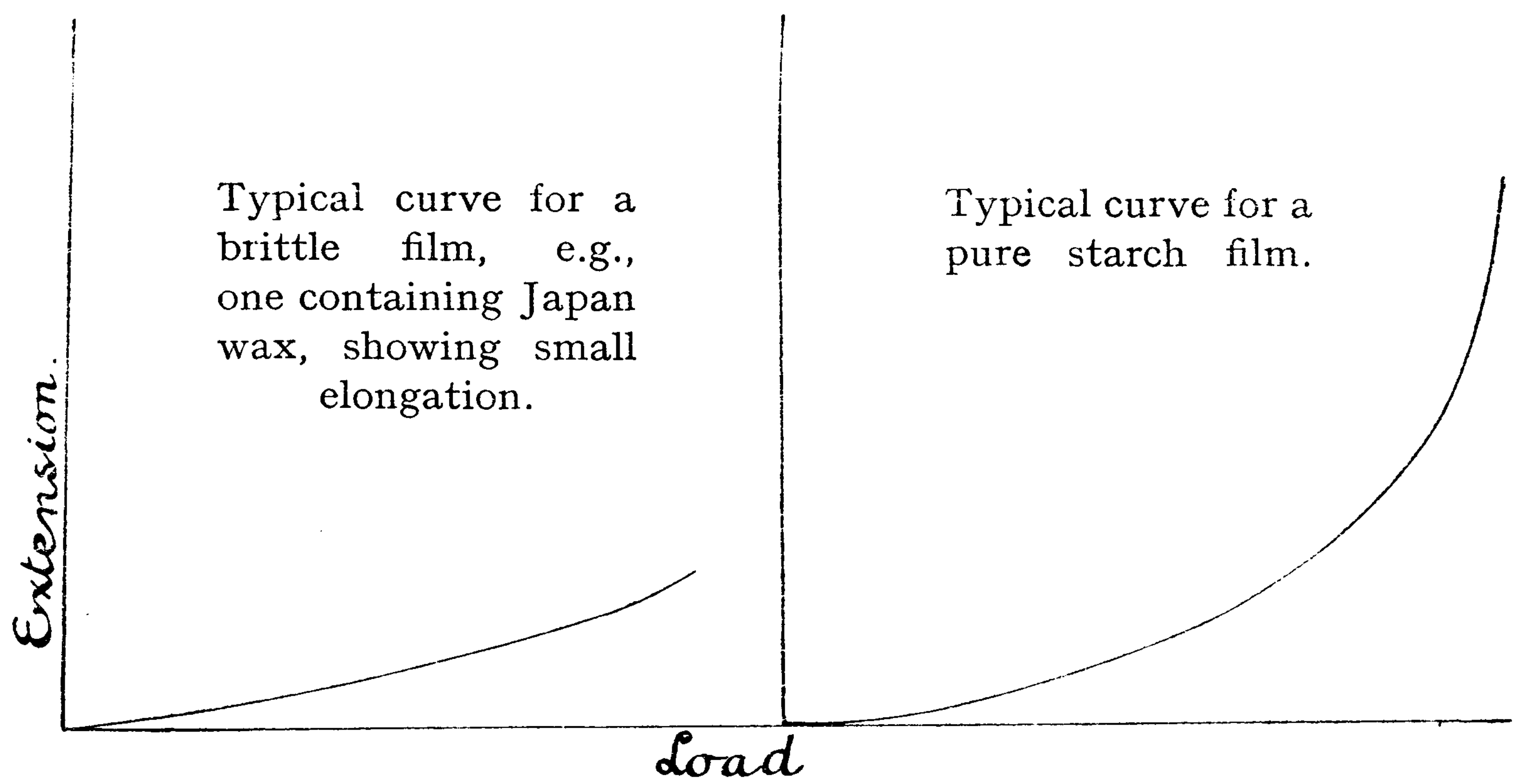


FIG. 2

The Elastic Behaviour of the Film

For a starch film, the form of the load-extension diagram (Fig. 2) closely resembles that of a moderately ductile metal, such as copper (*cf.* Dalby[3]). The curve is approximately rectilinear for small loads, but usually shows a much more rapid rise as the breaking point is approached. There is, however, no definite yield point, and the curve appears perfectly continuous. With loads below a certain value, the film instantly recovers its original length on unloading, but if the load be sufficient the instantaneous recovery is incomplete, and is followed by a slow contraction (Figs. 3, 4). This is the well-known elastic creep, generally ascribed to internal viscosity, and has been observed with many other substances, for example, iron, copper and glass[6, 7]. With high loads, especially if the time of application be considerable, a permanent stretch is observed. If the film be left under constant load, an equilibrium value of the length is approached asymptotically, but with high loads the rate of stretch is approximately constant, and the film eventually breaks (Fig. 4, *cf.* Ewing[5]). The elastic behaviour is thus very similar to that observed by Mardles[8] for cellulose acetate films, and by Maartens[12] with a rod of magnesium.

Films made from various starch preparations have been tested in the autographic apparatus, which requires about one minute for loading from zero to breaking, and the results of the load extension diagrams are conveniently expressed as—

(*a*) Young's modulus over the approximately elastic range (taken as 0-200 kg. per sq. cm.), expressed as dynes per sq. cm. $\times 10^{-10}$.

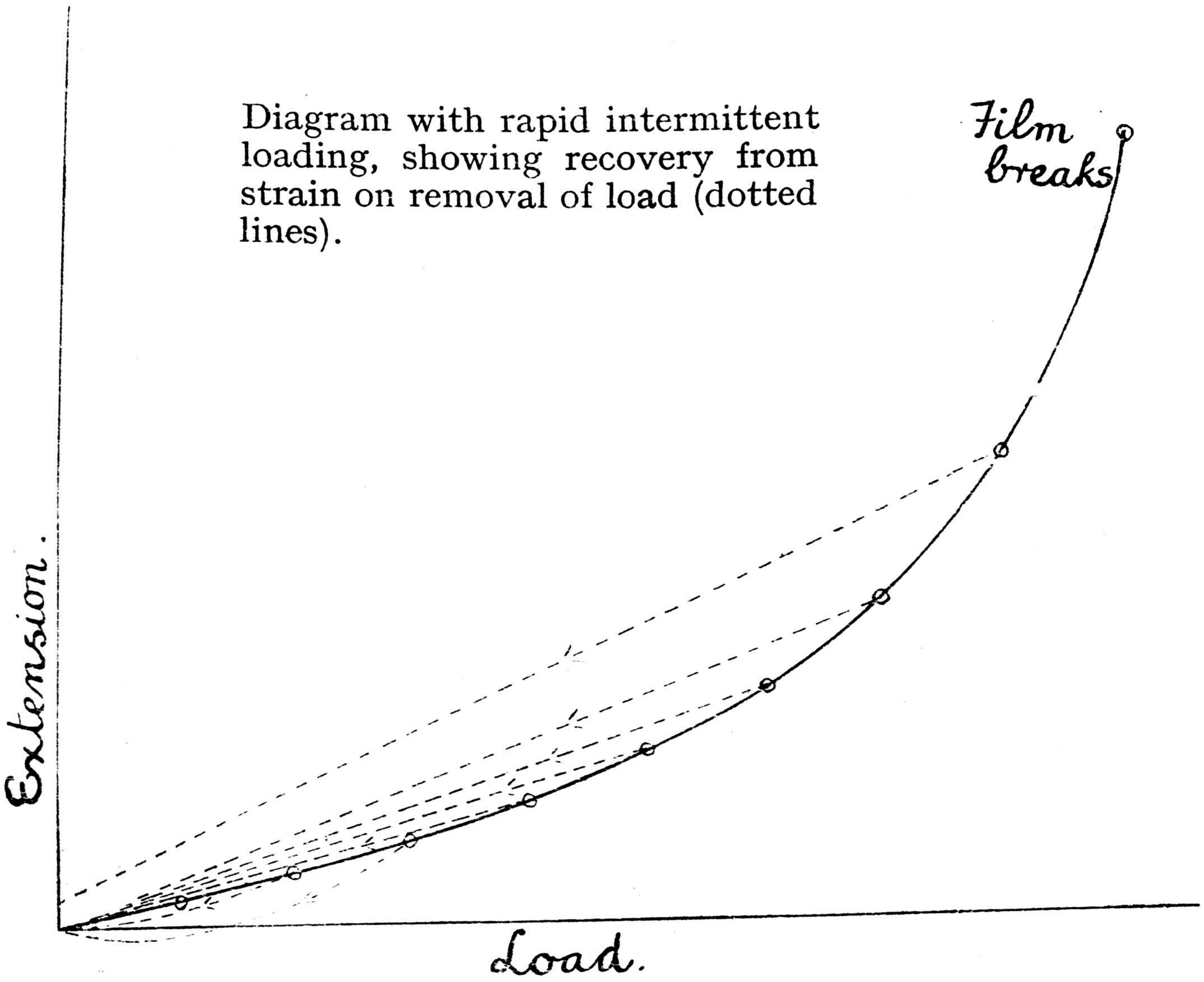


Diagram with rapid intermittent loading, showing recovery from strain on removal of load (dotted lines).
Film breaks
Extension.
Load.

FIG. 3

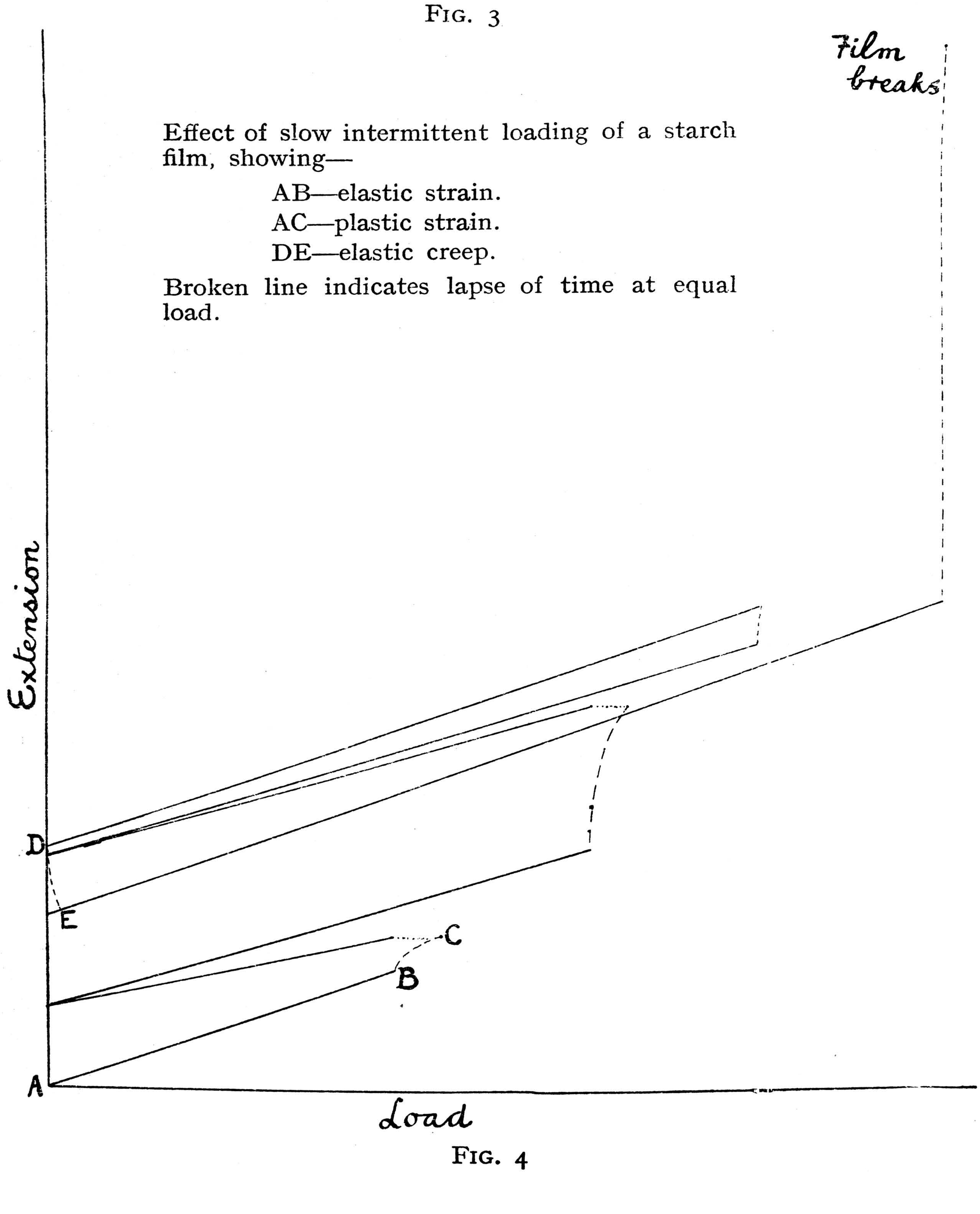

Effect of slow intermittent loading of a starch film, showing—
AB—elastic strain.
AC—plastic strain.
DE—elastic creep.
Broken line indicates lapse of time at equal load.
Film breaks
Extension
D
E
C
B
A
Load

FIG. 4

(*b*) Tensile strength, calculated per sq. cm. of original area (kg. per sq. cm.).

(*c*) Ultimate elongation, expressed as a fraction of the original length.

The values of the above constants, together with the probable errors,* are given in the specified units in the following tables—

Pure Maize, Farina and Sago Films (Fig. 5).

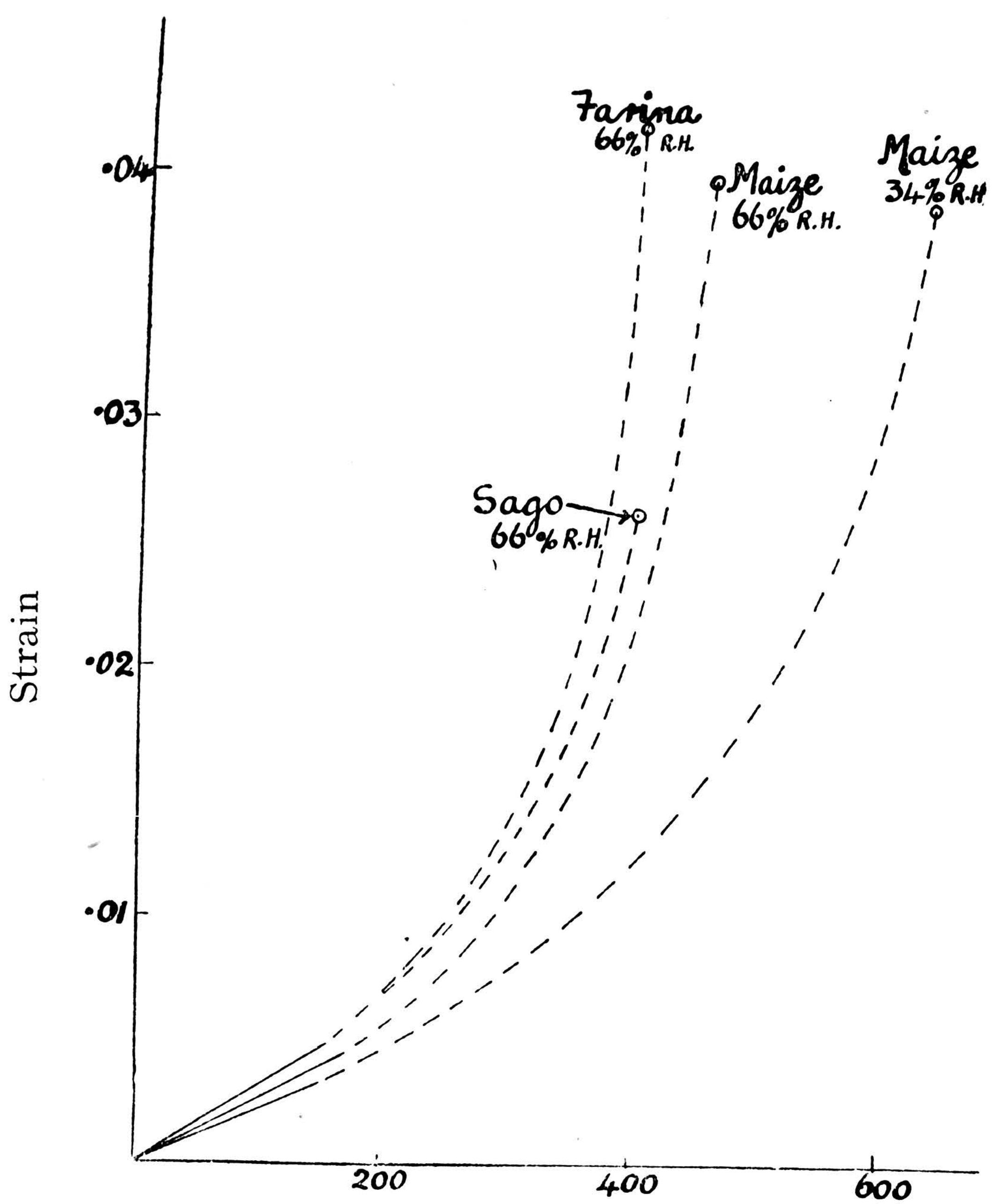
Nature of Film	Relative Humidity %	No. of Breaks	Average Thickness (cm × 10⁴)	Young's Modulus	Tensile Strength	Ultimate Elongation	Remarks
Farina I.	66	17	61	3·6 ±0·05	437±12	0·038 ±·003	
„ II.	66	16	64	3·0 ±0·1	395±9	0·040 ±·004	
„ III.	66	17	56	3·8 ±0·06	416±6	0·029 ±·002	
„ IV.	66	19	114	2·6 ±0·07	410±8	0·062 ±·004	
Average values— (I. to IV.)	66	Total 69	74	3·25	414	0·042	
Maize V.	66	9	66	3·5 ±0·06	477±20	0·049 ±·002	
„ V.	34	5	61	4·0 ±0·3	600±16	0·039 ±·001	
„ VI.	34	7	71	4·5 ±0·2	468±18	0·013 ±·002	From a paste of abnormal viscosity
„ VII.	34	10	64	5·5 ±0·2	650±13	0·032 ±·003	Four compound breaks
„ VIII.	66	14	69	3·6 ±0·02	517±5	0·048 ±·002	„
„ VIII.	34	6	61	4·45±0·1	695±9	0·045 ±·004	Five compound breaks
„ IX.	66	5	43	4·6 ±0·2	560±4	0·028 ±·003	
	66	10	104	3·36±0·04	435±7	0·048 ±·002	
„ X.	66	18	84	3·5 ±0·05	423±4	0·039 ±·003	
„ XI.	66	14	51	3·9 ±0·1	464±11	0·041 ±·003	
„ XII.	66	10	106	3·7 ±0·1	400±8	0·026 ±·002	
Average values— (V. to XII., omitting VI.)	66	Total 70	74	3·8	468	0·040	
	34	Total 21	64	4·65	648	0·039	
Sago XXX.	66	7	30·5	3·25±0·10	406±10	0·018 ±·004	
„ XXXI.	66	5	86	3·0 ±0·2	395±20	0·035 ±·007	
Average values	66	Total 12	58	3·12	400	0·026	

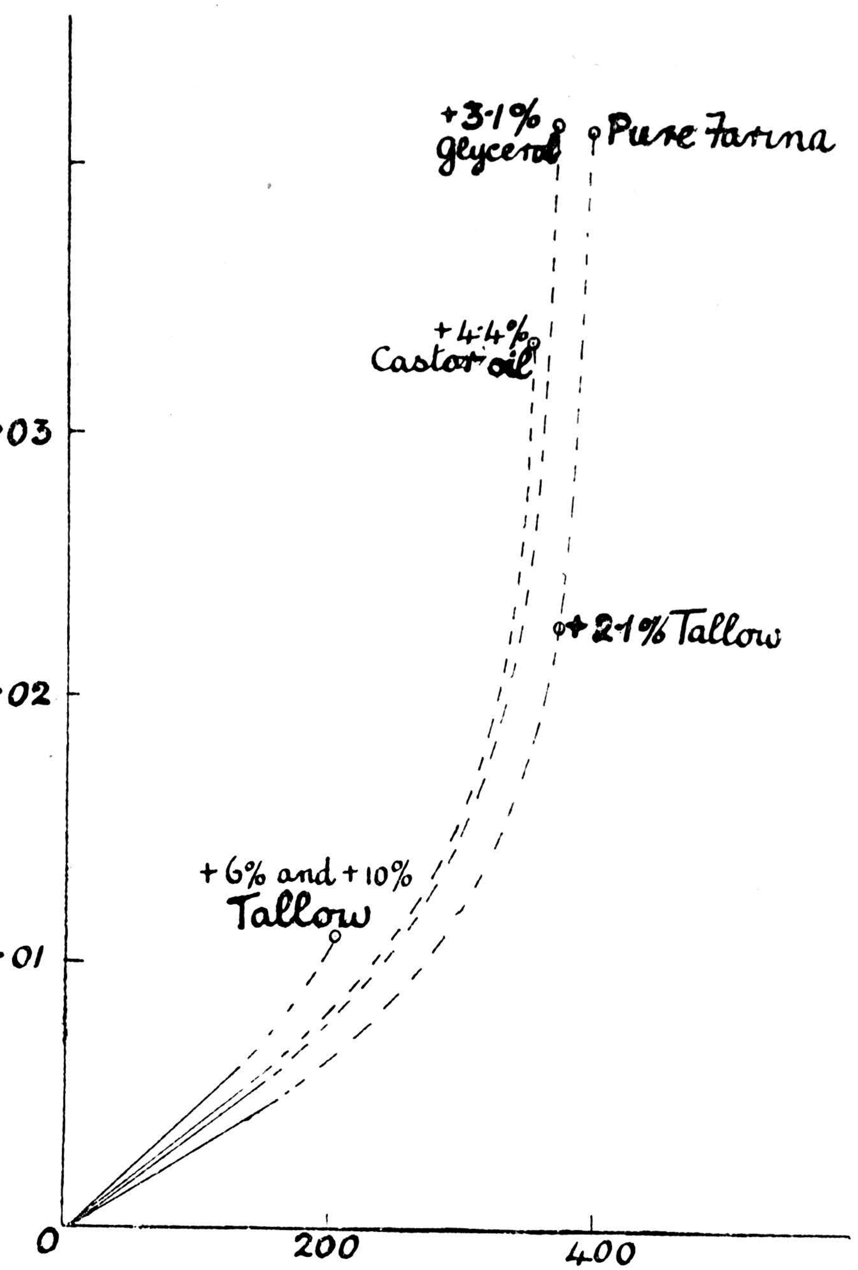
* The probable errors have been calculated by means of the formula—P.E. = 0·845 × average error ÷ √(number of observations—1).

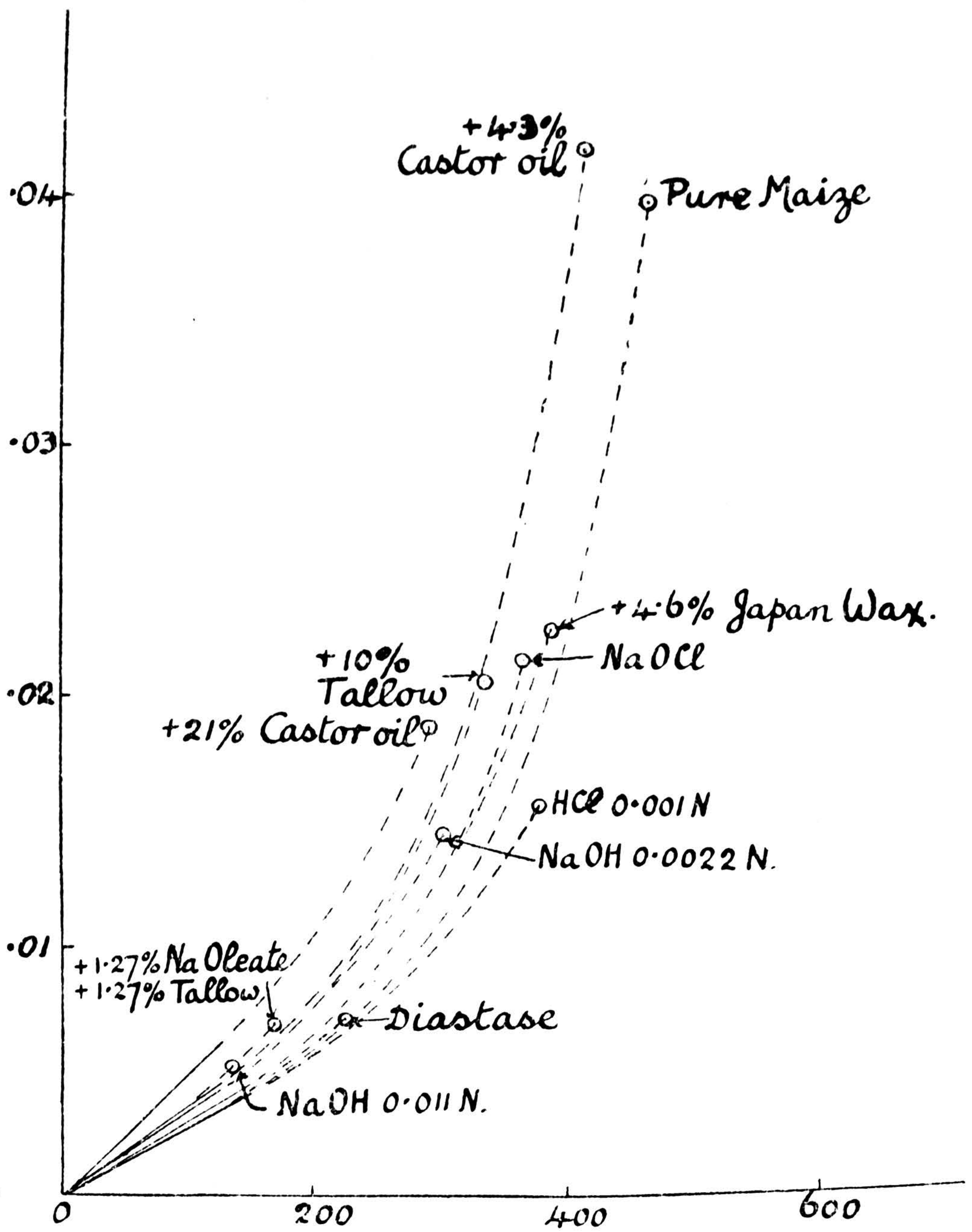
The various preparations above involve original concentrations of paste from 2·3% to 5·2%, times of steaming from 1 to 8 hours, and drying temperatures from 18° C. to 100° C., but as these factors were not found to have any appreciable influence on the properties of the film they are not specified in the table. No marked differences between the various starches are brought to light, but maize films appear to be a little "harder." There is a tendency towards increasing "softness" with increasing thickness of the film (IX., XXX., XXXI.) This effect is evidenced by a lower Young's modulus and breaking strength, with higher ultimate stretch. The maize films show at the lower humidity considerable increases in Young's modulus and in tensile strength, but increasing "brittleness" is shown by a tendency to compound breaks, that is, simultaneous fracture at more than one point.

Films of Starch with Various Additions

The foregoing measurements had shown that no marked differences are appreciable by this method between starches of different origin, and it was thought desirable to see if any effect could be detected when substances such as are normally present in size are included in the starch paste. The additional substances chosen include the "softeners," fats, glycerol and soap, while some of the preparations are such as might be expected to be produced by the published processes for making soluble starch. The results of measurements on these preparations are given in the following table, and are graphically summarised in Figures 6 and 7.







Load, kilograms per sq. cm.

FIG. 5

Average load-extension diagram of pure starch films to breaking point.

FIG. 6

Average load-extension diagram of farina films with additions.

FIG. 7

Average load-extension diagram of maize films with additions.

The initial (solid) portions of the curves, and the terminal points represent experimentally determined values. The broken curves have no quantitative significance.

Nature of Film	Relative Humidity %	No. of Breaks	Average Thickness (cm × 10⁴)	Young's Modulus	Tensile Strength	Ultimate Elongation	Remarks
XIII. Farina + 4·4% castor oil...	66	11	92	2·5 ±0·09	365±4	0·034 ±·002	
XIV. Farina + 3·1% glycerol ...	66	14	81	2·65±0·04	381±6	0·043 ±·004	
XV. Farina + 4·9% glycerol ...	66	13	92	2·3 ±0·07	319±6	0·023 ±·001	
XVI. Farina + 2·1% tallow ...	66	23	41·7	3·8 ±0·1	380±13	0·022 ±·002	
XVII. Farina + 6·3% tallow ...	66	17	171	2·15±0·06	200±8	0·011 ±·0005	
XVIII. Farina + 9·7% tallow ...	66	18	194	2·1 ±0·08	212±9	0·012 ±·0006	
*XIX. Maize + 4·6% Japan wax	34	4	64	4·4 ±0·1	530±30	0·018 ±·002	Three compound breaks
(First break)	66	3	79	3·3 ±0·1	390±20	0·023 ±·002	
(Second break)... ...	66	3	79	2·9 ±0·1	330±25	0·015 ±·003	
(Third break)	66	2	79	3·3	270	0·008	
XX. Maize + $N/72$ sodium hypochlorite in the cold, then washed & steamed	66	15	94	3·5 ±0·07	371±7	0·022 ±·002	
XXI. Maize + diastase overnight washed and steamed ...	66	11	76	4·1 ±0·1	400±20	0·014 ±·001	
XXII. Maize + diastase overnight steamed without washing	66	5	43	3·6 ±0·1	226±30	0·007±·0005	
XXIII. Maize + 0·001N-hydrochloric acid	66	13	58	3·6 ±0·12	383±11	0·016 ±·001	
XXIV. Maize + 0·0022N sodium hydroxide	66	12	53	3·10±0·1	307±15	0·0145±·001	
XXIVa. Maize + 0·0022N sodium hydroxide	66	14	84	2·9 ±0·1	340±12	0·0285±·003	Stored at 98% relative humidity before testing
XXV. Maize + 0·011 N sodium hydroxide	66	8	112	3·00±0·15	125±10	0·0046±·0004	
XXVI. Maize + 4·3% castor oil ...	66	17	104	2·76±0·07	420±6	0·043 ±·002	
XXVII. Maize + 21·3% castor oil	66	19	160	2·05±0·04	290±4	0·019 ±·001	
XXVIII. Maize + 10% tallow ...	66	17	58	2·86±0·01	336±8	0·021 ±·001	
XXIX. Maize + 1·27% sodium oleate + 1·27% tallow	66	8	153	2·75±0·1	163±7	0·0072±·0004	Film full of fine cracks

*With Film XIX. a fragment of the first broken piece was tested again, then a fragment from the second break, and so on; a progressive decrease in strength in the successive pieces was revealed.

Effect of Previous Treatment of the Starch

Partial oxidation of maize starch with sodium hypochlorite leads to a slightly weaker film (XX.). Treatment with diastase causes a pronounced loss of both strength and elongation (XXII.), but the effect is not so marked if the starch is washed with cold water after the diastase treatment (XXI.). This would suggest that the more or less soluble products of hydrolysis, which are partly removed on washing, are possessed of very little mechanical strength.

Effect of additions to the Starch Paste

(i.) *Acids and Alkalis*—Maize films (XXIII., XXIV., XXIVA, XXV.) show a considerable weakening effect due to incorporation of hydrochloric acid or of sodium hydroxide in the paste. The films containing alkali were so brittle that it was necessary to store them for several days at 98% relative humidity before test specimens could be cut.

(ii.) *Soaps*—Pastes were prepared containing either sodium oleate or ordinary household soap to the extent of 2% and 10% of the weight of dry starch, but these adhered strongly to the plates on drying, and finally broke into small pieces. It was found possible to prepare a film containing soap and tallow in equal proportions (XXIX.), but it was very brittle, and contained a large number of very fine cracks. The film was stored as before at 98% humidity before cutting, and gave very low values for strength and elongation.

(iii.) *Glycerol*—The addition of 3% of glycerol has a softening effect without appreciable loss of strength or elongation (XIV.), but 5% of glycerol (XV.) produces an appreciably weaker film.

(iv.) *Oils and Fats*—Castor oil, tallow and Japan wax were chosen as typical examples, and were emulsified in the paste by the process of steaming. The films were usually distinguishable from pure starch films, for these are almost perfectly clear and transparent, whereas those containing oil or fat

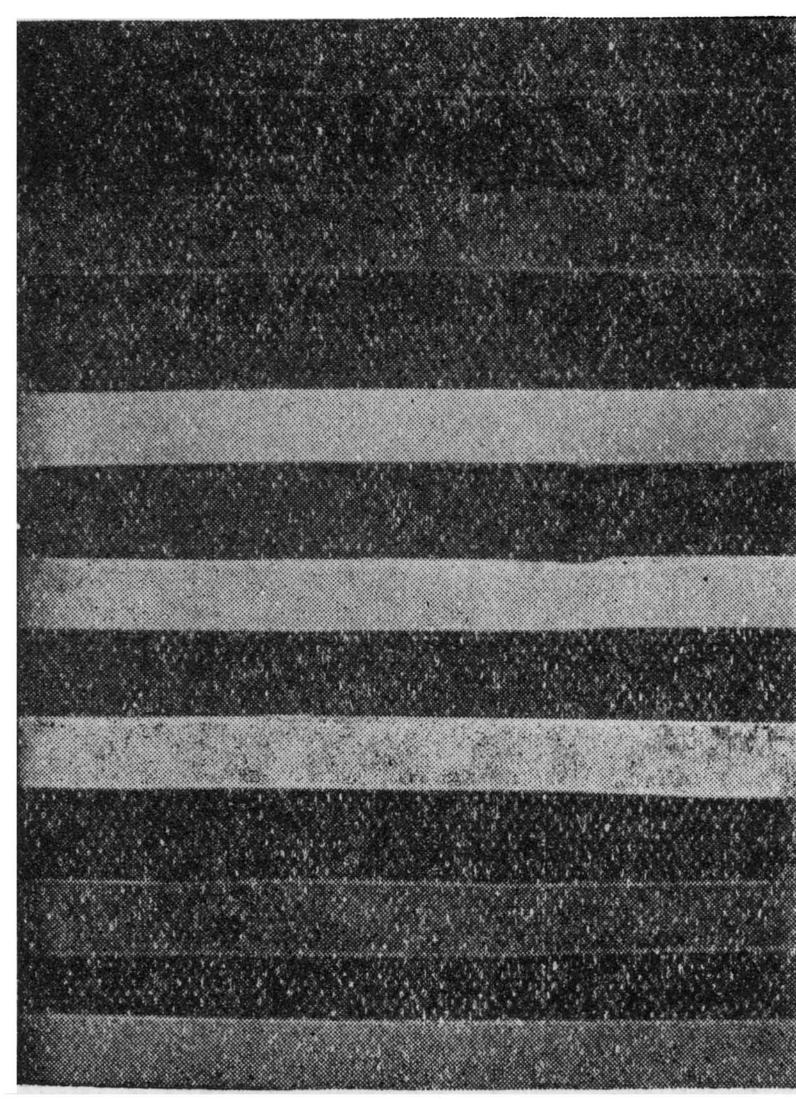


Fig. 8

Strips of starch film photographed on a black background, showing increasing opalescence due to the presence of fat.

are more or less white and translucent. The opacity increases in the order castor oil, tallow, Japan wax (*cf.* Fig. 8).

The addition of 4% of castor oil causes softening of the film without appreciable loss of strength (XIII., XXVI.), but a film containing 21% of castor oil is much weaker (XXVII.). Farina films containing 2%, 6% and 10% of tallow exhibit a curious parallelism between appearance and breaking strength. Fig. 8 shows that the films containing 6% and 10% of tallow are quite opaque, whilst that containing only 2% of tallow is less transparent than the pure starch film. Corresponding with this, Film XVI. (2% tallow) has elastic constants practically the same as those of the pure starch film, whilst films XVII. and XVIII. show much lower values. With maize film, however, the increase in opacity and decrease in strength brought about by addition of tallow are less pronounced (*cf.* Fig. 8, film XXVIII.).

Japan wax exerts a still greater weakening action (XIX.), the decrease in ultimate elongation being especially marked. This film was very brittle at 34% humidity, and usually shattered into several small pieces. At the higher humidity a very considerable decrease in strength was observed on breaking and reclamping specimens of this film, suggesting that such a film would be easily destroyed by alternating stresses. Other films usually show an increase in strength after each break, presumably owing to elimination of the weakest spot. The behaviour of films containing Japan wax is very similar to that observed by Griffith[7] with freshly drawn glass and quartz fibres, which shattered on breaking and showed a large reduction in the strength of the remaining pieces.

SUMMARY

The paper describes experiments made with the object of ascertaining the physical properties of starch in the form in which it is used as an adhesive. For this purpose pure starch pastes, as well as mixtures containing other sizing ingredients, have been evaporated to thin films suitable for mechanical testing. The results of the tests are summarised as follows—

1. The general elastic behaviour of a starch film is very similar to that of a ductile metal.
2. Maize, farina and sago films exhibit almost identical elastic properties.
3. The method of preparation of pure starch films has little effect on their properties, but thick films are weaker than thin ones of equal section.
4. Starch films are "harder" and more brittle in atmospheres of low humidity.
5. Oxidation or hydrolysis of the starch or the addition of acids or alkalis weakens the film.
6. Small quantities of soaps have a very large weakening effect.
7. Additions of glycerol, castor oil, or tallow have a softening effect on the film, loss of strength also becoming evident if more than about 5% be added.
8. A film containing 4·6% of Japan wax has been found to be comparatively weak and brittle.

It must be emphasised that these results refer only to the strength of the dried size, and their application will be dependent on a fuller knowledge of other factors, such as penetration, adhesion and lubrication. To obtain the maximum strength in the body of the adhesive, a pure starch paste is indicated as superior to mixtures, but the presence of other substances may possibly be desirable to produce a sized yarn with the best weaving qualities.

Much of the experimental work has been done by Mr. E. Jones.

REFERENCES

1 Bateman and Town, J. Ind. Eng. Chem., 1923, **15**, 371.
2 Clement et Rivière, "La Cellulose"; Paris, 1920.
3 Dalby, Proc. Roy. Soc., 1912, A**86**, 424; 1913, A**88**, 281.
4 Denby and Yngve, J. Amer. Chem. Soc., 1916, **38**, 1439.
5 Ewing, "The Strength of Materials," p. 24; Cambridge, 1914.
6 *Ibid*, p. 35.
7 Griffith, Phil. Trans., 1920, A**221**, 183.
8 Mardles, Trans. Faraday Soc., 1923, **18**, 327.
9 Nelson, Proc. Amer. Soc., Testing Materials, 1921, **21**, 111.
10 Prideaux, J. Soc. Chem. Ind., 1920, **39**, 182T.
11 Unwin, "The Testing of Materials of Construction," p. 17; London, 1910.
12 *Ibid*, p. 112.
13 Farrow and Swan, Shirley Inst. Mem., 1923, **2**, 329, or J. Text. Inst., 1923, **14**, T.465.

Shirley Institute
Didsbury

Received for publication, 1st *April* 1924.

ABSTRACTS

1—FIBRES AND THEIR PRODUCTION

(B)—Animal.

Selection of Flax; Studies in——. I.—Morphological Characters Utilised for the Separation and Control of Pure Lines. L. Blaringhem. *Rev. Bot. Appl. et Agric. Coloniale*, 1923, **3**, pp. 3-25.

Experiments for the selection of true-breeding fibre flaxes of high quality have been conducted since 1918 with *Linum usitatissimum* and *L. angustifolium.* The use of morphological characters, such as colour of flowers and seed, height of stem, form and shape of capsules, and branching and notching of seed within the capsules, has played a considerable part in the recognition of varietal impurities in commercial varieties. Most plants proved self-fertilised, so indicated immediately after flowering by the undisturbed pollen on the stigmas. It was found that fibre flaxes of good quality were accompanied by a higher percentage of aborted pollen grains than non-fibre flaxes. Also the tallest and most vigorous plants showed less perfect sexual organs. Lines with short distant internodes of 4 cm. or less were characterised as possessing good fibre characters. Apple-shaped capsules seemed to be characteristic of late and long fibre flax. Ciliated and non-ciliated septs were observed in varying ratios in all varieties under test. Only one flax bred pure for this character. From several selections of Russian flax one line named EGBK proved to be constant for five generations at least under dry and humid conditions. —L. I. R. A.

Sericulture in Algeria, Italy, and Bulgaria. *Bull. des Soies*, 1924, **48**, No. 2458, p. 6.

About 33 hectogrammes of seed were incubated for the Algerian crop of 1924. For the Italian crop 300,000 hectogrammes of seed is being used, compared with 220,000 hectogrammes for 1923. In Bulgaria the area under mulberries for 1924 is 4,000 hectares, compared with 3,200 in 1923, and 12,000 hectogrammes of seed, compared with 9,290 hectogrammes in 1923. —F. G. P.

Japanese Silk Harvest for 1923. *Bull. des Soies*, 1924, **48**, No. 2456, p. 7.

In spite of damp weather there was an increase of 14% over the figures for 1922. This is due partly to the high price of silk and partly to the progress made in cultivation. —F. G. P.

Machine Made Raw Silk. H. F. Hofer. *Amer. Silk Jl.*, 1924, **43**, No. 4, 73.

The label "machine made" attached to Japanese raw silk does not necessarily imply that it is steam-reeled. It denotes, rather, uniformity in preparation whether reeled by hand, foot or steam. Lower quality silks are produced, not by accident, but with intention, as it sometimes pays better to turn out inferior thread. The author does not consider that inspection by American buyers is sufficiently thorough to keep the filatures up to a high standard. A test of $\frac{1}{3}$% does not show accurately the quality of the remaining 99$\frac{2}{3}$% —F. G. P.

Structure of the Silk Fibroin. See Section 6.

Silk Fibroin: X-ray Analysis. See Section 6.

Colour Reactions with Wool. See Section 6.

Action of Sea Water on Wool and Silk. See Section 6.

(C)—Vegetable.

Pima Cotton: Pollination. T. H. Kearney. *U.S. Dept. Agric. Bull.*, **1134**, 1923, 68 pp.

Evidence is presented that although the cotton flower is admirably adapted to cross-pollination, most of the ovules usually are self-fertilised. The percentage of natural hybrids produced when two distinct varieties or types are grown side by side ordinarily is not large. In the Egyptian type of cotton particularly self-fertilisation has been found to predominate greatly over cross-fertilisation. Investigations, which are described, of the structure and later ontogeny of the flower, of the deposition of self pollen and of foreign pollen upon the stigmas, and of the competition of like and unlike pollens, contribute to an explanation of the predominance of self-fertilisation. Other aspects of the subject treated are the local and seasonal differences in the relative completeness of fertilisation and the effect upon fertility of continued self-fertilisation. Most of the data and conclusions relate to the Pima variety of Egyptian cotton, but comparison with Upland cotton has frequently been made. —B. C. I. R. A.

Upland-Egyptian Cotton Hybrid. T. H. Kearney. *U.S. Dept. Agric. Bull.*, 1923, No. 1164, 57 pp.

The Holdon variety of Upland cotton, a representative of the Texas big boll group, was crossed with the Pima variety of Egyptian cotton, and the resulting hybrid was studied in the first, second and third generations. Detailed results of the investigation are given, and it is inferred that, although the data on correlation indicate relative freedom of recombination, the chances are heavily against the isolation and fixation of a productive type of cotton, combining the most desirable characters of both parents, from the segregation products of so wide a cross as that between Upland and Egyptian. It is also evident that accidental cross-pollination between these cottons cannot but greatly impair both the uniformity and the fertility of either type. Both conclusions are in agreement with the practical experience of cotton breeders. —B. C. I. R. A.

Cottonseed Lint Hairs: Wall Thickness. *Chem. Abstr.*, 1924, **18**, 585 (from *Paper Mill*, 1923, **47**, 38, 40).

In connection with the use of linters for paper making, it is stated that that portion of the cotton hair which is rooted in the shell of the seed has much thicker walls than the hairs removed by the gin. —B. C. I. R. A.

Subsoil Nutrients: Efficiency. J. W. Crist and J. E. Weaver. *Bot. Gazette*, 1924, **77**, 121-147.

Experiments made to determine the effects of absorption of nitrates and phosphates from the subsoil on the quantity and quality of yield of barley show the importance of the subsoil as a source of nutrients for crops, and emphasise the values to be gained by fertiliser practices which take the composition of the subsoil into account. —B. C. I. R. A.

Tobacco. J. A. Honing. *Genetica*, 1923, **5**, 455-476.

In 1914 a bastard was developed from the *Deli* tobacco of Sumatra and named *Nicotiana deformis*. This species does not flower in the tropics, but regularly flowers in moderately warm greenhouses in Holland, where it has been proved to be constant. It is characterised by anomalous leaves and flowers and stunted growth, strongly suggestive of the "Kroepoek" disease of tobacco or mosaic diseases. The suggestion is made that the difference from normal *Deli* tobacco is quantitative, with an enzyme-like genetic factor. —B. C. I. R. A.

Artificial Light; Growth of Plants in——. R. B. Harvey. *Minnesota Sta. Report*, 1922, p. 103.

A brief account is given of experiments previously noted (*Exp. Station Record*, **48**, p. 26). The plants were grown in artificial light entirely, from the germination of the seed to the production of seed, during the winter season. The following points are noted—The method was not found to be excessively expensive. The light was left on continuously, and the time required to ripen fruit in artificial light was considerably shorter than that required out of doors in summer. None of the plants tested seemed to require a certain period of illumination to cause them to bloom. —L. I. R. A.

Plant Cell Walls. Mary E. Wurdack. *Bot. Abstr.*, 1924, **13**, 441 (from *Ohio J. Sci.*, 1923, **23**, 181-191).

The chemical composition of the walls of certain algae has been studied. Cellulose was identified by double refraction, solubility in cuprammonium solution and blue colour with iodine and sulphuric acid. Pectic acid was identified by single refraction in polarised light, and solubility in dilute alkali. Pectose was determined by the solubilities of the products of acid digestion. Chitin was detected by single refraction and the chitosan reaction. Chitin, and in some cases pectic substances, prevented the entrance of copper and iodine into the cell. B. C. I. R. A.

Cotton Cultivation in South Africa. W. B. Wilson. *Bot. Abstr.*, 1924, **13**, 330 (from *South African Sugar J.*, 1923, **7**, 808e-808g).

Cotton is suggested as a good crop to rotate with Uba cane in the Umhlali district. October seems the best month for planting. It should not be grown in the same field for a period of years because of the rapid spread of the boll rot and the insect causing the staining of the lint. Sea Island cotton does not grow well; the temperature is not high enough, and it is susceptible to plant diseases and pests. Good varieties of cotton for this region are Griffin or Bancroft Improved, Cleveland Big Boll, and Watts' Long Staple; the last is susceptible to insect pests. —B. C. I. R. A.

Cotton Stalk. M. N. Komarov. *Chem. Abstr.*, 1924, **18**, 1196 (from *Bumazhnaia Promyschlenost*, 1923, **2**, 206-210).

A study of the stalk of a bushy Asiatic cotton plant (name not given) as a paper-making material is described. A cross section of the stalk shows layers of bark, wood and pith. The inside bark consists of long bast fibres. The outside is covered by a thin skin. The pith is made up of thin-walled cells. The composition shown by analysis is—Bark, 32·7; wood, 65·1; pith, 2·2%. The layers were treated separately with 10% nitric acid at 60°-70°, followed by 2% sulphuric-nitric acid solution, and the following amounts of cellulose determined by the Cross & Bevan method—Seed, 36·4; bast, 32·9; wood, 40·4; root, 38·5%. Fibre measurements of average length and width respectively were—Bast, 2·5 and 0·02 mm.; wood, 1·0 and 0·025 mm.; roots, 1·0 and 0·025 mm.; seed fibres, 0·5 and 0·02 mm. Photomicrographs of the fibres are given. —B. C. I. R. A.

Action of Sea-water on Cotton. See Section 6.

Cotton Hairs: Testing. See Section 6.

Cotton Dusting Machinery. See Section 10.

Diseases in Flax. See Section 10.

(D)—Artificial.

Cellulose. Emil Heuser. *Papierfabr., Verein Zellstoff und Papier section*, 1924, **22**, 157-162.

A report of an address on the place of research in industries using cellulose. Several problems discussed are more specially those of the paper industry, but the lecturer also dealt with bleaching, mercerising and artificial silk. He is convinced of the importance of researches into the structure of cellulose, whether by means of X-rays or by the methods of organic chemistry. On the subject of mercerisation, he describes experiments in which "alkali cellulose" freed from adhering alkali as much as possible was extracted with boiling alcohol in a Soxhlet apparatus. Extraction ceased when the cellulose still contained a quite definite amount of alkali, but this amount depended on the concentration originally employed; more alkali was fixed from the more concentrated solutions. —B. C. I. R. A.

Lignin. Rud. Riefenstahl. *Z. Angew. Chem.*, 1924, **37**, 169-177.

A review of the present knowledge of the chemistry of lignin, with 178 references to the literature. —B. C. I. R. A.

Cellulose: Action of Alkali. F. Fischer and H. Schrader. *Chem. Zentr.*, 1924, **i.**, 2421 (from *Ges. Abh. zur Kenntnis der Kohle*, 1921, **6**, 115-127).

The products formed by heating filter paper with 5 *N*-sodium hydroxide in a high-pressure autoclave at 240°-450° C. have been examined. Acids are formed at 240° which with rise of temperature change into oils insoluble in alkali, these amounting to 18% of the initial cellulose at 400°. The proportion of volatile acids (chiefly formic and acetic) rises with rising temperature, 60 grams of cellulose giving as much as 373 cc. of *N*-acid, but the proportion of non-volatile acids falls. Oxalic acid is only formed in mere traces, but the main constituent of the ether-soluble fraction of the non-volatile acids is lactic acid. Pyromucic and succinic acids and mesityl oxide were also identified. —B. C. I. R. A.

Lignin in the Years 1918-1923. Hess. *Faserstoffe und Spinnpfl.*, 1924, **6**, No. 3, pp. 28-30.

A summary of recent work bearing on the nature and constitution of lignin. Thirty-six references to the literature are given. —L. I. R. A.

Cuprammonium Silk Manufacture. L. S. Fryer. *Chem. and Met. Eng.*, 1924, **30**, 743-748.

A general account of the manufacture of artificial silk by the cuprammonium process. —B. C. I. R. A.

Expansion of French Artificial Silk Industry. *Amer. Silk Jl.*, 1924, **43**, No. 2, p. 80.

A new organisation with a capital of fifty million francs and a plant for 4,000 kilos per day is to be completed in 18 months somewhere in Northern France, in the neighbourhood of other factories of artificial fibre, which are booked up with orders. —F. G. P.

Viscose Co. makes Yarn from Cotton Linters. *Amer. Silk Jl.*, 1924, **43**, No. 4, 95.

The fibre is said to be 10% stronger than that from wood pulp, of which the great bulk of viscose is at present made. It is stated that linters will be used exclusively. —F. G. P.

Patents

Cellulose Solutions: Preparation. L. Lilienfeld, Zeltgasse, Vienna. E.P.212,864.

Solutions of cellulose for making filaments, films &c., are prepared by treating a body of the cellulosic class with aqueous alkali solution whilst maintaining a temperature not substantially exceeding 5° C., and preferably at 0° to —25° C., or even lower; as the cellulose passes into solution, so it proceeds through various plastic and gelatinous intermediate stages. These are also included in the claim and also the jellies &c., into which a solution is converted, for instance, by being kept too long at low temperatures. By the use of low temperatures solutions of cellulose in alkalis are obtained without degradation of the cellulose molecule; in fact, if in the parent material the cellulose has been degraded by a preliminary treatment, it is found that such degradation is largely neutralised by subsequent solution under the conditions specified. —B. C. I. R. A.

Cellulose Xanthate. L. Lilienfeld, Zeltgasse, Vienna. E.P.212,865.

Viscose solutions are prepared while continuously or temporarily employing temperatures which do not substantially exceed +2° C., preferably of temperatures 0° + —25° C. or lower, particularly between —3° and —15° C.; the cooling may take place during or before or after the treatment of the cellulosic material with carbon bisulphide, the essential condition being that the action of the bisulphide proceeds wholly or in part before dissolution takes place, that is, before cooling begins. The effect of the various treatments is described. —B. C. I. R. A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal* (*Patents*)—

(A)—British.

211,691. **Artificial Silk Manufacture.** M. Hölken, Barmen, Germany.

211,739. **Extraction of Fibres from Plants.** M. Postiglione, Treviso, Italy.

211,762. **Silk: Cocoon Classification.** R. Naito, S. Nishikawa and K. B. K. Kwaisha, Tokyo-fu, Japan.

211,889. **Filaments from Cellulose Esters.** Tubize Art. Silk Co. of America, Philadelphia, U.S.A.

212,068. **Filaments from Ammoniacal-Copper Cellulose Solutions.** M. Hölken, Barmen, Germany.

212,885. **Apparatus for Making Artificial Silk: Lift Valves.** Count H. de Chardonnet, Place Malesherbes, Paris.

212,911. **Artificial Silk: Washing Apparatus.** A. G. f. Anilin-Fabrikation, Treptow, Berlin.

(B)—American.

Boll-weevil Catchers. 1,466,106.

Cotton Picking Machines. 1,462,307; 1,465,974.

Manufacture of Artificial Fibres &c. 1,463,793 (viscose); 1,464,048 (hollow filaments); 1,464,158 (cellulose ethers); 1,464,169, 1,464,170 (cellulose-ether solvents); 1,464,805 (viscose silk); 1,465,994 (cellulose acetate); 1,466,401 (cellulose acetate); 1,467,493 (cellulose acetate).

2—CONVERSION OF FIBRES INTO FINISHED YARNS

(A)—Preparatory Processes.

Cottonising Flax and Hemp Fibre. O. Johannsen. *Leipziger Monatschrift*, 1924, **39**, No. 3, pp. 59-66.

An account is given of experiments in spinning and weaving the fibrous material obtained from flax and hemp plants by breaking down or cottonising processes. It is found that fairly good yarns can be made when this material is mixed with up to 50% of cotton, but that spun alone very weak and irregular yarns result. The fabric woven from the yarns is not so strong as similar fabric made from pure cotton, but it is claimed that such fabrics will find many uses, and that their production will be commercially possible. —L. I. R. A.

Recent Developments in Plant and Machinery for the Preparation of Flax. E. Schulz. *Leipziger Monatschrift*, 1924, **39**, No. 3, pp. 67-68.

Short accounts are given of the following machines—(1) The Boby scutching machine, (2) the Etrich tow-preparing machine, suitable for treating low quality straw which cannot be satisfactorily broken and scutched, and also for treating straw waste and for further purifying badly cleaned tow; (3) the Kuchenmeister machine for cleaning tow and dividing up the fibre strands as far as possible. Machines for tow sifting and for removing the remaining fibre from the shives are also referred to. —L. I. R. A.

Petroleum Ret. H. Lowe. *Spinner und Weber*, No. 10, pp. 4-5.

The author's experiments lead him to conclude that the addition of petroleum or chlorinated hydrocarbons, as practised in the Peufaillit process is as a rule unnecessary. He considers, however, that it is conceivable that the petroleum might under some circumstances have a beneficial effect by penetrating the fibre bundles and so preventing the access of water. The danger of excessive breakdown of the fibre bundles would thus be diminished. —L. I. R. A.

Suffocating Silk Cocoons with Chloropicrin. *Bull. des Soies*, 1924, **48**, 2455.

The suffocation should take place as early as possible to avoid the chrysalides changing to moths, which, eating their way out, spoil the silk. It should be done, of course, in some way that will not injure the quality of the silk. Generally heat, either dry or damp, is employed, but both methods have disadvantages. Too little heat leaves some moths alive, which soil other cocoons; too much heat spoils the silk. Refrigeration is costly. Inert gases take too long to have full effect; poisonous gases, such as ammonia, sulphur dioxide and hydrocyanic acid, apart from obvious disadvantages, change the character of the silk. As chloropicrin is known to be a powerful insecticide, a number of unfortunate silkworms were tied up in a gauze bag while others were sealed up in cocoons and exposed to the vapour at 22° C. for 10 minutes. When removed and examined both lots were found to be dangerously near to intoxication. After this hopeful start many experiments followed, and as the result of four years' work it has been found possible to suffocate the chrysalides without having any deleterious effect on the silk, even on prolonged storage. This method is very simple and less costly than a heating installation. —F. G. P.

Opening. H. Brüggemann. *Leipziger Monats. Text.-Ind.*, 1924, **39**, 175-178.

The author traces the development of opening and cleaning processes from the time when cotton was opened with hand beaters to the present day. —B. C. I. R. A.

Retting Establishments; the Choice of Sites for——. G. Ruschmann. *Leipziger Monatschrift*, 1924, **39**, No. 6, p. 246.

Discusses the various factors which influence the choice of a site for a retting

establishment. The author shows how the quantity and quality of the available water, the disposal of the effluents and the nature of the retting process which is to be carried out have all to be taken into consideration. The choice is also influenced by the location of the area in which the fibre-yielding crop is produced.
—L. I. R. A.

Faulty Rets. "False" Pectin Fermentation. G. Ruschmann. *Faserforschung*, 1923, **3**, No. 4, pp. 314-318.

A considerable fall in temperature (e.g., 10° C.) of the water in a retting tank is liable to disturb the normal course of retting and set up abnormal fermentation characterised by the production of considerable quantities of marsh-gas. The effect is to prolong the duration of retting very considerably. Steps should be taken to avoid any such considerable fall in temperature during the progress of a ret; for example, by suitably covering the retting tanks. —L. I. R. A.

Retting processes in Factory Practice; Comparison of——. G. Ruschmann. *Faserforschung*, 1923, **3**, No. 4, pp. 301-313.

Describes the results obtained in about twenty rets in which a fairly large quantity of flax straw was used (2-14 cwt.). The following processes were investigated—Warm water tank ret, carbone ret, aerobic ret, and treatment in autoclave under pressure. A table is given showing the yield, strength and quality of the fibre &c. The aerobic process was found to give very satisfactory results. (*Cf. Faserforschung*, 1922, No. 2, p. 184.) —L. I. R. A.

Rolling Retted Flax. W. Muller. *Leipziger Monatschrift*, 1924, **39**, S-N 1, p. 16.

Briefly reviews the pros and cons for the rolling of retted flax. At present it appears doubtful that the process has any advantages sufficient to justify its adoption. Among the advantages claimed are (1) better colour and suppleness of the fibre obtained, (2) greater ease of drying, (3) the fibre is more easily cleaned of shives in scutching. Against these must be set (1) the possibility of the fibre being weakened, (2) the process is not successfully applicable to all kinds of retted flax and a special retting process is necessary.
—L. I. R. A.

Casablancas Drafting Mechanism. A. Hawlina. *Leipziger Monats. Text.- Ind.*, 1924, **39**, 35-36.

The author describes some observations on the Casablancas system, made on a recent tour of mills in Spain. Test yarns spun on the Casablancas system are stated to be more even and stronger than yarns spun by the usual methods. The author's impression of the system was entirely favourable. —B. C. I. R. A.

Waste Hemp. T. Yoshida. *Chem. Abstr.*, 1924, **18**, 757 (from J.P.42,193).

Purified waste hemp fibres are wrapped on a spool to a thickness of about 2 cm., and one side is then cut to form a sheet. These sheets are immersed in a solution of caustic soda of 40°-42° Bé. at 5°-15° for 20 mins., neutralised with dilute sulphuric acid, treated with Marseilles soap and non-drying oil, and loosened to cotton state.
—B. C. I. R. A.

Flax Stem Anatomy in Relation to Retting. See Section 1C.

(B)—Spinning and Doubling.

Mule Carriage Driving Mechanism. R. Fletcher. *Text. Manufacturer*, 1924, **50**, 111-112.

A general description of the mechanism which drives the carriage and front rollers of spinning mules. —B. C. I. R. A.

Spinning-Mule Rimshaft: Control. L. J. Mills. *Text. Manufacturer*, 1924, **50**, 48-49; 84-85.

The present article, which is the final one of a series on the rimshaft of cotton-spinning mules, deals with the lateral motion of the rimshaft, the backing-off lever, duplex rim pulleys, screeching of rim frictions, overheating of backing-off friction, broken backing-off wheels, rimshaft stopped on outward run of carriage, rimshaft friction geared too keen, and rim friction not clearing at the locking of the fallers.
—B. C. I. R. A.

Spinning Spindles. O. Johannsen and —. Krauter. *Leipziger Monats. Text.-Ind.*, 1924, **39**, 178-179.

The importance of yarn breakage as a criterion in judging spun yarns and the efficiency of machine parts is emphasised. This criterion has been applied by the authors to a study of the relative efficiencies of several types of spindles and the effect of knotless and knotted spindle bands. The present communication is only preliminary. —B. C. I. R. A.

Ball-Bearing Spindle. A. Kahl. *Leipziger Monats. Text. Ind.*, 1924, **39**, 4-6.

The principal feature of the spindle described, known as the D.W.F. ball-bearing spindle, is the collar formed of four ball races which are free to move in an axial direction independently of each other. Consequently, the series of balls can yield to the requirements of the spindle when the number of revolutions is very high or the spindle is unevenly loaded. Easy running, economy in power consumption and extraordinary durability are claimed for the spindle. —B. C. I. R. A.

Compressed Cotton: Spinning Value. W. R. Meadows and W. G. Blair. *U.S. Dept. Agric. Bull.*, **1135**, 1923, 18 pp.

Spinning tests on cotton compressed to different densities show that compressing cotton when in a dry or normal condition to standard or high density is not injurious to its spinning value. Compressing wet cotton to high density either increases the percentage of waste or reduces the breaking strength of the yarn, or may do both. Compressing cotton into a round bale with a hard core reduces the strength of the yarn about 7%. If the round bale were to be used continuously in a mill, special opening equipment would be required. —B. C. I. R. A.

(D)—Yarns and Cords.

Yarn Twist. E. Roscher. *Leipziger Monats. Text.-Ind.*, 1924, **39**, 180-181.

The difference between right and left-handed twist in yarns is explained and the dependence of twist on the fineness of the yarn, the raw material, the length of the fibre and the purpose for which the yarn is required is discussed, also the effect of right and left-handed twist on the appearance of fabrics. —B. C. I. R. A.

Effect Yarns and Threads. J. Sponar. *Leipziger Monats. Text.-Ind.*, 1924, **39**, 181-183.

The characteristics, and in some cases the construction of a number of effect yarns and threads are described. Effect yarns are understood to include dyed, printed, bleached, gassed, mercerised and otherwise treated yarns and yarns containing neps, metal threads, artificial silk &c. Effect threads are understood to include yarns doubled under varying conditions, and of the same or different materials, plaited threads &c. —B. C. I. R. A.

Genoa Cord: Manufacture. M. Loescher. *Leipziger Monats. Text.-Ind.*, 1924, **39**, 38-40.

A general account of the manufacture of Genoa cord, a weft pile cotton velvet. —B. C. I. R. A.

Patents

Spinning: Wooden Stripping Roller. A. Lees & Co., Ltd., and L. Dunkerley, Oldham, Lancs. E.P.211,789.

Wooden rollers, such as stripping rollers used in carding engines, for use in machines for treating cotton and the like, are formed from a single piece of wood hollowed out from each end to leave a central disc. Discs are fitted at each end, and, if desired, at other intermediate points. The spindle is passed through central holes in the discs, and is secured thereto by cross pins. Metal discs are provided at each end of the roller. —B. C. I. R. A.

Winding Machine Spindle. W. McGee and Son, Ltd., and J. B. White, Albion Works, Paisley. E.P.211,728.

The patent relates to spindles for holding cardboard cones, tubes or the like in yarn winding machines, of the kind wherein loose clutch devices, comprising rods or rollers, are mounted in longitudinal grooves in the spindle, so that they automatically move to engage or release the tube upon relative movement of the spindle and tube. The spindle is provided with circumferential grooves to accommodate wire or other binding elements which engage grooves in the clutch rollers. —B. C. I. R. A.

Plant Fibre: Woollenising. Farbwerke vorm. Meister, Lucius & Brüning, Hoechst-on-Main, Germany. E.P. 211,467.

Vegetable fibres which have been treated without tension by acid, particularly concentrated nitric acid, and have thus undergone a modification analogous to mercerisation, are further treated with ammonia in the form of gas or aqueous solution. The wearing qualities of the product are greatly increased, and the fabrics obtained closely resemble wool. A concentrated lye of ammonium nitrate may be obtained by the repeated re-charging and re-using of the ammonia solution. —B. C. I. R. A.

Carding Engines: Condenser Tape Cleaning. C. E. Sykes, Hyde Park Road, Leeds. E.P.211,028.

The tapes of tape condensers are cleaned by flat or cylindrical brushes extending across the full width of the grooved feed rollers, and, in the case of cylindrical brushes, driven in a direction contrary to that of the direction of the tapes by sprocket gearing from the dividing rollers. —B. C. I. R. A.

Yarn Drying. J., T. & J. Brandwood, Bury, Lancs. E.P.210,674.

Yarns are dried by forcing or drawing hot-air through them whilst they are supported, in compact wound form, upon perforated spindles, the spindles being secured to hollow carriers supported without securing means, upon dishes which are secured to flanges on the hot-air pipes arranged within the drying chamber. The direction of flow of the air through the yarns may be reversed. —B. C. I. R. A.

Bobbin Cradle. C. U. Reynolds, Stockport, Cheshire. E.P.210,562.

In bobbin cradles for winding and gassing frames of the kind wherein one arm is movable against the action of a spring, to facilitate the insertion and removal of the spindle, the arm is slidably mounted on the cross-bar, and is operated against the action of a spring by means of a cam and a handle. The cross-bar may be circular in cross-section, or tubular, the foot of the arm being correspondingly shaped to slide

thereon. Ball bearings are provided for the spindle. The Provisional Specification describes an arrangement wherein the movable arm oscillates about an axis at right angles to the spindle.
—B. C. I. R. A.

Bobbin Mounting Nipple. H. A. E. Liebert and J. Holroyd & Co., Ltd., Milnrow, near Rochdale, Lancs. E.P.210,560.

Hollow nipples for centring the upper ends of bobbins and paper tubes on the spindles of spinning and like machines are made of drawn sheet metal or of spun metal tubing. They may be formed with inturned ends or provided with discs at one or both ends, so as to engage the spindles at their ends, or with an inner tube so as to engage the spindles throughout their length.
—B. C. I. R. A.

Reeling Machine Swift. Maschinenfabrik Schweiter A.-G., Horgen, Zürich, Switzerland. E.P.211,858.

The swift in a reeling machine is supported on an arm oscillatably mounted on a stud, and it comprises a hub fixed on a sleeve and provided with arms which carry hank supporting frames, the frames being also jointed by links to arms on a collar, slidable on the sleeve. The swift is driven by means of a wheel on the hub from a second wheel. A spring tends to force the collar away from the hub, and thereby to maintain the hank supports in their operative positions. —B. C. I. R. A.

Reeling Machine Thread Guide. Maschinenfabrik Schweiter A.-G., Horgen, Zürich, Switzerland. E.P.211,859.

Yarn is cross-wound on a swift by means of a light guide actuated by a slotted drum and guided by a resilient rod. The guide is shaped to conform to the surface of the drum, and is provided with a pressed-out part to engage the slot therein, and engages the rod by means of a horizontal slot. Arcuate guides are mounted on the frame. Each guide may be provided with a central rib to form two yarn-guide slots.
—B. C. I. R. A.

Spinning Spindle: Driving. Maschinenfabrik Schweiter A.-G., Horgen, Zürich, Switzerland. E.P.211,860.

A spinning or doubling spindle is supported in a bearing and is driven by a member which frictionally engages the conical part of a wharl. The drive is transmitted through a carrier which is fixed to the spindle and supports the bobbin, whilst springs coiled around the guide-pins are inserted in holes in the driving member, and, being compressed between the carrier and the said member, strengthen the friction connection between the driving member and the conical part of the wharve.
—B. C. I. R. A.

Spinning Mule: Stop Motion. W. Buckley, Oldham, Lancashire. E.P.212,005.

The strap-relieving motion rod, or other rod connected thereto, is oscillated so as to bring stops thereon into the path of a member on the carriage, whereby it is operated to stop the carriage during its outward run, by means operable upon the winding drum band breaking or slackening, the thickening or roving of the twist band or of the taking-up band, when the counter-faller moves into an abnormally high position, and when a set of cops is complete. —B. C .I. R. A.

Slivers: Drying, Moistening and Drawing. F. Werner, Asch, Bohemia, Czecho-Slovakia. E.P.212,255.

The slivers are passed over a table, through drawing mechanism and in a zig-zag path through a drying chamber having sieves and a heating device. From the drying chamber the slivers pass through a moistening chamber and drawing mechanism, by which they are drawn, so that four slivers show the same number as three original slivers to the delivery device.
—B. C. I. R. A.

Yarn Winding Machine. E. N. Baines and J. W. Schmidt, Longsight, Manchester. E.P.212,411.

In winding cops, cheeses and the like, the yarn is wound from a tension device across the edge of a revolving plate by means of which it is traversed on the yarn package. The spindle which carries the cop is spring pressed against the concave surface of a guide-plate, and as the cop is wound is moved away therefrom. The yarn passes over the edge of the guide-plate and is traversed to and fro upon it in a straight line. By regulating the speed ratio between the revolving plate and the spindle, and by using a cam-plate consisting of more than one wing, various types of yarn packages may be wound.
—B. C. I. R. A.

Reeling Machine. Maschinenfabrik Schweiter A.-G., Horgen, Zürich, Switzerland. E.P.212,529.

The patent relates to reeling machines on an arm, and the stop-motion is automatically operated after a predetermined number of revolutions of the swift or after a pre determined travel of a measuring screw. The swift is carried in an arm which, upon completion of the winding and the stopping of the machine, is moved so as to disconnect the measuring gear, and so allow it to be automatically returned to its initial position. —B. C. I. R. A.

Combing Machine Detaching Roller: Driving. C. Payen, Mulhouse, France. E.P.212,571.

The detaching roller of combing machines of the Heilmann and like type is driven by a wheel actuated by a ratchet pawl on

a disc adjustably connected to an eccentric on the shaft. A spring acts to remove the pawl from the teeth of the ratchet wheel during the inoperative stroke.
—B. C. I. R. A.

Yarn Clearing Device. H. Barlow, Crosland Moor, and G. Muff, Primrose Hill, both Huddersfield. E.P.212,769.

In a yarn clearing device of the kind comprising a disc provided with slits of different widths, and a shield or guard-plate designed to expose only one of the slits at a time, a guide-wire sprung on the boss of the guard-plate spans the slot in the guard-plate and serves to retain the yarn in the slit of the disc which is opposite the slot. The edges of the slits are bevelled, and their ends are of fish-tail formation. The slits may be marked to indicate the count of yarn for which they are suitable, and, if desired, one side of the disc may be marked for worsted and the other for cotton. To facilitate setting, the edge of the disc is notched on each side of the slits to register with the slot in the guard-plate. A slit of greater width than any yarn to be dealt with is provided for use when a mild or no clearing action is desired.
—B. C. I. R. A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal* (*Patents*)—

(A)—British.

210,574. **Spinning: Gill Box.** T. Barbour, Falls Foundy, Belfast.

210,963. **Combing Machine: Circle Heater.** J. Smith & Sons, Ltd., and J. W. Adams, Bradford, Yorks.

210,011. **Combing Machine: Dabbing Brush.** F. Pickford, Bradford, Yorks.

211,053. **Combing Machines: Clearer-Roller.** A. Lees & Co. Ltd., and R. Taylor, Oldham, Lancs.

211,729. **Cleaning and De-greasing of Wool.** F. B. Dehn, Doughty Street, London.

211,732. **Spinning: Thread Guides.** E. Briggs, Shelf, near Halifax, and P. M. Holt, Bradford, both Yorkshire.

212,282. **Noble Comb: Feeding Device.** J. W. Pearson, Farsley, and E. Pearson, Armley, both near Leeds.

212,517. **Silk Degumming Process.** H. B. Smith, New York, U.S.A.

(B)—American.

Cotton Trampers. 1,461,579; 1,461,639; 1,463,186; 1,463,221.

Cotton Ginning. 1,464,810; 1,464,811.

Cotton Cleaning and Opening. 1,461,562; 1,462,458; 1,463,522; 1,466,927 (linter saw); 1,468,243 (flier for preparing machines); 1,468,244 (cotton chopper).

Fibre Openers, Mixers &c. (other than Cotton and Wool). 1,462,459; 1,465,046 (cleaner); 1,465,047 (cleaner); 1,465,048 (conveyor); 1,465,049 (conveyor); 1,465,050 (Mixer); 1,465,235 (opener).

Wool Cleaning and Opening. 1,462,458.

Carding, Combing and Intermediate Machines. 1,461,527 (carding); 1,462,203 (carding); 1,463,816 (combing); 1,463,844 (gill-bar); 1,464,098 (detaching motion); 1,464,820 (swinging nippers); 1,465,670 (card clutch brake); 1,466,846 (comb); 1,469,005 (condenser).

Spinning and Doubling. 1,462,774 (top roller clearer); 1,464,730 (doffing apparatus); 1,465,238 (yarn guide frame); 1,465,514 (spindle drag); 1,466,180 (doubler); 1,466,577 (thread guide); 1,467,286 and 1,467,287 (cap spinning frames); 1,467,457 (spindle rail extension); 1,468,427 (bobbin head ring); 1,468,487 and 1,468,488 (slub catcher); 1,468,489 (yarn tension device); 1,468,996 (doubling frame).

Yarn Winding and Reeling. 1,461,641 (cop); 1,461,705 (hank); 1,462,292 (guide and clearer); 1,463,181; 1,463,205 (bobbin); 1,463,462 (doffing mechanism); 1,463,479 (doffing device); 1,465,520 (bobbin lift device); 1,468,583 (drive-roll device).

3—CONVERSION OF YARNS INTO FABRICS

(C)—Weaving.

Shuttle Box Swells. E. Ullrich. *Textilberichte*, 1924, **5**, 234-236.

Various types of shuttle box swells are described and discussed. —B. C. I. R. A.

Loom Assembling. P. List. *Textilberichte*, 1923, **5**, 236-237, 301-303.

A detailed account of the method of assembling a power loom, in the course of which the author refers to the single parts by the various names by which they are frequently known, with a view to generalising a more uniform system of nomenclature for loom parts. —B. C. I. R. A.

Weaving. G. Lehmann. *Textilberichte*, 1924, **5**, 299-301.

Some general notes on the prevention of faults in weaving cotton and linen fabrics. The importance of good selvedges is especially emphasised. —B. C. I. R. A.

Artificial Silk Yarn: Weaving. F. Müller. *Textilberichte*, 1924, **5**, 296-299.

The technique of artificial silk weaving is discussed. This material is coming more and more into use for warps and on account of its peculiar properties requires careful treatment. —B. C. I. R. A.

Loom Driving. E. Ulrich. *Textilberichte*, 1924, **5**, 295-296, 373-374.
A general discussion of the mutual adjustment of loom parts and speeds for looms weaving various kinds of materials. —B. C. I. R. A.

Rep Fabrics. M. Loescher. *Textilberichte*, 1924, **5**, 293-295, 371-373.
The construction of reps and similar weaves is discussed and point-paper plans of a number of reps and fancy reps are reproduced. —B. C. I. R. A.

Looms: Anti-Vibrating Device. F. Hymans. *Text. World*, 1924, **65**, 97-101.
A device for eliminating loom vibrations comprises an angle iron fastened to both frames of the loom. The iron extends beyond the frames and carries at each end a flat spring and a weight. If all these parts are properly dimensioned, upon operation of the loom the weight will swing to and fro in more or less precise opposition to the motion of the lay. It thereby sets up forces which neutralise the shaking forces of the lay and thus eliminate vibrations. —B. C. I. R. A.

Weaving Cottonised Flax and Hemp. See Section 2A.

(E)—LACEMAKING AND EMBROIDERING.

Lace Curtain Manufacture. C. Town. *Text. Rec.*, 1924, **42**, No. 495, 63.
The process of making "Two Gait" and "Two Gait Filet" on the Nottingham lace curtain machine is illustrated. The curtain machine is capable of making a large variety of fabrics. The three main factors governing them are—(1) Changes in the length of throw by the guide bar. (2) Nature of the yarn used on the spool board. (3) The manner in which the jacks are introduced. —B. C. I. R. A.

(G)—FABRICS.

The Field of Artificial Silk in Hosiery and Underwear. B. C. Clarke. *Silk N. Y.*, 1924, **17**, No. 4, p. 67.
After deploring the scant tribute paid by the American press to the memory of the late Count Chardonnet, the author gives a short history of silk and the invention of artificial fibres. He speaks of greater evenness of the mechanically made thread as compared with naturally produced silk from different sized worms and claims that hosiery made with artificial fibre in which a little silk is mixed is a better looking article than pure silk. Owing to the absorption qualities of artificial fibres they are said to be sanitary and comfortable, if mixed with sufficient of another thread to hold the garment together when it gets damp. Silk is stated to rot if exposed to perspiration and artificial fibres resist its effect. A high quality mineral oil may be used, it is said, to lubricate the thread as it will not turn rancid or deteriorate the yarn. —F. G. P.

Doubled Yarn Fabrics. Paul List. *Leipziger Monats. Text.-Ind.*, 1924, **39**, 8-10.
Some faults occurring in finished fabrics made from doubled yarns are discussed. Frequently these fabrics have slipshod selvedges and the warp threads run in a curved direction instead of being straight. This is due to the fact that in many mills insufficient care is given to the beaming of warps. Other faults frequently met with are the occurrence of patches of ribbed weft in the fabric and of widely different numbers of warp threads in a given breadth of fabric. —B. C. I. R. A.

Fancy Leno Manufacture. *Text. World*, 1924, **65**, 3317.
In the type of leno discussed, the ground makes it possible to weave elaborate patterns having the appearance of cloths woven on a jacquard loom. These jacquard effects are produced on the ordinary dobby loom, using the worsted doup, and it is the flexibility of the worsted doup with the addition of a second ground end that makes this possible. An account of the production of these fancy lenos is given. —B. C. I. R. A.

Nanking Satin Industry. *Amer. Silk Jl.*, 1924, **43**, No. 4, p. 71.
Although Hangchow and Suchow claim merit for beautifully coloured satins, Nanking has for ages stood pre-eminent for the production of the imperial black satin; in pre-republican days the city received a royal subsidy from Peking for this material. It is thought that 2,000 looms and 3,000 people are at present working on it. About 5,000 bales (133⅓ lb. each) of hand reeled silk are consumed annually in Nanking, half of which comes from villages south of the city. 50% of the satin made is black, 25% green-black, 25% grey. The dyeing of the silk thread is performed by a close-mouthed federation and is handed on from father to son. The process takes 20 days. The looms are very primitive hand machines, worked by one man for plains, two for figureds. One man makes a plain bolt of about 60 feet, 33¼ in. to 48¼ in. wide in 10 days. It is believed that 1,000,000 bolts are sent out from Nanking annually, but no reliable statistics are available. —F. G. P.

Construction of Reps. See Section 3C.

Union Fabrics; Dyeing of——. See Section 41.

Striped Zephyrs: Faulty Dyeing. See Section 41.

Mexican Fabrics: Dyeing. See Section 4[illegible]

Cotton Fabrics: Testing. See Section

Crepe Fabrics: Faults. See Section 6.

Patents

Billiard Cloth: Manufacture. F. Reddaway, Pendleton, Manchester. E.P.211,706.

A reversible, napless cloth for covering billiard tables consists of a homogeneous multiple fabric of two or more cloths solidly woven from folded cotton yarns of fine counts twisted into the required number of folds and dyed the appropriate colour either in the piece or in the yarn from which the cloth is woven, the cloth being finished by a process suitable to the production of a smooth, napless, reversible fabric such as by calendering. The cloth may be woven with a plain or twill weave, on one or both surfaces. The yarn may be of Egyptian cotton from 60 to 100 counts, twisted into the required number of folds, and, if desired, cleaned and gassed.

—B. C. I. R. A.

Smallware Loom. J. & J. B. Poyser, Mansfield, Nottingham. E.P.211,595 and 212,851.

Improvements are described in the shedding motion, healds, beat-up motion, lay, reed and shuttle race of looms of the type comprising a divided batten having upper and lower displaceable portions, each provided with reeds or plates, the reeds being adapted to overlap. —B. C. I. R. A.

Knitting Machine: Fabric Take-up Device. E. Barth, Chemnitz, Germany. E.P. 211,440.

The needle cylinder is adapted for intermittent rotation, say through one needle space at each revolution of the cam ring, and is fitted with an annular base which rotates with it and has a take-up device suspended by means of rods secured to bosses on the base and an annular platform respectively. The platform is rotatably held in a frame and carries an internally toothed ring, a pinion in mesh therewith, a swinging frame with take-up rolls, and a friction clutch, one portion of which is on the shaft of the pinion whilst the other portion drives the rolls at such a rate that normally the rolls tend to climb up the fabric and disconnect the clutch. The ring carries teeth on the underside which mesh with a bevel pinion on a shaft driven by a belt. —B. C. I. R. A.

Looms: Weft Feeler Mechanism. Salt's Textile Co., Lyons, France. E.P. 211,309.

Weft feeler mechanism for stopping a loom or causing bobbin changing when the weft on a bobbin is substantially exhausted, comprises a feeler rod, or two feeler rods in the case of a double shuttle loom, which are normally pressed towards the shuttle boxes to an extent limited by collars, and at the beat-up enter through apertures in the shuttle boxes and slots in the shuttles. Normally the weft on the bobbins then engages the feeler rods, but if the weft is sufficiently exhausted in a bobbin it exposes a recess, opening or slot into which a feeler rod enters, thus actuating mechanism to operate a knock-off lever, which disengages a spring shipper lever from a detent, this lever stopping the loom either by shifting a fork for the driving belt or by operating a switch to cut off the electric current from the motor which drives the loom.

—B. C. I. R. A.

Loom Bearings. H. Morley, Burnley, Lancs. E.P.211,306.

A bracket for a rocking rail comprises an upper bearing member and a lower bearing member having a slotted part resting on the loom frame adapted to receive a cotter for adjusting the height of the lower half of the bearing. The parts are secured by a bolt to the frame, and a well for lubricant is formed in the lower bearing member, which is provided with a plain cover or a cover formed with a lip whereby it may be opened by the spout of an ordinary oil-can. —B. C. I. R. A.

Looms: Shuttle Box. T. & G. H. Marsden, Nelson, Lancs. E.P.211,249.

The slots of a rotary shuttle box are recessed or countersunk, and are lined with steel or other metal linings, the edges of which come flush with the adjacent portions of the walls of the slots. The linings are held between the iron end-plates of the box, or, when they do not extend quite to the outer ends of the slots, by one end plate. —B. C. I. R. A.

Circular Loom: Warp Tensioning. T. H. Jones, Woodthorpe, Nottingham. E.P. 211,190.

The warp threads pass through perforations in warp carriers or sliders, having flat stems guided in vertical slots, or flat recesses in a vertical cylinder. Cam grooves in a rotating cam cylinder engage butts on the sliders whereby the warps are moved to form a shed to receive the weft from a torpedo-like sheet-metal shuttle of arcuate formation, which is traversed through the warps by the engagement of the sliders with the tapered tail end of the shuttle. —B. C. I. R. A.

Elastic Fabric: Weaving. G. C. and T. Moore, Westerly, Rhode Island, U.S.A. E.P.211,057.

Pairs of fine warp threads, or pairs of groups of warp threads cross over pairs of heavy cord warps comprising wound or covered elastic strands, so that the warp threads alternately diverge and converge, being bound in by passing over and under one or more wefts. An elastic fabric with a reticulated honeycomb effect is thus produced. —B. C. I. R. A.

Heald Repairing Tool. B. Atkinson, Harle Syke, Burnley, Lancs. E.P.210,954.

A tool for use in repairing healds in looms is made U-shaped and preferably of wire, one limb of the U being shorter than the other, with a large loop formed at the long end to act as a handle, and a smaller loop at the other end through which is threaded a prepared heald length. In use, the tool is put down between the warps, and brought up again with its short end behind the heald stave but with the loop tilted forward through the heald. The end of a prepared heald-length is passed through the loop and held between the finger and thumb. The tool is now pushed down and brought up again with the loop in front of the stave, carrying with it the heald-length, which is thereby looped around the stave and its other end is brought up so that it can be fastened to the first end. —B. C. I. R. A.

Knitting Machine: Set-up Device. C. Bellhouse, Vancouver, Canada. E.P. 210,924.

Set-up devices for use with circular machines comprise a circular body with a turndown rim, through perforations in which extend radially disposed arms formed from a length of steel wire bent in U-shape, the adjacent arms being twisted together to form eyes through which an endless cord is threaded. The body is attached to a central rod at the upper end of which is a spring clip for receiving the end of the knitting thread. The device is placed with the cylinder so that the eyes and cord extend about the circle of needles, a weight is then hung on the centre rod, and the thread is passed round and formed into stitches by the ordinary operation of the machine. —B. C. I. R. A.

Loom Change-Box Mechanism. J. C. Duffin, Eccles St., Belfast. E.P.210,904.

The checking levers are acted upon simultaneously by the pattern cards on two cylinders, the main cylinder being rotated regularly every other pick and carrying cards that control the levers, and also govern the rotation of the second or regulating cylinder by acting on a lever. This regulating cylinder is provided with cards, which do not interfere with the control of the levers by the main cylinder, and with blank cards which prevent these levers from falling. The regulating cylinder may be arranged behind the main cylinder. An arrangement is also described in which the regulating cylinder is above the main cylinder. The levers operate the usual grab to push it on to a tappet-operated lifting lever to cause the usual draw catch to rotate the shuttle box. —B. C. I. R. A.

Circular Knitting Machine. Trent Engineering Co. Ltd., and W. Lacey, Nottingham. E.P.210,850.

For the production of solid-patterned effects on machines fitted with a series of dependent thread guides forming vertical striping or patterning mechanism, the guides work between and are supported laterally by blades extending radially from an annulus secured to the head. The blades are provided with feet, cast or otherwise, secured to the annulus, which may be made in two parts, and taper outwardly. This construction allows of the use of a guide for each needle, and presents other advantages. —B. C. I. R. A.

Stiffener Fabric: Weaving. British United Shoe Machinery Co. Ltd., and W. H. Bancroft, Belgrave Road, Leicester. E.P.210,849.

Thermoplastic toe stiffeners are made of a single sheet of woven cotton fabric, heavily fluffed or raised on both faces, as a vehicle for the thermoplastic impregnant. The cotton fabric has a double weft of coarse, loose thread, and it is mainly the weft that is raised or fluffed. After impregnation, blanks are cut so that the weft runs lengthwise of the shoe stiffener. An alternative fabric is swansdown raised on both surfaces. —B. C. I. R. A.

Looms: Detachable Shuttle Peg. J. Penswick and J. Oldham, Ashton, Preston, Lancs. E.P.210,667.

The detachable shuttle peg is screwed into a tapped hole in the head provided with the usual pivot pinhole, and a detachable spring is provided with a T-head or a split ring head to embrace the peg and fit in a groove therein. The free end of the spring enters a hole &c. that exists between a flat on the peg and the adjacent part of the head. A double spring may be used, the peg being in this case formed with a flat on two sides. The split ring may be soft soldered into the groove. A pin may be passed through the head and peg. The spring may be hardened, the arms of the T-head being left soft. —B. C. I. R. A.

Loom Stop Motion. J. Whittle, Mellor, near Blackburn, Lancs. E.P.210,641.

The patent relates to stop motions acting on the derangement of jacquard mechanism. To stop the loom when the cards in a double lift double cylinder jacquard get out of time, two spare needles and hooks controlled by the odd and even cards respectively control a perforated finger. The finger is connected by a spring and a cord to a catch lever mounted on the weft fork holder shank, the cord being actuated to move the catch lever into the path of the weft hammer if the cards get out of time, whereby the loom is stopped, whilst normally the catch lever is moved out of the path of the weft hammer by a weight. —B. C. I. R. A.

Knitting Machine: Balancing Device. T. S. Grieve, Queen Street, Leicester. E.P. 210,572.

Circular machines of the superposed cylinder and conical ribber bed types are provided with bearings or steadying devices for reducing sway due to unbalanced masses in the upper cam boxes and associated rotary parts. —B. C. I. R. A.

Lace Machine: Bobbin Removal Device. Sir E. Jardine and F. Dalby, Nottingham. E.P.210,570.

Improvements are described in machines of the kind in which the carriages are delivered from a magazine into revolving carriers, which advance step by step and transfer the carriages first to a mechanism for extracting the empty bobbins, and then to a mechanism for inserting full bobbins into the carriages and threading them.
—B. C. I. R. A.

Lace Machine. Sir E. Jardine and H. Montgomery, Nottingham. E.P.210,547.

The outer rolling lockers of twist lace machines such as are used for making traverse net are so actuated that the two tiers of carriages approach each other in their extreme front and rear positions and separate in intermediate positions. This enables shorter combs to be used and affords more time for shogging the comb bars. —B. C. I. R. A.

Loom Temple. J. Chambers and H. Duckworth, Bury, Lancashire. E.P. 210,477.

In a pin ring temple the pin rings are mounted concentrically on circular sleeves having end flanges, against which the rings bear, and central inclined holes of angular section whereby they are mounted in inclined position on a spindle of corresponding section. The spindle is mounted in a slotted frame held in position in a trough-like fixing secured to the loom, the fabric being directed and deflected between the fixing and the series of toothed rings. A tapered frame with a series of rings successively decreasing in diameter may be used. —B. C. I. R. A.

Looms: Measuring Stop Motion. Meters, Ltd., Manchester, and T. A. Orme and A. Stansfield, Oldham, Lancs. E.P. 212,071.

A device for indicating and recording the number of picks inserted or yards woven &c. in a loom, is used to drive a device for stopping the loom at a predetermined time, as, for example, after the required length has been woven &c.
—B. C. I. R. A.

Cloth: Embroidering. W. Buckley, Ltd., Delph, and G. A. Buckley, Oldham, Lancs. E.P.212,347.

Cloths used as shawls, tablecloths, rugs, curtains &c., are ornamented by embroidering patterns on them and then carding or otherwise raising the surface so that the stitches of the embroidery are concealed. The embroidery may be of different colours and is conveniently done in a Cornely or like machine. When a shawl or tablecloth is surrounded by a border of patterns, the corner patterns may be embroidered over the woven patterns and carded.
—B. C. I. R. A.

Looms: Weft Feeler Mechanism. E. Hollingworth, Dobcross, Yorkshire. E.P. 212,413.

The patent relates to weft-detecting mechanism of the type comprising a casing, member or slide, slidable in a stand and carrying a rearwardly projecting fixed detector and a movable pivoted detector, these detectors remaining normally in a fixed position when they are forced back by the weft, but assuming an abnormal position when the weft is substantially exhausted whereby weft replenishment is initiated. —B. C. I. R. A.

Pile Fabric Loom. M. B. Behrman, Brooklyn, New York, U.S.A. E.P. 212,443.

Each pile forming and cutting wire or needle has a U-shaped holder into the recess of which a detachable cutter or blade can be secured. —B. C. I. R. A.

Looms: Shuttle Guard. N. Hough, Daubhill, Bolton, Lancs. E.P.212,481.

A shuttle guard comprises a net attached to a roller, automatically rotated by the starting and stopping of the loom to unroll the net, to extend it over the lathe, or to roll it up. —B. C. I. R. A.

Circular Knitting Machine. Wildman Manufacturing Co., Norristown, Pennsylvania, U.S.A. E.P.212,581.

To knit a succession of stockings of equal length, and consisting each of an equal number of courses, no special matching to make up pairs being required, the yarn is supplied to the needles by plain or toothed conical or cylindrical rolls, in accordance with demands, irrespective of variations of tension, one roll being pressed against the other, which is positively driven, by a spring, so as to accommodate itself to changes in the position of the yarn. Variations in the yarn tension cause the yarn guide to shift in position along the rolls. —B. C. I. R. A.

Fabric Piling Mechanism. J. J. Lyth, Valleyfield, Quebec, Canada. E.P. 212,631.

The patent relates to mechanism for piling fabrics in rope form. The feed-conduit through which the cloth is fed into the kier, bin &c., rotates about a vertical axis passing through the axis of its inlet hopper, whilst its delivery end, which is eccentrically positioned, terminates in a section having an oscillating movement, also about a vertical axis. Thus, the mechanism as a whole rotates about an axis that corresponds to the axis of the kier &c., whilst the point of delivery extends from the centre of the kier to a point at its periphery. —B. C. I. R. A.

Looms: Dobby Pattern Lag Punching Machine. T. Livesey and F. D. Moore, Great Harwood, near Blackburn. E.P. 212,707.

In a machine for removing the pegs or pins from the pattern lags of dobbies, the lag chain, comprising lags, connecting links and staples, is passed over an intermittently rotated grooved roller, and a reciprocating punching bar, provided with steel punches, descends, so that the punches eject the pattern pegs &c. that may be present in any of the holes in the lags, these ejected pegs &c. entering the grooves in the roller.
—B. C. I. R. A.

Leased Warp Selector Needles. J. E. Moore, Blackburn, Lancashire. E.P.212,773.

Selector needles for use in selecting and separating leased warp threads &c. as described in various specifications, are provided with adjustable notches. For this purpose the needle may be slotted to receive a plate, pivoted and adjusted by a screw to cause the point of the slanting end of the plate to project from the needle to a varying extent, and thus form a notch of varying size. The plate may be clamped in position by a clamping screw. Modifications are described wherein the plate is moved endwise. The carrier or holder may be provided with a spring to enter a notch or hole in the carrier &c. and to engage a notch in the needle, whereby this may be readily attached to, or detached from, the carrier &c. The needle may have more than one notch, so that its position in the carrier &c. can be adjusted.
—B. C. I. R. A.

Looms: Warp Beam Flange. R. E. Starkie, Burnley, Lancs. E.P.213,008.

Flanges for warp beams &c. are made of aluminium or aluminium alloy, and are combined with strengthening pieces of steel or wrought-iron. The strengthening pieces are arranged radially around the flange, and have their inner ends cranked to lie in pockets projecting from the tubular boss, the outer ends of the pieces lying in pockets in the flange, which may be cast around the strengthening pieces.
—B. C. I. R. A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal (Patents)*—

(A)—British.

210,619. **Looms: Change-box Motions.** T. Foulds & Son, Ltd., and W. Riley, Colne, Lancashire.

210,653. **Circular Knitting Machine.** W. Carpmael, Southampton Buildings, London.

211,015. **Looms: Stop Motion.** E. Hollingworth, Dobcross, Yorkshire.

211,019. **Looms: Weft-feeler Arrangement.** E. Hollingworth, Dobcross, Yorkshire.

211,193. **Looms: Stop Motions.** H. R. Ross and R. Cunningham, both Belfast.

211,529. **Looms: Shedding Motion.** H. Lindsay, Cleveland, Ohio, U.S.A.

211,871. **Braiding Machines: Gearing.** A. Lund, Barmen, Germany.

211,908. **Looms: Picking Motion.** H. Thomson, D. Macfarlane and R. Ramsay, Dundee.

211,913. **Knitting Machines: Yarn Control Wheel.** F. Billson, Stratford Square, Nottingham.

212,416. **Lace Machine Bobbin Construction.** Sir E. Jardine and H. Lambert, Nottingham.

212,591. **Lace: Square Mesh Traverse Net.** J. Farmer, Sherwood Rise, Nottingham.

212,851. **Looms: Beat-up Motion.** J. Poyser and J. B. S. Poyser, Mansfield, Nottingham.

212,854. **Looms: Dobbies; Shedding Levers.** J. H. Duckworth, Darwen, Lancashire.

(B)—American.

Preparatory Processes. 1,465,063 (warp beaming); 1,465,064 (warp beaming); 1,465,359 (creel); 1,465,586, 1,465,587 and 1,465,588 (beam heads); 1,468,054 (beam heads).

Sizing. 1,462,442 (slasher).

Weaving (includes Looms and Accessories). 1,461,281 (warp uniting); 1,461,536 (tension device); 1,461,547 (reed); 1,461,861 (weft replenisher); 1,461,872 (feeler mechanism); 1,462,192 (tuft yarn spool); 1,462,502 (buffer check); 1,462,520 (spool bearing bracket); 1,462,548 (warp stop motion); 1,462,549 (narrow ware loom); 1,462,554 (weft detector); 1,462,603 (marquisette comb device); 1,462,920 (wire head); 1,463,131 (feeler mechanism); 1,463,203 (filling-end controller); 1,463,207 (let-off mechanism); 1,463,225 (thread-parter mechanism); 1,463,226 (take-up mechanism); 1,463,286 (shuttle thread block); 1,463,292 (thread extractor); 1,463,435 (automatic loom); 1,463,614 (picker stick attachment); 1,463,886 (pile fabric loom); 1,463,965 (self-threading shuttle); 1,463,966 (let-off mechanism); 1,464,181 (pile forming wire); 1,464,212 (shuttle winder); 1,464,484 (drag roll); 1,464,485 (warp stop motion); 1,464,847 (hand loom); 1,465,693 (take-up mechanism); 1,466,100 (warp beam tensioner); 1,466,485 (yarn clamp); 1,466,521 (shuttle bobbin); 1,466,542 (battery feed for automatic looms); 1,466,847 (bobbin chute); 1,466,848 (self-threading shuttle); 1,466,849 (shuttle thread block); 1,466,855 (filling feeler mechanism); 1,467,232 (filling feeler mechanism);

1,467,653 (weft carrier magazine); 1,467,697 (warp holder); 1,468,207 (warp gluing device); 1,468,576 (warp carrying drum); 1,469,180, -181, -182, -183, -184 and -185 (tube frame devices).

Knitting Machines. 1,461,172; 1,462,551 (circular machine); 1,463,719 (lace attachment); 1,463,741 (stop motion); 1,464,052 (striping attachment); 1,465,934 (tension device); 1,467,239 (loop-forming mechanism); 1,467,626 (seaming device); 1,467,691 (web holder); 1,468,513; 1,468,518 (needle); 1,468,697.

Lacemaking and Embroidering. 1,464,034 (twist lace net); 1,465,526 (needle adjustment.).

Fabrics. 1,461,125 (stitching); 1,462,333 (holder); 1,462,367 (uniting looped fabrics); 1,462,378 (uniting looped fabrics); 1,462,858 (weftless tyre fabric); 1,463,239 (pile cutting knife); 1,464,289 (embroidered fabrics); 1,464,715 (rubber-cored fabric); 1,465,321, 1,465,322 (fabric measuring machines); 1,465,479 (fabric winding machine); 1,466,523 (stretching and clamping device); 1,466,868 (shaping and pressing device); 1,468,351 (fabric stretching machine).

Braiding Machines. 1,462,213; 1,465,554; 1,467,551 (stop motion).

4—CHEMICAL AND OTHER PROCESSES

(C)—Washing.

Cleansing Power of Soaps and Evaluation of Curd Soaps. Elwart. *Chemical Abstracts*, 1924, **18**, No. 6, p. 914 (from *Siefensieder Ztg.*, 1923, **50**, 711-2).

An account of the most suitable soaps for use in various textile manufacturing processes. —B. L. R. A.

Hydrohexalin; Use in the Manufacture of Soaps and Water-Soluble Oils. P. Friesenhahn. *Chemical Abstracts*, 1924, **18**, No. 6, p. 913 (from *L. Deut. Ocl-Fett-Ind.*, 1923, **43**, 695).

Friesenhahn emphasises the superiority of hydrohexalin for preparing permanent emulsions for cleansing, cutting oil and disinfecting emulsions. —B. L. R. A.

Transparent Soaps. J. Leimdorfer. *Chemical Abstracts*, 1924, **18**, No. 6, p. 913 (from *Seifenseider Ztg.*, 1923, **50**, pp. 399-400, 411-2, 441-2, 455-6).

An account of the properties of transparent soaps and the cause of their transparency. —B. L. R. A.

(E)—Drying and Conditioning.

Modern Drying Apparatus in the Textile Industry. E. Blau. *Leip. Monatsch*, 1924, **36**, No. 5, pp. 223-6.

A description of the drying chambers and drying canals manufactured by the Zittauer Maschinenfabrik for drying yarn, flax straw &c. —L. I. R. A.

(G)—Bleaching.

Bleaching and Detergent Agents, methods Recently Employed in the Investigation of——. P. Heermann. *Leip. Monatschrift*, 1924, **39**, No. 5, pp. 215-20.

A detailed review of methods which have recently been employed in the experimental investigation of the bleaching and detergent action of various agents and their action upon the fibre. —L. I. R. A.

Bleaching. M. Freiberger. *Textilberichte*, 1924, **5**, 397-400.

A review of recent progress in the bleaching of cotton. The present article deals with de-sizing and bowking processes. —B. C. I. R. A.

Bleaching. W. Blasius. *Textilberichte*, 1924, **5**, 305-306.

A general discussion of the methods of joining pieces of cloth and conveying them from place to place in bleach works. Sewing the pieces together with a sewing machine is stated to be the best method of joining them whilst the abolition of wagon transport in favour of overhead conveyance in rope form is advocated. The method of conveyance depends largely, however, on the arrangement of the works considered. —B. C. I. R. A.

Coloured Cotton Shirtings Woven with Stripes: Bleaching. O. Gaunitz. *Textilberichte*, 1924, **5**, No. 4, pp. 244-5.

Emphasises the importance of desizing the goods before the boiling process. Several methods of bleaching which have been found satisfactory are briefly discussed. —L. I. R. A.

Bleaching Kier. F. Ebinger. *Chem. Zentr.*, 1924, **i.**, 1596 (from G.P.389,812).

A circulating bleaching kier is described which is so constructed that, by telescopic arrangement, the steam jets are always the same distance below the level of the bleaching liquor and the distributing jets are always the same distance above the level of the liquor whatever the depth of goods in the kier.—B. C. I. R. A.

Monel Metal for Dyeing, Bleaching and Finishing Equipment. R. J. McKay and E. A. Turner. *American Dyestuff Report*, 1924, **13**, 54-62.

Monel metal is called a natural alloy since it contains nickel and copper in the same proportions in which they existed in the original ore, namely, nickel 67%, copper 28% and other metals 5%. It is a white metal stronger than mild steel, tough, ductile, rust-proof and capable of taking and retaining the high polish of nickel. Its advantages in the textile industry over other metals of equal or less cost are—elimination of rust and other metal stains, longer life of the apparatus. Its strength and high fatigue lead to improved design of machinery and it is conveniently cleaned. —L. I. R. A.

Cotton Piece Goods; the Bleaching of——. W. F. Deady. *American Dyestuff Report*, 1924, **13**, 1-4; 43-4; 74-5.

The subject is considered under the following topics—Stamping with lot numbers, sewing the pieces end to end, singeing, desizing, piling and washing machines, kier boiling, mercerising, chemicking, scouring and washing. These various operations are discussed with a view to attaining the highest degree of efficiency in each and of making the operations as continuous as possible. —L. I. R. A.

Cellulose Bleaching. See Section 1D.

Determination of Available Chlorine in Bleaching Powder. See Section 6.

(H)—MERCERISING.

Cotton. S. Meissner. *Textilberichte*, 1924, **5**, 406 (from *Spinner und Weber*, 1924, No. 7, p. 6).

Temperature has practically no effect on the mercerisation of cotton when caustic soda of 30° Bé is employed. It is, therefore, unnecessary to cool solutions of this concentration. More dilute solutions have as good a mercerising action when cooled to 0-10° C. as solutions of 30° Bé at normal temperature. The processes of Schaeffler & Heberlein & Co. are especially emphasised. —B. C. I. R. A.

Cotton Cloth Mercerisation. S. Ota. *Chem. Abstr.*, 1924, **18**, 757 (from J.P.42,175).

A silky lustre and feel is imparted to cotton threads or cloths of vegetable fibres by hot mercerisation with a mixed solution of alkali hydroxide and grape sugar. Practical details are given.—B. C. I. R. A.

Mercerising Cellulose. See Section 1D.

(I)—DYEING.

Substantive Dyes. A. Ganswindt. *Leipziger Monats. Text.-Ind.*, 1924, **39**, 46-47.

A general discussion of air-temperature dyeing processes. The possibility of dyeing cotton with substantive dyes depends on the solubility of the dye. The author has studied the behaviour of a number of substantive dyes in cold-dyeing processes and has ascertained that—(1) There is an optimum temperature of solution characteristic for each dye. (2) The cotton dyes only when the dye is in actual solution, not when it is in suspension. (3) The optimum solution temperature is the best temperature at which to carry out the dyeing. (4) The shade obtained in cold dyeing processes depends directly on the quantity and form of the dyestuff in solution in the cold bath. —B. C. I. R. A.

Turkey Red Oil Substitute. H. Pomeranz. *Leipziger Monats. Text.-Ind.*, 1924, **39**, 44-46.

A general article describing the preparation, properties and application of Turkey Red oil and of the series of similar products which is obtained by using different raw materials and different methods of sulphonation and neutralisation. —B. C. I. R. A.

Substantive Dyestuffs; Temperature Coefficients of——. R. Auerbach. *Kolloid Z.*, 1924, **34**, 109-112.

The author discusses the effect of temperature on the dispersion of substantive dyestuffs and the relation of the degree of dispersion to the amount of dye absorbed by cotton. Each dyestuff is considered to have an optimum degree of dispersion at which the amount of dye absorbed is at a maximum. In this connection it is shown that a substantive dyestuff has a positive temperature coefficient of absorption if it gives a coarse dispersion at low temperature and approaches the optimum dispersion as the temperature is raised. Conversely it has a negative temperature coefficient when its degree of dispersion is already above the optimum at low temperatures and a rise in temperature increases the dispersion still further. These considerations apply only when the degree of dispersion of the dyestuff is sufficiently removed from the optimum over the range of temperatures involved. In the neighbourhood of the optimum the effect of slight changes in the degree of dispersion is masked by other factors which influence the temperature coefficient. Erika B.N. which has the highest degree of dispersion of the substantive dyes studied shows a negative temperature coefficient when dyed on cotton, since it is far removed from the optimum point. If, however, it be dyed on wool under the same conditions, it shows a positive temperature coefficient because by raising the temperature its degree of dispersion approaches that of the highly dispersed wool dyestuffs. —L. I. R. A.

Union Fabric. E. Herzinger. *Textilberichte*, 1924, **5**, 394-395.

A short general account of methods for obtaining pale shades on half wool and half cotton fabrics. —B. C. I. R. A.

Alkaline Vat Control. G. C. Gerardt. *Textilberichte*, 1924, **5**, 394.

An observation is described in which the line of demarcation between the white and coloured stripes of some striped zephyrs was very indistinct. The fault arose only in the case of dark-coloured stripes for which vat dyes had been used and was traced to the strong alkalinity of the dyebath. The author suggests that the influence of alkalinity and temperature of the vat is a subject for research. —B. C. I. R. A

Indanthrene Dyes. E. Seeger. *Textilberichte*, 1924, **5**, 308-310.

A further consideration of the properties and application of Indanthrene Dyes. The importance of following the process recommended by the makers for each individual dye is pointed out. Brief reference is made to such matters as the use of Indanthrene dyes in beam dyeing, in printing and for a variety of special purposes (e.g., blueing in textile finishing).
L. I. R. A.

Indanthrene Dyes. Their uses and their Dyeing and Fastness Properties on the Textile Fibres. E. Seeger. *Textilberichte*, 1924, **5**, 241-243.

This article deals briefly with the fastness properties of the Indanthrene dyes as a class and refers to the special properties of a few individual dyes. The addition of Ludigol is recommended when coloured goods are to be soda boiled. It is moreover important to desize the fabric carefully before the soda boil. —L. I. R. A.

Mexican Cloths; Dyeing of——. A. Peters. *Textilberichte*, 1924, **5**, 249-250.

A general article on the dyeing and finishing of typical Mexican fabrics of which cotton goods form the biggest section. Mexico has an extensive domestic industry as well as many modern mills. The domestic industry comprises chiefly the manufacture of coloured cotton shawls known as "Rebozos," large coloured shawls of wool and cotton for men's wear, and drawn thread table covers, bed covers, and ornamental covers of all kinds. In the mills the principal products are crude, unbleached, heavily-loaded cotton fabric and a cotton fabric dyed with substantive dyes. Another extensively produced fabric is the so-called "Mezclillas," a strong blue-white fabric for workmen's clothing. This fabric is responsible for most of the synthetic indigo consumption. Khaki-coloured and grey drills are also manufactured and calico printing is practised in many of the big mills. —B. C. I. R. A.

Ice Colours. A. Gotthardt. *Textilberichte*, 1924, **5**, 248-249.

Various formulae for preparing ice colours for direct printing are given and the methods discussed. —B. C. I. R. A.

Slop-Padding Machine. Zittauer Maschinen Fabrik A-G. *Textilberichte*, 1924, **5**, 315-316.

A slop-padding machine for vat dyes is described. It is so constructed that, by rapid working, the frothing difficulties which usually occur in the application of vat dyes are avoided. The squeezing bowls, instead of being arranged directly one above the other, are arranged so that a line joining their axles is inclined at about 45° to the perpendicular, and the surface of the liquid is level with the nips of the squeezer bowls. The deposition of scum and spotting are thus avoided.
—B. C. I. R. A.

Cellulose Acetate Silk. Etablissements Mercier & Fessy. *Chem. Zentr.*, 1924, **i**, 1596 (from F.P.563,785).

The silk is treated with a solution of stannous or stannic chloride, washed, immersed in a solution of an alkali salt such as sodium silicate, sodium carbonate, sodium hydrogen phosphate or borax and, after washing, is dyed in the customary way.
—B. C. I. R. A.

Substantive Dyes: Physical Chemistry of Dyeing. T. R. Briggs. *J. Phys. Chem.*, 1924, **28**, pp. 368-86.

The author has carried out a number of experiments on the absorption of various direct dyes by cotton and concludes that the process of dyeing by a substantive dye is attributable to the tendency of the colloid or fine suspension in water to collect at the interface between two phases, one of which is the aqueous dispersion medium and the other the solid fibre. Anything added to the dye solution which adds to the stability of the suspension will tend to prevent this interfacial phenomenon and so lessen absorption, whereas a coagulating agent, such as common salt, reduces the stability and so should aid absorption, provided it is not present in sufficient amount to cause actual coagulation. A coagulating agent, therefore, should act as an assistant in substantive dyeing, increasing in effectiveness up to a certain optimum concentration which will be higher the smaller the coagulating power. A stabilising agent, on the other hand, ought to act as a restrainer provided that it is not also a mordant. —L. I. R. A.

Cotton, Flax, Hemp. R. Bartunek. *Cellulosechemie*, 1924, **5**, 25-26; 33-44.

An extended account of the author's researches. —B. C. I. R. A.

Dyes: Precipitation by Salts. E. Wertheimer. *Chem. Zentr.*, 1924, **i**, 2185 (from *Pflüger's Arch. Physiol*, 1924, **202**, 383-394).

Neutral salts effect the solubility of basic dyes (Methyl Violet, Gentian Violet, Methylene Blue, Safranine) according to the Hofmeister anion series, -CNS having the greatest precipitating power. For the precipitation of highly-dispersed acid dyes ("Trypanblau," Congo Red) the cation series is $Ca < Mg < Na < K < NH_4$. The precipitation of basic dyes by neutral salts also depends on the concentration of the dye, higher concentration favouring precipitation. In addition, heat lowers the tendency to precipitation, as does the addition of starch, gelatin, gum arabic, soap or plant mucilages. Serum proteins, especially globulins, however, promote precipitation of basic dyes.—B. C. I. R. A.

Substantive Dyeing; Theory of——. T. R. Briggs. *J. Phys. Chem.*, 1924, **28**, 368-386.

From a consideration of the general process of colloid distribution, a special theory of substantive dyeing has been formulated and tested by experiment. A substance which destabilises the suspension of the dye will act as an assistant in the dyebath up to the point of actual flocculation. A substance which stabilises the suspension of the dye will act as a restrainer, providing it does not act as a mordant toward fibre and dye. A stabilising substance and a destabilising substance may each exert their specific effects in the same dyebath. Transition dyes exist which combine with their properties of acid or basic dyes the characteristics of substantive dyes.

—B. C. I. R. A.

Monel Metal for Dyeing Equipment &c. See Section 4G.

Dye Solutions: Fluorescent Radiation. See Section 6.

(J)—PRINTING.

The Story of Printed Fabrics. J. W. Stephenson. *Amer. Silk Jl.*, 1924, **43**, No. 2, p. 77.

An illustrated account of printing from earliest times to the days of the East India Company. Chintz is described as being painted and dyed on English grey jaconets bleached completely on the spot and pounded to make the fabric soft. Bamboo pens wound with balls of wool to hold ink like a fountain pen were used. Wax acted as a resist and mordants have been used for centuries. Letters are quoted showing the interest taken by the officials of the John Company in the industry.

—F. G. P.

Textile Fabric Printing. L. Dufay. *Chem. Zentr.*, 1924, **i**, 1596 (from F.P. 563,756).

The pattern is first transferred to a bearer of opaque paper, celluloid, copper, zinc, or wood and thence to the moistened material. In single colour printing the saturated printing colours used in typography can be employed. The pattern on the bearer can be dusted with the powdered dyestuff and then printed on the fabric. For the production of multi-coloured patterns, the three-colour printing process is used with water or alcohol-soluble dyes. —B. C. I. R. A.

Textile Fabric Printing. M. Rodamel. *Chem. Zentr.*, 1924, **i**, 2012 (from F.P. 563,064).

In a process for printing fabrics with several colours the fabric is led over several heated, nickel-plated rollers in order to give it a smooth surface. It is then printed in the way used for books. —B. C. I. R. A.

Tapestry Carpet Yarn. L. J. Matos. *Text. World*, 1924, **65**, 2529 (from *Dyestuffs*).

A general article describing the printing of yarns for the manufacture of tapestry, Brussels carpets and rugs. In tapestry yarn printing, the coloured design is printed directly on each individual warp thread that is eventually to appear as the face of the carpet. The space occupied by each colour on the warp thread is somewhat longer than it will appear in the finished carpet in order to allow for take-up in weaving. —B. C. I. R. A.

The Story of Printed Fabrics. J. W. Stephenson. *Amer. Silk Jl.*, 1924, **43**, 6, 65.

The history of the industry in France dates from 1759, although the edict against wearing prints then repeated had been flagrantly disobeyed. By 1789 there were over 100 print works in France. Oberkampf printed his first linen in 1760 and immediately became famous; he was designer, engraver, printer and dyer, and his factory at Jouy was called "Royal." Some of these prints even to-day retain their brightness and beauty. Copperplate printing was introduced about 1780, and 17 years later rolls were used. —F. G. P.

Textile Fabrics: Lithographic Printing. *Text. World*, 1924, **65**, 3643.

The application of the lithographic method of printing to textiles is discussed. The method is especially applicable to the manufacture of specialities such as children's dresses, kindergarten slippers, table covers &c., and in the preparation of samples. In the case of print samples the cost of engraved copper cylinders for designs for which there may be no demand is avoided, and for rugs, carpets &c., the colours and design may be reproduced on wool felt thus reducing the bulk of the traveller's samples. —B. C. I. R. A.

Calico Printing Problems. See Section 4I.

(K)—FINISHING.

Dextrin-Soap Finishing Mixtures. *Textilberichte*, 1924, **5**, 387-389.

Twenty-nine recipes for dextrin-soap finishing mixtures are tabulated and the typical effect of each is indicated.

—B. C. I. R. A.

Cotton Fabrics. Totaro Aoki. *Chem. Abstr.*, 1924, **18**, 757 (from J.P. 42,057).

Cotton threads or cloths are immersed in a solution containing potassium hydroxide and zinc oxide for about 30 mins., separated from the solution, washed with water and dried, then passed through a viscous solution of vegetable fibres in concentrated zinc chlorides and finally through a solution of ammonium chloride or dilute acids, and washed and dried. The product is strong, lustrous, and resistant to friction.

—B. C. I. R. A.

Textile Materials. K. Yasumoto and T. Kimura. *Chem. Abstr.*, 1924, **18**, 757 (from J.P. 42,179).

Threads or cloths of silk, cotton, wool or hemp are immersed in a solution of 20 grams of barium chloride or calcium chloride, 1 gram of sodium acetate, 1 gram of glycerol or phenol, 20 grams of milk and a small amount of gum Arabic in 180 ccs. of water, dried, passed through cold sulphuric acid of 2-4° Bé., washed with water, and then dried in the air by heating.
—B. C. I. R. A.

Schreiner Calender. A. C. Freeman. *Text. World*, 1924, **65**, 3629-3630.

Some general notes on Schreiner calenders and their action. The number of engraved lines per inch, their direction, the nature of the steel used for the top roller, and methods of driving are dealt with.
—B. C. I. R. A.

Cloth Desizing. H. L. Toman. *Chem. Zentr.*, 1924, **i.**, 2639 (from F.P. 564,649; also E.P.213,923).

The fabric is saturated in a slop-padding machine with a solution of ferments, such as diastase or pancreatin, or substances containing them, passed through squeeze rollers, passed over guide rollers in a drying chamber at 90-100° or over hot rollers, and then through boiling water. The process is very rapid and can be run continuously. —B. C. I. R. A.

Monel Metal for Finishing Equipment, &c. See Section 4G.

(L)—WATERPROOFING.

Waterproofing Cloth. S. Murachi and T. Okazawa. *Chem. Abstr.*, 1924, **18**, 757 (from J.P. 42,559).

The cloth is immersed in a colloidal solution of alumina, then in a 5% solution of magnesium sulphate, washed and dried. It is then passed through a benzene solution of a mixture of metallic palmitate and oleate, and a mixture of the powdered palmitate and oleate, dried and rolled. The colloidal solution is prepared by passing steam into a 0·5% solution of aluminium acetate for 7-20 hours at 100°, or by dialysing a mixture of 5% aluminium acetate and a small amount of hydrogen peroxide at 60-70°. —B. C. I. R. A.

Waterproof Finish; A Permanent——. J.C.R. *Textile American*, 1924, **41**, No. 3, pp. 57, 59 and 61.

Describes the use of a paste prepared in the cold from wood-pulp (dry "matte"), caustic soda and carbon bisulphide. The cloth is *filled* by running it through the printing machine in the usual manner, the paste being padded on by means of a suitably engraved roller. Drying is effected on the usual drying cylinders. After filling or printing, the cloth is passed through an ordinary aniline ageing machine at about 202° F. Wide goods (tarpaulins) &c. may be filled on a back starching machine. The paste may also be applied by a Scotch mangle. The process shrinks the goods considerably (e.g., 4 to 6 inches on 36 inch goods). The goods may be dyed after passing through the ageing machine. They are first thoroughly wet-out in some castor-oil soap and boiling water and then dyed on the jig with one of the direct colours. The cloth will stand boiling out and still retain its permanency of finish. The strength and durability of the goods are materially increased by the waterproofing process. The process has a wide range of uses (window blinds, tarpaulins, book cloth, upholstery cloth &c.
—L. I. R. A

PATENTS

Tentering Machine. A. A. Whitley and Bentley & Jackson, Ltd., Bury, Lancs. E.P.211,688.

In machines having a weft-straightening device such as is described in Specification 15,488/08 the controlling lever of the weft-straightener slides between springs on a rod or a series of connected rods, the last of which is connected to a lever having a handle and a spring-controlled part adapted to be retained in one of a number of notches in a quadrant. In a modification, the springs are arranged at the other end or at an intermediate part of the rod. A series of rods may be employed and be supported by rocking levers, balance weights being employed to maintain the lever in the mid or inoperative position. —B. C. I. R. A.

Yarn Dyeing Device. Fuld and Hatch Knitting Co., Albany, New York, U.S.A. E.P.211,437.

Yarn is passed over a disc rotating in a bath of dye. It is caused to reciprocate vertically by a vibrating finger carried by a shaft driven by a shaft upon which a number of discs are mounted.
—B. C. I. R. A.

Pile Cutting Machine: Stop Motion. F. Varley, Morecambe, Lancashire. E.P. 211,191.

In a machine for cutting the pile of velvet, corduroy &c. cords, in which each cord is cut by a disc cutter revolving in a longitudinal slot in a guide needle, which guide passes into and raises the ribs of material to the knife, an electric stop motion operates if the guide should penetrate the material upwards or downwards or if it should foul the material and thereby be forced back by it in its travel.
—B. C. I. R. A.

Mineral Pigments: Application. Plauson's (Parent Co.) Ltd., Pall Mall, London. E.P.211,178.

Fibres, fabrics, fur, feathers, cellulose esters, wood and paper are dyed by immersing the material in a dye-bath containing a colloidal dispersion of an insoluble mineral or half-mineral pigment, including bodies such as the heavy metal compounds of organic dyestuffs, and coagulating the dispersion on the substrate. The use of a dispersion of an oxide of a metal of the iron group in dilute soap solution is specifically excluded. The coagulation may be effected physically, for example, by heat, ultra-violet light or electric current, or colloid-chemically, such as by the addition of colloids of opposite polarity or of the same polarity but different intensity of charge, or by the addition of an electrolyte, particularly compounds of bivalent or tervalent metals, or of an organic compound containing halogens, sulphur, nitrogen &c., for example, sulphonic acids or heterocyclic compounds. Some examples are given.

—B. C. I. R. A.

Cop-Dyeing Apparatus. F. Schumacher, Basle, Switzerland. E.P.210,765.

The patent relates to the dyeing of cops by the passage of dye-liquor in a longitudinal direction through a series of layers, each composed of a number of rows of cops arranged compactly and compressed. To prevent longitudinal displacement of the cops, and to secure even distribution of the liquor, packing pieces shaped to correspond with the spaces at the ends of the rows and extending the whole length of the rows, are arranged along the sides of the vat. —B. C. I. R. A.

Drying Cylinders: Heating. W. J. Mellersh-Jackson, Southampton Buildings. E.P. 210,672.

In apparatus for drying paper and fabrics where the heating of the drying cylinders is effected in groups, a main steam supply pipe is divided to accommodate this group heating by valves, and the return mains by similar valves, bye-pass pipes being situated between corresponding pairs of valves. The bye-pass pipes are provided with valves. By suitable manipulation of the valves the separate groups may be heated in succession, or two or more adjacent groups may be heated together.

—B. C. I. R. A.

Cheese Dyeing Machine. J., T. & J. Brandwood, Bury, Lancs. E.P.210,661.

In the dyeing, bleaching or like treatment of yarn cheeses, the cheeses are pressed from the tubes on which they have been wound on to fluted spindles so assembled that the dye or like liquor may be forced radially through the cheeses into the flutes of the spindles and thence back to the pump. The cheeses are finally passed to separate holders of the same cross-sectional area and configuration as the spindles.

—B. C. I. R. A.

Drying Cylinder: Steam Joint. A. Buchanan, Reddish Vale, near Stockport, Cheshire. E.P.210,571.

A steam-tight joint is maintained between the doll-head and the trunnion of a steam-heated drying cylinder by means of a non-rotary member which carries a flexible washer, and which is pressed against the trunnion end by a spring, the non-rotary member being capable of slight universal movement and considerable longitudinal movement. Mounted within the doll-head is a ball bearing which is adapted to move longitudinally with the trunnion. In a modification, the flexible washer is carried on the end of the non-rotary member and abuts against the end of the trunnion. —B. C. I. R. A.

Loose Fibre Dyeing Machine. W. Rhys-Davies and T. Haigh, Bradford, Yorks. E.P.210,545.

In dyeing, bleaching or similarly treating wool and other fibrous materials, the material is subjected, while immersed in treating liquor contained in a single bowl or tank, to a succession of frequently applied nips or squeezers of such pressure as to effect the removal of occluded air as well as other impurities. A tank containing treating liquid and having a false bottom is provided with pairs of nip rollers operating, preferably simultaneously, beneath the surface of the liquid. The upper roller of each pair is provided with springs and preferably also with an adjustable scraper. A series of inclined and perforated platforms up which the material is fed by oscillating arms or prongs directs the material between the rollers.

—B. C. I. R. A.

Artificial Silk Union Fabric: Finishing. W. Marshall, Cheadle Hulme, Cheshire. E.P.210,484.

Fabrics are made from unmercerised or incompletely mercerised yarn and acetyl cellulose yarn, the fabric being subjected to caustic alkali of mercerising strength. The mercerising may be effected with the fabric under tension, or without tension when a crepe effect is to be produced. The goods to be treated may contain dyed warps or wefts, or both, of acetyl cellulose or natural cellulose. After treatment with the caustic alkali, the fabric may be bleached, dyed &c. The mercerising bath may be caustic soda of about 48° Tw. to 60° Tw., at a temperature not higher than about 60° F. The goods may be woven to produce a crepe effect.

—B. C. I. R. A.

Mineral Pigment: Application. Plauson's (Parent Co.), Ltd., Pall Mall, London. E.P.211,912.

Textile fibres and fabrics are dyed by means of mineral pigments, produced on the fibre in the colloidal form by the interaction of a plurality of reagents in presence of a protective colloid. The colour is then fixed by coagulating the colloid by chemical physical or electrochemical means. In the case of chemical coagulation, the coagulant may be applied to the fibre before or after the pigment-forming reagents. Several examples are quoted. —B. C. I. R. A.

Tubular Fabric Calendering Machine. B. J. Dykes, Gleadless, near Sheffield. E.P. 211,996.

A machine for calendering tubular fabrics comprises two or three pairs of superimposed, heated calendering gauges, the upper gauge being carried between adjustable carriages, fitted with positively driven guide rollers. The upper gauge is formed in two parts held in adjusted position on guide bars by pawls. —B. C. I. R. A.

Singeing Machine. Calico Printers' Association, Ltd., Manchester, and W. Beverley, Stalybridge, Cheshire. E.P. 212,023.

The fabric passes under tension rollers on frames which are rocked about the axis of the cylindrical part of the single plate, by adjustable link and lever mechanism. The frames are raised and lowered to facilitate insertion of the fabric and to adjust its pressure on the singe plates by sliding bars, pivoted to the frames, and controlled by a hand-wheel, through toothed gearing and link mechanism. The heights of the frames at the end of each singe plate are adjusted independently by hand wheels acting through screw and bevel gearing to adjust the lengths of links connected by bell-crank levers to the sliding bars. —B. C. I. R. A.

Bleaching Kier: High-Pressure Type. W. Smethurst, Harwood, Bolton. E.P. 212,084.

High-pressure kiers used in bleaching and similar operations are provided on the external circuit through which the liquor is circulated, with one or more transparent inspection members or windows mounted in such a manner that in the case of failure of a window the bracket in which it is mounted may be isolated from the system, as by cocks arranged on either side thereof. —B. C. I. R. A.

Dyeing Machine. H. Nuttall, Chorley, Lancashire. E.P.212,146.

A series of dye-vats to which yarn in sheet form is fed so that different sections of the sheet are differently dyed is combined with a yarn-drying chamber provided with a wince and a fan rotating in opposite directions. —B. C. I. R. A.

Tubular Fabric Stretching Device. G. Hunt, West Bridgford, and C. W. Campion, Nottingham. E.P.212,369.

A device for stretching tubular fabric and guiding it in a continuous manner to calendering rollers, comprises a beam supported solely by rollers so as to leave both its ends free, and provided with angularly adjustable fabric-extending arms, rollers driven from the calendering machine engaging the fabric to feed it over the stretching device. —B. C. I. R. A.

Hank Dyeing Apparatus. Courtaulds, Ltd., London, and F. T. Wood, Coventry. E.P.212,749.

The hanks are supported on bent rods, which are given a movement about stationary rods so that the hanks are alternately raised and then lowered on to these rods, and are at the same time traversed with respect to their length. —B. C. I. R. A.

Coloured Non-metallic Powders. C. Gentner, Würtemburg, Germany. E.P. 212,804.

Fibrous materials, such as cloth, buckskin, and the like, are coloured by rubbing the material with a textile bag containing the colour in the form of a colloidal powder, the bag being of a texture such that only the finest particles can penetrate. Preferably the powder is originally packed in bags suitable for this use. —B. C. I. R. A.

The following is a list of patents of which abridgements have recently appeared in the *Illustrated Official Journal (Patents)*—

(A)—British.

210,462. **Dyeing with Azo Dyes.** Chem. Fabr. Griesheim-Elektron, Germany.

210,865. **Waterproofing Fabrics.** J. C. Grant, Barnes, Surrey.

210,969. **Tentering Machine: Pinning Brush.** H. J. Scottorn, Huddersfield, Yorks.

211,188. **Waterproofing Fabrics.** R. Russell, Rhodes, near Manchester, and H. Broomfield, Hazel Grove, Cheshire.

211,370. **Dyeing Apparatus.** Usines de Keukelaere, Ghent, Belgium.

211,720. **Dyeing Cellulose Acetate.** British Dyestuffs Corporation, J. Baddiley and A. Shepherdson, Blackley, Manchester.

212,546. **Vat Dyes: Dyeing and Printing Processes.** Soc. Anon. Durand et Huguenin, Basle, Switzerland.

212,763. **Pressure Boiling Kier.** C. H. Garner, Manchester.

(B)—American.

Dyeing Processes. 1,461,330 (skein dyeing); 1,461,822 (skein dyeing).

Other Processes. 1,461,445 (fabric coating); 1,462,172 (finishing); 1,462,381 (waterproofing); 1,463,780 (coating and bonding); 1,465,541 (coating process); 1,468,396 (selvedge trimmer).

5—LAUNDERING AND DRY CLEANING

Cleansing Power of Soaps. See Section 4c.

Hydrohexalin: Use in Manufacture of Soaps. See Section 4c.

Transparent Soaps. See Section 4c.

Soap Analysis. See Section 6.

Water: Determination of Hardness. See Section 6.

Waste Soap Recovery. See Section 6.

Soap Solutions: Electrical Resistances. See Section 6.

PATENTS

(B)—AMERICAN.

Laundry Appliances. 1,462,952 (recorder).

6—ANALYSIS, TESTING, GRADING AND DEFECTS

Sols: Viscosity and Elasticity. H. Freundlich and Emmy Schalek. *Z. Physikal. Chem.*, 1924, **108**, 153-174.

The behaviour of a large number of sols with respect to Poiseuille's Law has been examined. One series, to which the sols of arsenic trisulphide, lanthanum oxide, zirconium oxide, calcium fluoride, and a sulphur sol belong, obey the law. Many sols, however, show considerable deviation. Of these, the sols of alumina and cerium oxide show moderate deviation, aged sols of ferric oxide a greater deviation, and sols of benzopurpurin, cotton yellow, gelatin and sodium stearate very great deviation. This behaviour is explained on the grounds that these sols are not only viscous but also elastic. Since this latter factor must be taken into account when determining the viscosity of sols, the Ostwald viscometer is not suitable for the purpose.

—B. C. I. R. A.

The Constitution of the Proteins. The Structure of the Silk Fibroin. E. Abderhalden and W. Stix. *Z. Physiol. Chem.*, 1923, **129**, 143-156.

The authors have found that certain substances, notably 2-4 dinitrochlorbenzene, condense with free amino groups of amino acids in the presence of sodium bicarbonate yielding, in this case, dinitrophenylamino compounds. It also combines with diketopiperazine rings, but not with -NHCO- groups. The authors hydrolysed silk fibroin with 70% H_2SO_4 for two days at room temperature and found that more dinitrochlorbenzene combines with the product than corresponds with the free amino groups present. This might be explained by the presence of diketopiperazine groups in the hydrolysed and hence in the original silk. They state that silk hydrolysed by above method contains 17·78% total and 4·99% amino nitrogen. A number of compounds obtained by the condensation of individual amino acids are described.

—B. S. R. A.

Starch: Hydrolysis. R. Kuhn. *Z. Physiol. Chem.*, 1924, **135**, 12-15.

Preparations of emulsin from both bitter and sweet almonds brought about a considerable hydrolysis of soluble potato starch, at an optimum acidity of *p*H 5·5. A specially purified sample of the enzyme converted the amylose of the starch grains quantitatively into maltose.

—B. C. I. R. A.

Cotton Fabric: Faults. Percy Bean. *Text. Mercury*, 1924, **70**, 367-368.

A lecture dealing generally with stains and faults in grey cloth which cause damage when the cloth is bleached, dyed, printed and finished. The conditions mainly responsible for damage are—(1) The use of unsuitable sizing ingredients; (2) the use of yarns of various qualities in the same cloth; (3) the use of yarns of different spinnings in the same cloth; (4) the use of yarns of uneven spinning; (5) weaving faults due to broken ends, uneven reed spaces, bent reeds, crooked beams and unequal tension on weavers' beams; (6) oil splashing; (7) rubbing of faced cloths with soap and water or chemicals to remove stains; (8) the development of mildew on the weavers' beam; (9) the use of unsuitable colours for borders and headings; (10) accidental stains caused by contact with tar, paint &c.; (11) fat stains; (12) tinting yarn with unsuitable colours.

—B. C. I. R. A.

Liver Amylase. O. Holniberg. *Z. Physiol Chem.*, 1924, **134**, 68-96.

The amylase was obtained from pig's liver. The liver tissue contains substances which arrest saccharification by pancreatic amylase. The optimum acidity of liver amylase in the presence of a sodium chloride and phosphate buffer mixture is *p*H 6·9. The activity is increased six times by dialysis but the enzyme is reduced to about half its original value. The optimum activity is attained in 0·008-0·5—normal solutions of sodium chloride and potassium chloride. Iodine ions arrest the saccharification process but hasten the formation of dextrin. —B. C. I. R. A.

Ultra-Red Light. A. Terenin. *Z. Physik.*, 1924, **23**, 294-297.

A photographic method for investigations in the ultra-red is described. It depends on the clearing effect of ultra-red rays on an exposed plate. A very sensitive, coarse-grained plate (Ilford "Monarch") is soaked in the dark in a dilute solution of Iodine Green, dried, exposed (10-20 seconds, 1-2 candle power, 1 metre distant), and then used in the spectrometer behind an ultra-red light filter (Wratten Nos. 29 and 45 together). The plate is then developed and fixed in the usual way, using a rapid developer. —B. C. I. R. A.

Colour Measurement. O. Meissner. *Z. Physik.*, 1924, **21**, 68-72.

According to Ostwald, every colour may be defined by three characteristics, namely, the colour tone, *c*, (in the scale of 100 divisions 0=yellow, 25=red, 50=blue, &c.) the white content, *w*, and the black content, *s*, from which the purity, *r*, as a dependent variable is derived, where $r \equiv 100-(w+s)$. The grey content is $w/(w+s)$. All derivatives of a definite pure colour form a colour triangle, and by its rotation about the grey axis there arises a double cone, the properties of which are mathematically described and by it the characteristics of a mixed colour determined from its components. It is shown that the purity of a composite colour is always lower than the arithmetic mean of the purities of the separate shades. An example is given for forming grey out of three colours. The paper is an interesting application of elementary mathematics to colour technology. —B. C. I. R. A.

Photochemical Technique; The Present Position of——. J. Plotnikow. *Zeit. Tech. Physik.*, 1924, **5**, No. 4, pp. 113-125.

Following a review of the properties of light obtained from the chief sources in common use a description is given of the most modern types of apparatus and methods used to obtain and measure constant and definite amounts of light energy. The production of monochromatic filters is mentioned. —L. I. R. A.

Silk Fibroin, i. R. Brill. *Annalen*, 1923, **434**, 204.

Nine different kinds of silk have been subjected to X-ray analysis, from which it is concluded that the crystalline matter present in all cases is the same. Brill states that mulberry silk and tussah silk show distinct differences from the other silk examined; there is some confusion here as tussah silk is obtained from either the *Antherea mylitta* or *A. pernyi*, both of which silks he has examined. From the X-ray diagrams he calculates the dimensions and hence the molecular weight of the crystalline substance. From the work of Abderhalden he calculates that the molecule should consist of tyrosine, aniline and glycine in the proportion of 1:5:9: with a molecular weight of 1,049 or a multiple thereof. From the X-ray diagram he concludes that the molecular weight should lie between 500 and 660 and that the crystalline substance does not belong to the Triclinic system and that hence tyrosine is not present in the molecule. His final conclusions are—(1) Silk fibroin is a mixture of at least two proteins. (2) One of these proteins is crystalline. (3) In the nine silks examined the same crystalline substance is present. (4) The crystalline constituent of silk is formed from glycine and alanine. Brill's conclusions do not appear to be fully justified. B. S. R. A.

Dye Solution. S. J. Vavilov. *Z. Physik.*, 1924, **22**, 266-272.

Employing a spectrophotometric method, the author has determined the value K of the ratio of the energy of the secondary fluorescent radiation emitted by dilute solutions of various dyes to the total energy absorbed. The values for typically fluorescent dyes such as fluorescein are about 0·8, a figure which would not be anticipated from the classical theory of thermal absorption. —B. C. I. R. A.

Rock Salt Crystal. A. Joffé, M. W. Kirpitschewa and M. A. Lewitzky. *Z. Physik*, 1924, **22**, 286-302.

The method of X-ray analysis has been applied to the measurement of the elasticity of rock salt crystals and to an explanation of plastic deformation and strength. Plastic deformation is found to consist in the parting of the single crystal into several which glide over the rhombododecahedral faces and thereby rotate through different angles. The elastic limit is defined as the minimum strain causing distortion in the X-ray diagram, and it is shown that this is a characteristic definite constant of the material which falls with rising temperature. The tensile strength of rock salt, in a direction parallel to one plane, is about 450 grams/mm^2 and is roughly independent of temperature between —190° and +650° C. At 200° the elastic limit and the tensile strength coincide; below 200° rock salt breaks without permanent deformation, but above 200° it suffers plastic flow. Such a transition point, brittle→plastic, is also observed with other crystals. The tensile strength of rock salt is increased twelve-fold by plastic deformation. The discrepancy between the observed tensile strength of rock salt (0·45 kg./mm^2) and the calculated value (200 kg./mm^2) is ascribed to surface effects, probably minute cracks. If the surface is continually renewed by the action of water, the crystal reaches the elastic limit at about 700 grams/mm^2 and then flows. The tension at break thereby approaches the theoretical and values up to 160 kg./mms were actually observed. —B. C. I. R. A.

Crystals: Plastic Deformation. E. Schmid. *Z. Physik.*, 1924, **22**, 328-333.

The equation of the extension curve for a single crystal with one slipping plane has been converted into a load-extension diagram and an effective strain-extension diagram, assuming the internal friction to remain constant. From the calculation that the load falls during the extension

of a single crystal, it follows that the strengthening of polycrystalline specimens on extension cannot be explained by assuming different orientation of the single components. The discrepancy between actual and ideal extension curves is accounted for, on the other hand, by the fact that the internal friction of the crystal is not constant but rapidly increases up to the breaking point. This "internal strengthening" of the crystal is almost entirely the cause of the increase in the force necessary to maintain the extension, geometric re-orientation of the single crystals playing but a small part.
—B. C. I. R. A.

Sucrose: Inversion. H. Colin and A. Chaudun. *J. Chim. Physique*, 1923, **20**, 471-483.

The actions of acids and enzymes in hydrolytic phenomena are compared. The hydrolysis of sucrose by diastase is considered and it is shown that the velocity of the reaction does not increase with the concentration of the sucrose, *a*, nor with the concentration of the diastase, *n*, but rather with the ratio of these concentrations, a/n. The condition under which the reaction follows Wilhelmy's law is that a/n shall be less than a value a^1/n^1 which is characteristic for each diastase solution. When this condition is fulfilled the amount of sucrose transformed each instant can be calculated by Wilhelmy's formula so that, under these conditions, the rates of hydrolysis by acids and diastase are identical. When a/n is greater than a^1/n^1 the initial velocity is independent of *a* and proportional to *n*. These facts indicate that the enzyme forms a complex with the sugar, which then decomposes with a finite velocity in keeping with the law of mass action. These statements apply exactly to the action of emulsin on glucosides. The velocity of inversion by diastase decreases with increasing viscosity of the solution, but in the case of hydrolysis with acids the viscosity appears to have no influence on the velocity of the change.—B. C. I. R. A.

Cellulose: Copper Number. H. Gault and B. C. Mukerji. *Compt. rend.*, 1924, **178**, 711-713.

The authors have applied the Fontès-Thivolle molybdomanganimetric method for the micro-estimation of copper to the determination of the copper number of cellulosic materials. About 1 gram of the cellulose is added to 50 ccs. of Fehling's solution diluted with 100 ccs. of water and previously heated as 120° in a calcium chloride bath. Heating is continued for exactly 15 minutes, the mixture then filtered, the cuprous oxide (or the copper obtained therefrom by reduction) dissolved in the phosphomolybdic reagent, and determined by titration with permanganate.
—B. C. I. R. A.

Oil-Water Interface: Effect of Fatty Acids. R. Dubrisay and P. Picard. *Compt. Rend.*, 1924, **178**, 205-208.

Solutions of aliphatic acids in benzene have been examined by the drop method, the volume of 10 drops (of benzene solution) formed in (1) N/1250-sodium hydroxide. (2) N/2500-sodium hydroxide. (3) N/2500-sodium hydroxide containing 1% of sodium chloride being measured. This volume decreases in the order—(1) Lauric, myristic, oleic, palmitic, erucic, ricinoleic, stearic acid; (2) lauric, myristic ricinoleic, oleic, erucic, palmitic, stearic acid. Similar experiments have been carried out with different concentrations of stearic, oleic, and ricinoleic acids. With increasing concentrations, the volume of the 10 drops at first diminishes and then increases. —B. C. I. R. A.

Liquids: Miscibility Test. N. Perrakis and A. Massol. *Compt. Rend.*, 1924, **178**, 322-323.

Micromiscibilities are readily determined by a titration method, the end-point being determined by the appearance of cloudiness. Two mixtures of water, alcohol, and an oil were examined, the water or the oil being present in traces only.—B. C. I. R. A.

Colour Reactions with Wool. L. Meunier and G. Rey. *Rev. Gen. Mat. Col.*, 1924, **28**, No. 327, p. 66.

An epitome of the colour reactions given by wool with (1) Quinone. (2) Sodium nitrite. (3) Millon's reagent, showing how the previous history of the wool (e.g., insolation, bleaching by SO_2) affects these colours. —B. L. R. A.

Tendering of Cotton by Acids. *Rev. Gen. Mat. Col.*, 1924, **28**, No. 327, p. 89-90.

A comparison is given of the tendering of cotton fibres caused by the drying in of weak solutions of oxalic and acetic acids. The latter shows scarcely any effect, but a 1% solution of the former causes a fall in strength of 90%. Tables are given for strengths from 0·1% to 1% acids.
—B. L. R. A.

Liquid Crystals: Anistropy. W. Kast. *Ann. Physik.*, 1923, **73**, 145-160.

Liquid crystals fall into two groups in which the dielectric constant is respectively a maximum and a minimum in the direction of the length-axis of the molecule. The relations of the heat-conductivity differ in the two groups. —B. C. I. R. A.

Sodium Oleate: Molecular Dimensions. P. Lecomte du Noüy. *Compt. Rend.*, 1924, **178**, 1102-1104.

The sharp minimum in the value of the surface tension of certain colloidal solutions at a particular concentration is attributed to the formation of an orientated unimolecular layer of the disperse phase at the surface of the liquid. The supposition is confirmed by the slowness of evaporation at the same concentration. For solutions of pure sodium oleate, allowed to stand for 2 hours in watch glasses, the minimum occurs at a concentration of 1/750000, and has a value of 56·0 dynes per sq. cm. The calculated thickness of the unimolecular layer is $12{\cdot}6\times10^{-8}$ cm., and the width of the molecule $6{\cdot}8\times10^{-8}$ cm., in agreement with Langmuir's results for oleic acid. The increase in length ($1{\cdot}4\times10^{-8}$ cm.) due to the sodium atom is close to Langmuir's value for that due to the carbon atom ($1{\cdot}3\times10^{-8}$ cm.). The probable length of a molecule of crystallisable egg-albumin is $52{\cdot}8\times10^{-8}$ cm. and the width $29{\cdot}2$—10^{-8} cm. —B. C. I. R. A.

Soap: Constitution &c. Erwin Kratz. *Chem. Zentr.*, 1924, **i**, 1489 (from *Z. Dtsch. Ol-u. Fettind.*, 1924, **44**, 25-27, 37-38, 49-50, 62-65).

The crystalline form of sodium stearate solutions and gels has been examined under the ultramicroscope. The action of potassium hydroxide and of salts such as potassium chloride on solutions of potassium stearate and potassium palmitate has been examined and a comparison has been made of the change of conductivity with change of gold number for solutions of sodium stearate and sodium oleate on dilution and cooling. The true solubility of sodium stearate and sodium palmitate has been found by filtering the colloidal solutions at room temperature through membrane filters. The degree of hydrolysis was estimated by the amount of alkali in the filtrate. Finally, the author attempts to explain the existence of different sodium stearate hydrates. No break in the hydration and dehydration isotherms could be found. —B. C. I. R. A.

Alkali-Starch Product. Ferdinand Sichel Komm-Ges. *Chem. Zentr.*, 1924, **i**, 1599 (from G.P.389,748).

Alkali compounds capable of hydrolytic cleavage are mixed with the starch at ordinary temperatures in such quantities that, on the addition of water at the high temperatures reached in the dry process, at least 1% of alkali hydroxide, calculated on the weight of the starch, becomes available by hydrolysis. Resins are simultaneously added to the starch. The swelling which takes place when free alkali is used, and which is a hindrance in the dry process, does not occur. Very small quantities of water are sufficient to bring the mass to a suitable consistency for the dry process. —B. C. I. R. A.

Tetralin Derivatives. G. Lockemann and W. Ulrich. *Chem. Zentr.*, 1924, **i**, 1811 (from *Desinfektion*, 1924, **2**, 1-9).

The disinfecting power of the following tetralin derivatives has been studied—1-tetralol, 2-tetralol, 1-brom-2-tetralol, 1, 3-dibrom-2-tetralol, sodium tetralinsulphonate, and sodium octahydroanthracenesulphonate. By taking up four hydrogen atoms in the one ring of the naphthalene nucleus the disinfecting action of the naphthols towards typhus and paratyphus-B bacilli is very considerably increased. Further, the entrance of one bromine atom into the molecule of 2-tetralol, i.e., tetrahydro-2-naphthol, increases its activity towards paratyphus-B, whilst the entrance of two bromine atoms considerably diminishes its bactericidal power towards both types of bacterium. The sulphonates of tetrahydronaphthalene and octahydro-anthracene show the increased bactericidal activity due to the hydrogen atoms taken up in the benzene nucleus. —B. C. I. R. A.

Liquid Spray: Drop Size. F. Häusser and G. M. Strobl. *Chem. Zentr.*, 1924, **i**, 1886 (from *Ber. Gesellsch Kohlentechnik*, 1923, 305-312).

A method has been devised by which it is possible to obtain an accurate conception of the distribution of drops in a stream of atomised liquid and to estimate their size. The object glass of a microscope is drawn rapidly through the stream of liquid at a distance of about 3 cms. from the nozzle. The object glass is provided with a suitable trap liquid, such as bone oil for water and glycerol for oil. The adhering drops can then be measured and counted under the microscope. —B. C. I. R. A.

Cottonseed Oil Refining. J. Davidson. *Chem. Zentr.*, 1924, **i**, 2315 (from *Seife*, 1924, **9**, 100-102).

To make cottonseed oil edible by refining with caustic soda, it is advisable to regulate the concentration of the alkali according to the proportion of free fatty acids in the oil. For 0·5-1% acid alkali of 12° Bé is recommended; for 1-2%, 14° Bé, and 2-3% 16° Bé. —B. C. I. R. A.

Savonette Oil; and Savonade. —. Welwart. *Chem. Zentr.*, 1924, **i**, 2316 (from *Seife*, 1924, **9**, 102).

"Savonette Oil" is a fatty acid containing resin; *d* 0·965, acid number 150-165, saponification number 155-170, iodine number 105, acetyl value 4·9. It is used for textile or boring oils or saponified with ammonia or alkali carbonates or hydroxides to form soaps and soap powders. Soaps mixed with hydrogenated phenols are used in the textile industry. For example, "Savonade" made from savonette oil, methylhexalin and ammonia, is an emulsifying agent for solvents, mineral oils &c.

Oils, Fats: Emulsifying. J. Neumann. *Chem. Zentr.*, 1924, **i**, 2613 (from G.P. 384,250).

In the preparation of aqueous-alkaline emulsions of oils and fats by shaking with colloidal silica, the silica gel employed is obtained by the action of borax or other alkali derivative of boric acid on water glass. Benzene derivatives are then intimately mixed with the silica gel. Very rapid emulsification of oils and fats is brought about by this means.

—B. C. I. R. A.

Soluble Starch. G. & I. Neustadt. *Chem. Zentr.*, 1924, **i**, 2645 (from G.P. 392,660).

Starch soluble in cold water is prepared by heating the disintegrated raw material with aqueous solutions of neutral salts and drying and grinding the well-kneaded paste. Soluble starch may be employed as raw material for the process. A mixture of 3 kg. of calcium nitrate, 2 kg. of barium sulphate, and 3 kg. of magnesium chloride with 100 kg. of starch is recommended.

—B. C. I. R. A.

Cellulose: Absorption of Alcohol. G. L. Stadnikow. *Chem. Zentr.*, 1924, **i**, 2754 (from *J. Russ. Phys.-Chem. Soc.*, 1916, **48**, 301-302).

Cotton and flax fibres which had been treated with ether and alcohol for degreasing purposes were not free from alcohol after washing with water for eight months. A more rapid method of displacing the alcohol is to boil the fibre with successive changes of water.

—B. C. I. R. A.

Starch Iodide. M. Bergmann and S. Ludewig. *Ber.*, 1924, **57**, 961-963.

In support of a previous contention that the union of starch and iodine may be of a chemical nature, the authors show that acetylated starch possesses the typical affinity of starch for iodine and potassium iodide. Further, starch and acetylated starch both take up considerable quantities of elementary bromine from a solution of bromine and potassium bromide.

—B. C. I. R. A.

Amylose and Amylopectin: Constitution. H. Pringsheim and K. Wolfsohn. *Ber.*, 1924, **57**, 887-891.

Two independent experimental proofs that amylose is a disaccharide and amylopectin a trisaccharide are submitted. Amylose and amylopectin were prepared by the method of Ling and Nanji. On acetylation in the presence of sulphuric acid they gave acetates which were found to be respectively the acetate of a disaccharide and the acetate of a trisaccharide. In a second series of experiments amylose and amylopectin were heated in glycerol, as described by Pictet and Jahn, and gave respectively a dihexosan and a trihexosan.

—B. C. I. R. A.

Poly-Amyloses. Hans Pringsheim and J. Leibowitz. *Ber.*, 1924, **57**, 884-887.

The authors have obtained a 68% yield of a new disaccharide from α-tetra-amylose by subjecting the sugar to partial hydrolysis with cold, concentrated hydrochloric acid. The properties of the product, to which the name amylobiose has been given, are described and its constitution is shown to be that of a glucosido-3-glucose. The same product has been obtained from β-hexa-amylose, the yield being 61%. —B. C. I. R. A.

Methyl Alcohol. W. M. Fischer and A. Schmidt. *Ber.*, 1924, **57**, 693-698.

A method for the separation and estimation of methyl alcohol is described. Sodium nitrite is added to the acidified solution containing the alcohol. Methyl nitrite is formed instantaneously and on account of its low boiling point and insolubility in aqueous solutions, escapes from the reaction mixture. The nitrite is freed from any nitrous fumes by passage through solid sodium nitrite and bicarbonate and is then saponified, using a solution of potassium idodide acidified with hydrochloric acid. The saponification is instantaneous and complete and the iodine liberated by the nitrous acid is estimated with sodium thiosulphate. With a slight temperature modification the method can be used for the separation and estimation of methyl alcohol and other monohydric alcohols. Full practical details are given.

—B. C. I. R. A.

Cellulose Esters: X-Ray Structure. R. O. Herzog and G. Londberg. *Ber.*, 1924, **57**, 750.

The authors point out a possible source of misunderstanding in their recent communication. They did not intend to infer that it was not possible to preserve the fibrous structure of cellulose during esterification. It is possible to do so and they only intended to mention that they were unable to obtain the mono-acetate and mono-benzoate because the esterification in the surface layer proceeds more rapidly than the conversion to the mono-ester in the centre of the fibre. —B. C. I. R. A.

Starch Iodide. Max Bergmann. *Ber.*, 1924, **57**, 753-755.

The author has prepared compounds of acetol-methylcycloacetal and of acetoin-methylcycloacetal with iodine and potassium iodide, and shows that four atoms of iodine are present to one molecule of potassium iodide in the products as in the case of starch iodide. He deduces, therefore, that in starch, as in the cyclo-acetals, oxygen bridges with pronounced residual affinities are present which enable iodine and potassium iodide to be taken up. The possibility that the formation of starch iodide is of a chemical nature is, therefore, not excluded. —B. C. I. R. A.

Malt Diastase: Purification. R. Fricke. *Ber.*, 1924, **57**, 765-768.

Some modifications in the method of purification by electrodialysis and electro-osmosis are described. —B. C. I. R. A.

Aluminium Hydroxide Gel: Properties. A. Lottermoser and F. Freidrich. *Ber.*, 1924, **57**, 808-813.

The preparation is described of a non-ageing aluminium hydroxide gel, as free as possible from electrolytes. It was found that the gel peptises with aluminium chloride and also is completely peptised by ammonia giving a negatively charged, unstable sol which has not hitherto been prepared. The changes which take place in the structure of the gel with changes in temperature have been followed by means of viscosity measurements.—B. C. I. R. A.

Determination of Available Chlorine in Bleaching Powder. V. Rodt. *Z. Angew. Chem.*, 1924, **37**, 38.

The accuracy of Penot's method is enhanced if, instead of determining the end-point by means of starch-iodide paper, the titration is continued until the blue coloration is no longer visible in the paper, and 1 cc. of the starch-iodide solution used in impregnating the paper is then added to the mixture. This addition invariably produces a blue coloration, and the titration is then continued until the colour of the liquid is finally discharged.

—L. I. R. A.

Water: Determination of the Hardness of, for Technical Purposes. G. Weissenberger. *Z. Angew. Chem.*. 1922, **35**, 177-179.

Tables are given comparing the hardness of a number of samples of water, as determined by gravimetric analysis, by Winkler's potassium oleate method, Blacher's potassium palmitate method and the modified soap method. The potassium oleate method is found to give reliable results only in the case of water with a low degree of hardness and containing no excess of magnesium salts, such as purified water, the results are affected only to a slight extent by the presence of free carbon dioxide. Results obtained by the potassium palmitate method are reliable in the presence of neutral salts, but are unreliable if free carbon dioxide is present. Free carbon dioxide, however, can be removed by neutralising the water with dilute hydrochloric acid, using methyl orange or methyl red as indicator, blowing air through the solution and then making it faintly alkaline by the addition of two drops of alcoholic sodium hydroxide solution. The solution is then titrated with potassium palmitate in the presence of phenolphthalein. The potassium palmitate method gives reliable results with waters having a moderate or high degree of hardness, if carbon dioxide is removed it can be used for natural and purified waters. The modified soap method is found to give the most accurate results, and it is the most suitable for the rapid determination of the hardness of all waters used for technical purposes.

—L. I. R. A.

Adsorption of Aluminium Hydroxide from Aluminium Sulphate Solutions by Cotton and Wood Cellulose. C. G. Schwalbe. *Z. Angew. Chem.*, 1924, **37**, pp. 125-8.

Contradictions which occur in the literature as to whether aluminium hydroxide is adsorbed from aluminium sulphate solutions by cotton and wood-cellulose are ascribed to the fact that the adsorptive power of fibres is conditioned by a large number of variable factors, such as the duration and temperature of steeping, concentration of the solution in which the fibre is steeped and, especially, the previous history of the fibre as regards age, temperature and period of drying, degree of swelling, and content of incrusting residues, such as lignin, or decomposition products such as hydrocellulose and oxycellulose, factors which have an important effect on the nature of the surface. No adsorption occurred when dry cotton fibre was steeped in a solution of aluminium sulphate, aluminium acetate and sodium aluminate even when the cotton was thoroughly milled. Cotton fabrics treated with 3% sulphuric acid and heated for four hours at 70° C. had a considerably higher adsorptive power than samples free from hydrocellulose and oxycellulose as also had pieces of the fabric which were over-bleached with bleaching powder. It is uncertain whether this increase is due to the presence of hydrocellulose and oxycellulose or to a change in the nature and extent of the surface which had occurred. Contradictory results obtained in corresponding experiments with sized wood cellulose are ascribed to their varying degrees of fineness. Adsorptive power increases with fineness of particles up to a certain point and thereafter remains approximately constant. The swelling of wood cellulose fibres also has a great influence on the adsorptive power. The number of factors in the case of wood cellulose is even greater than in the case of cotton cellulose owing to the varying quantities of pentosans and hexosans which may be present. —L. I. R. A.

Viscosity of Highly Viscous Substances; Determination of the——. E. Berl, M. Isler and A. Lange. *Z. fur Angew. Chem.*, 1924, pp. 128-31.

Accurate determination of the relative viscosities of highly viscous liquids can be made by substituting for one pan of a suitable balance a short pan from which is suspended a vertical wire (about 1mm. diam.), pointed at the lower end and provided with an indicator at the side. The wire dips into a jacketed vessel containing the liquid to be tested, which is adjusted vertically until the indicator touches the surface of the liquid and the whole is then balanced. A suitable additional weight is added to the other pan of the balance and the arrestment is released at the same time as a stop-watch is started. The time required for the pointer to pass over a certain number of scale divisions (3-5) is taken as a measure of the viscosity. The method can be used also for liquids in which a limited proportion of solid matter, as colloidal graphite or silicic acid is suspended. —L. I. R. A.

Starch Estimation. O. Wolff. *Z. Angew. Chem.*, 1924, **37**, 206-207.

Details are given of a method for estimating the starch content of commercial starch products and plant parts directly by means of the interferometer. The results are lower by this method than by Lintner's method and the difference is attributed to the solution of cellulose by the acid in the latter method.

—B. C. I. R. A.

Starch: Zymolysis. O. Holmbergh. *Biochem. Z.*, 1924, **145**, 244-248.

Potassium iodide inhibits the formation of maltose from starch by the action of malt amylase, whilst it increases the similar actions of salivary and pancreatic amylases. The last two amylases, therefore, differ from liver amylase in their behaviour towards potassium iodide. The varying extents to which dextrins and maltose are formed by the action of liver amylase on starch have been investigated in concentrations of potassium iodide varying from N/10 to 2N. The amount of maltose formed when the achromic point is reached diminishes with increasing concentrations of the iodide, but the rate of formation of the dextrins themselves is increased. —B. C. I. R. A.

Starch: Decomposition by Salts. W. S. Iljin. *Biochem. Z.*, 1924, **145**, 14-17.

Experiments are described in which starch was decomposed by various concentrations of sodium, lithium and calcium chlorides without the intervention of an enzyme. Potassium, magnesium, and barium chlorides are said to give similar results.

—B. C. I. R. A.

Malt Diastase: Inactivation. L. Pincussen. *Biochem. Z.*, 1924, **144**, 372-378.

Sodium chloride protects both the diastase and maltase in malt diastase from inactivation by exposure to sunlight. M/6-Phosphate solution protects malt diastase and the maltase of "pancreatin Rhenania" from inactivation by ultra-violet light, whilst more dilute phosphate solutions are less effective. Similar results are given by acetate solutions of the same *p*H. In the presence of a phosphate buffer, with or without the addition of sodium chloride, the protective action is at a maximum at *p*H 6·64. Ammonium, potassium and lithium chlorides, potassium bromide, and sodium fluoride protect taka-diastase from ultra-violet light to varying degrees, an effect which is more marked in dilute solutions of these salts than in more concentrated solutions. Potassium and sodium nitrates and nitrites give similar results but do not show the same varying effects at different temperatures. —B. C. I. R. A.

Malt Diastase: Inactivation. L. Pincussen and F. di Renzo. *Biochem. Z.*, 1924, **144**, 366-371.

The inactivation of the ultra-violet light of 0·1% of malt diastase acting on 1% starch solution at varying *p*H proceeds as a unimolecular reaction, whilst in the presence of 0·5% of starch only the later stages correspond with the unimolecular equation. The departure from the simple equation is still more marked in the presence of 0·25% of starch. A 0·2% solution of the enzyme gives complex results in the presence of 1·0, 0·5, and 0·25% starch.

—B. C. I. R. A.

Malt Amylase: Inactivation. H. Lüers and P. Lorimer. *Biochem. Z.*, 1924, **144**, 212-218.

The zone of maximum thermo-stability of malt amylase is displaced towards higher *p*H values by increased concentration of an acetate buffer. Gelatin, egg-albumin, and gum arabic protect the amylase from heat inactivation especially between *p*H 6·0 and 7·0, and produce a flattening of the zone of maximum stability. Maltose has a similar protective influence and a direct proportionality exists between log c maltose and the coefficient of inactivation. The inactivation of amylase by ultra-violet radiation follows neither the mono nor bi-molecular equation, nor the Schutz law. The effect of alterations in the hydrogen-ion concentration is much less marked in this case than in that of heat-inactivation. The temperature coefficient for ultra-violet inactivation is k^{30}/k^{20} 1·30, and physico-chemically the two methods of inactivation are dissimilar. —B. C. I. R. A.

Calcium in Organic Material, by De Waard's Method; Determination of——. G. Hecht. *Biochem. Zeit.*, 1923, **143**, 342-346.

Dealing with quantities of calcium as small as 0·1 mg., De Waard's micro-method for determining this element in tissue fluids and organs gives results accurate to within 5%. The determination is not affected within these limits by the presence of phosphates, magnesium or iron.

—L. I. R. A.

Colour Theory. Max Becke. *Textilberichte*, 1924, **5**, 184-187, 246-247.

Becke's reply to Lagorio's criticism of his "natural colour theory." —B. C. I. R. A.

The Action of Sea Water on Textile Fibres. Dorèe, *Textilberichte*, **24**, No. 3, p. 199 (from *Deutsche Färber-Zeitung*. 1923, p. 406).

Experiments have shown that cotton and silk are destroyed after three weeks in sea water. Wool keeps a little longer.

The destructive action on cellulose is due to some micro-organism and not to light, oxygen or the salts. The destruction of the fibre is similar to that which is caused by mechanical treatments in washing. Mono-acetulated cellulose is more resistant to sea water and acetate silk can stand its action for several months without being damaged. —B. R. A. W. & W. I.

Rejtö Strength Tester for Yarns and Fabrics. Dezsö, *Textilberichte*, **24**, No. 3, p. 189.

A discussion of dynamometers in general and the qualifications they should possess is followed by a description of the Rejtö Strength Tester. It is a modification of Krafft's dynamometer and like the latter is worked by a spring. Both working method and control of the tester are very simple and slight alterations make it also possible to use the apparatus for tearing tests with paper, wire &c.

—B. R. A. W. & W. I.

Soap Waste: Recovery. F. Schoeller. *Textilberichte*, 1924, **5**, 243-244.

A method for the recovery of the fatty acids from waste liquors containing soap is outlined. The waste is treated with a cheap waste acid, the mixture is fed to a system of cascade concentrators and the fatty acid which collects on the surface is skimmed off and filtered to remove the greater part of the water. The remaining water is removed by bringing the mixture into a boiler, indirectly heated and provided with a stirring apparatus, and the fatty acid is subsequently pumped to a filter press. The cost of the plant and its up-keep is so low that the process is profitable wherever reasonable quantities of soap are consumed. —B. C. I. R. A.

Cloth, and Yarn Testing. H. Rudolph. *Textilberichte*, 1924, **5**, 172-175, 239-240.

Some general remarks on the advantages of scientific control in spinning and weaving, and suggestions for establishing such control in mills. Yarn should be tested for counts, strength and stretch, twist, evenness, covering power and moisture content. Fabrics are tested according to the material but in all cases for yarn thickness, weight, strength and moisture content. A brief account of the methods employed is given.

—B. C. I. R. A.

Sodium Para-Toluenesulphochloramide, and Soluble Starch: Preparation. R. Haller. *Textilberichte*, 1924, **5**, 389-390.

Soluble starch may be prepared by the action of Aktivin, a white powder smelling of chlorine and one of the trade products derived from sodium para-toluenesulphochloramide. The starch is heated with a certain percentage of aktivin in a covered vat by means of steam, the process requiring about 10 minutes. The product has many advantages over similar products prepared by other methods; it contains only decomposition products of starch and no substances which would be detrimental to its application. The small quantities of sodium chloride which are present are harmless and chlorine is completely absent from the solution. The hydrolysed starch is suitable for sizing all types of goods and is especially suitable for finishing indigo-dyed fabrics as it does not affect the colour in any way. —B. C. I. R. A.

Flax Fibre: Tensile Tests. G. Böhm. *Faserforschung*, 1923 **3**, 218-228.

The determination of the "breaking length" of flax fibre strands is described and results are given showing the influence on the values obtained of the rate of loading, the length of the test piece and the number of tests carried out. It is found that strands from the middle of the stem are strongest and those from the top end are weakest.

—B. C. I. R. A.

Protective Power and Elasticity of Hydrosols; The Possibility of a Connection between the——. H. Freundlich and L. F. Leob. *Kolloid-Z.*, 1924, **34**, 230-233.

Double refraction by "streaming" (H. Zocher. *Z. f. Physik. Chem.*, 1921, **98**, p. 293) has been used as a measure of the protective action of a series of hydrosols including gelatine, dextrin, soluble starch, sodium stearate and oleate, agar, saponium and gum arabic) on the coagulation of Benzopurpurine solutions. It appears probable that there is a definite connection between the protective action and the "displacement elasticity" of solutions. This is especially evident in the case of sodium stearate and sodium oleate.

—L. I. R. A.

Oil-Water Emulsions: Surface Tension. S. S. Joshi. *Kolloid-Z.*, 1924, **34**, 280-283.

The surface tensions of emulsions of castor oil and olive oil in water, using sodium oleate as emulsifying agent, have been determined and found to be identical in every case with that of the oil used as dispersion medium. A new method for ascertaining the type of an emulsion is described and for determining the point at which transition from one type to another takes place in an emulsion. The transition point is characterised by a sudden change in the surface tension of the emulsion. —B. C. I. R. A.

Night Blue: Colloidal Properties. F. V. von Hahn. *Kolloid-Z.*, 1924, **34**, 162-169.

Pure Night Blue dissolves with difficulty in solvents which have a dielectric constant smaller than 5 to give green solutions in which the dye is molecularly dispersed. In solvents which have a higher dielectric constant, Night Blue dissolves more readily to give blue solutions containing colloidal aggregates, which are largest in an aqueous solution. Yet toluene, which belongs to the first class of solvents, will completely extract the dye from dilute aqueous solutions. Blue shades are produced on filter paper, cotton, and barium sulphate both by the green molecular disperse solutions and the blue colloidal solutions, except in the case of the blue aniline solution, which gives greenish-blue or green shades on the absorbents named. In the presence of Night Blue the interfacial tension between toluene and water is doubled, whilst that of each liquid against air is only slightly raised by the addition of the dyestuff. Night Blue precipitated from aqueous solution by sodium hydroxide dissolves in toluene in the same way as a pure dyestuff and does not appear to be a sodium salt.

—B. C. I. R. A.

Cellulose; Colloid Chemistry of——. H. Wislicenus and W. Gierisch. *Kolloid-Z.*, 1924, **34**, 169-181.

The authors describe experiments showing the influence of prolonged dry grinding on the properties of cellulose. The following properties have been studied—Solubility in water, percentage of methylene blue absorbed, copper number, iodine adsorption and hydrolysis with sulphuric acid. Tabulated results are given. —L. I. R. A.

Soap Solution. Martin H. Fischer. *Kolloid-Z.*, 1924, **34**, 140-145.

The electrical resistance of M/2 soap solutions was measured whilst they were slowly cooling, and abrupt increases in the resistance were found at temperatures which were characteristic for each soap. This behaviour is analogous to that of the system phenol-water and is accounted for by a change from an emulsion of soap in water, which has a low resistance, to an emulsion of water in soap, which has a high resistance. Agitation of the solution destroys the structure of the outer soap phase and gives an emulsion of less hydrated soap in an aqueous outer phase.

—B. C. I. R. A.

The Isoelectric Point of Gelatin at 40° C. D. I. Hitchcock. *J. Gen. Physiol*, **6**, No. 4, 1924, pp. 457-462.

Measurements were made at 40° C. of the osmotic pressure and viscosity of 1% gelatin solutions containing various amounts of HCl. and of NaOH. Each property showed a decided minimum at *p*H 4·7. In the osmotic pressure measurements the *p*H of the inside solutions was greater than that of the outside solutions at *p*H values below 4·7, while it was less than that of the outside solutions at values above 4·7. These results indicate that gelatin at 40° C. retains its isoelectric point at about *p*H 4·7. —E. A. F.

Methylene Blue as Indicator of Bleaching Damage. See Section 4G.

7—BUILDING AND POWER

(A)—Construction of Buildings.

Choice of Sites for Retting Establishments. See Section 2A.

(D)—Lubrication.

Lubricating Oil: Viscosity &c. J. Don. *Kolloid-Z.*, 1924, **34**, 312-313.

An apparatus devised for comparing the viscosity and surface tension of fresh oil with similar oil which had been for some time in a motor conveyance is described. The oil is allowed to flow over an extensive surface formed by small steel balls contained in a tube which is kept in a thermostat and discharges into a small cylinder. The time required for 100 drops to fall, and the weight of this quantity gives a means of comparing the viscosity and surface tension at different temperatures. It is shown that after being in use for a distance of 500 miles the viscosity of the oil is about 30% less than the original viscosity whilst the surface tension remains practically unchanged. —B. C. I. R. A.

Lubricating Oils: Specific Heats. E. H. Leslie and J. C. Geniesse. *Ind. Eng. Chem.*, 1924, **16**, 582-583.

The specific heats of six typical lubricating oils have been measured over a range of temperatures from 38° C. to 143° C. An increase of 35 to 40% in specific heats was found. The variation of specific heats with temperature is not the same for all oils and it is suggested that further study might disclose some connection between the temperature rate of change of specific heats and the lubricating properties of an oil. —B. C. I. R. A.

Lubricant: "Oiliness." D. P. Barnard, H. M. Myers and H. O. Forrest. *Ind. Eng. Chem.*, 1924, **16**, 347-350.

A series of experiments on the effect of oiliness of the lubricant on the carrying power of a conventional type of journal bearing is described. The results indicate that the carrying power is somewhat greater when oiliness, as measured by the coefficient of static friction, is increased. This increase in carrying power is small for variations among commercially practicable lubricants. —B. C. I. R. A.

Patents

Humidification Atomiser. Parks-Cramer Co., Boston, U.S.A. E.P.211,071.

In an atomiser, more particularly for use for humidifying purposes, comprising a head having a cylindrical chamber provided with a tangential inlet for compressed air, an outlet, and a liquid delivery member in alignment with the outlet, the delivery member is provided with a conical nozzle extending concentrically into the outlet, and means for positioning the nozzle in the outlet opening. For this purpose the nozzle member, which is screw-threaded to engage a part of the head, is provided with a shoulder which engages a corresponding shoulder in the head. The head and delivery members are formed as solids of revolution from bar stock in an automatic machine. —B. C. I. R. A.

9—COMMERCE, ECONOMICS, LABOUR &c.

Textile Research, U.S.A. (Massachusetts Institute of Technology). G. B. Haven. *Text. World*, 1924, **65**, 2994-2999.

An article on the work of the Massachusetts Institute of Technology with reference to Textile research. Mention is made of the following studies—(1) The part played by moisture in the manufacture of cotton. (2) Rate of moisture regain in various fabrics. (3) Measurements of fabric porosity in felts and ducks. (4) Measurement of crimp and take-up in weaving processes. (5) The development of a constant rate of loading testing machine. (6) Abrasion and flexure in fabrics. —B. C. I. R. A.

Cotton Consumption Statistics, U.S.A.: Sources of Error. *Text. World*, 1924, **65**, 2107-2108.

An enquiry has been conducted into the reason why the monthly cotton consumption statistics of the Census Bureau fail so frequently to coincide with the known operating conditions in the industry. Two sources of error appear to be involved, namely, that some mills report by 4 or 5 week periods instead of by calendar months, and frequently a mix is reported as consumed when it is laid down. —B. C. I. R. A.

Old Hands do Best Work. *Amer. Silk Jl.*, 1924, **43**, No. 6, p. 82.

Mr. H. B. Cheney, an American silk maker, has collected statistics which show that while weavers of under 3 years' experience only do 50% of the set standard, those with 10-20 years' service produce 66·7%; even the oldest, 30-50 years' service, are 4% better than the young ones. It is said that a weaver is worn out after 15 years' work, but this research shows that though quantity may decrease quality is retained. —F. G. P.

Foreign Silk Notes. *Amer. Silk Jl.*, 1924, **43**, No. 6, p. 74.

The government of Kwantung province has a sericultural bureau which supervises the production and sale of certified seed. The Minister of Industry, Bogotá, Colombia announces that there are now 2,100 trees to supply mulberry leaves for silk worms and that the quality of the silk is very high. While the Armenians and the Greeks were in Brusa there was a silk industry employing 5,000 people who exported a large quantity of fine silk goods to Turkey. Now the lack of communication in the district makes it impossible to send the silk to the markets and the industry has practically ceased.—F. G. P.

Reconsider Adoption of Glos. *Amer. Silk Jl.*, 1924, **43**, No. 4, p. 89.

The name "Glos" for artificial fibres has been refused by the National Retail Dry Goods Association of America.—F. G. P.

Silk Back to Pre-Earthquake Level. *Amer. Silk Jl.*, 1924, **43**, 2, 90.

It is said that owing to buyers refusing to pay the prices demanded just before the earthquake the rise after that calamity was only about 10%. Even then trade declined, buyers would not move and now the manufacturers have come down to the pre-earthquake figures. —F. G. P.

Canton Christian College. *Silkworm*, 1924, **6**, No. 3, p. 84.

An optimistic account of the Sericulture department, where the students are requiring extended premises. Tested seed is sent to Central China as well as to the South. Manurial experiments on mulberries are in progress. —F. G. P.

The Trade Name "Glos" and the Law of Misbranding. W. G. Merritt. *Silkworm*, 1924, **6**, No. 3, p. 85.

Gives numerous cases of attempts to swindle the public by representing artificial fibres as a kind of silk. These appear to be contrary to American Law. Use of all words which are associated in the public mind with silk are forbidden on cotton or artificial fibres. —F. G. P.

Silk Association's Attitude to Immigration Bill. *Silkworm*, 1924, **6**, No. 3, p. 83.

The American Silk Association has protested strongly to President Coolidge against the exclusion of Japanese by the immigration bill, as tending to be a violation of American efforts for world friendship and to cause annoyance to an educated and sensitive people. —F. G. P.

Cotton Mill Economies. E. H. McKitterick. *Mechanical Engineering*, 1924, **46**, 343-344.

The importance of the mechanical engineer in the textile industry is discussed. It is shown that there is a wide field for the engineer in reducing the cost of manufacturing by improving power, lighting and heating systems and methods of handling goods between processes, but it is claimed that this fact is not sufficiently recognised by textile manufacturers.
—B. C. I. R. A.

Italian Silk Industry. *Bull. des Soies.*, 1924, **48**, No. 2457, p. 5.

The output of cocoons in 1923 was $42\frac{1}{2}$ million kilos.; the pre-war average was 40 million. Generally the import of cocoons to filatures and throwsters has decreased but weaving has increased. About 175,000 people are now employed in weaving and finishing. —F. G. P.

Society for Insurance Against Pilfering. *Bull. des. Soies.*, 1924, **48**, No. 2457, p. 3.

Pilfering and theft of silk appear to be as prevalent in France as in America and the Society has brought 89 culprits to book during the past year with punishments ranging from fines up to 20 years' hard labour. It is thought that the great severity of some of the sentences may have a deterrent effect upon the criminals. —F. G. P.

Silk Industry in Hungary. *Bull. des Soies*, 1924, **49**, No. 2453, p. 7.

Excellent beginnings of an industry have been made; 600 looms are working and there is a filature of 620 basins. The production of silk cloths for 1923 is given as 1½ million metres. —F. G. P.

Silk Prohibited in Iceland. *Bull. des Soies*, 1924, **48**, No. 2454, p. 6.

All sorts of silk goods are prohibited imporation unless the Minister of Commerce can be persuaded that in special cases they are indispensable. —F. G. P.

Macclesfield Silk. *Manchester Guardian Commercial*, 1924, **9**, No. 1, p. 19.

The shortage of silk weavers which is noticeable in several parts of the country is stringent in Macclesfield, and an association has been formed for the training of boys and girls as they leave school. —F. G. P.

Missing Property Bureau. *Silk N. Y.*, 1924, **17**, No. 4, p. 72.

The Silk Association of America is cooperating with other bodies to prevent thefts of silk. Drivers and helpers of vans containing silk are registered men whose finger-prints are taken and who have special police protection. Motor patrols are posted on roads frequented by silk trucks. Special supervision is applied to piers, freight yards and warehouses. —F. G. P.

Japanese Silk Harvest for 1923. See Section 1B.

Expansion of French Artificial Silk Industry. See Section 1D.

10—MISCELLANEOUS

Illuminometer and Reflectometer: Description. G. A. Shook. *J. Optical Soc. America*, 1924, **8**, 803-805.

An illuminometer is described which is so designed that when used in connection with an integrating sphere it becomes a portable reflectometer. As such, it has the advantage that only one source of current is required and no ammeter or rheostat is necessary. The comparison lamp of the illuminometer furnishes the illumination for the sphere and as the current for this lamp may be obtained from a small flash-light battery attached to the sphere, no auxiliary apparatus is required when the instrument is used as a reflectometer. The instrument does not give the absolute value of the reflection factor but might be arranged to do with some modifications. A magnesium carbonate block is used as a standard and as it reflects very nearly 100% its reflection factor may be taken as 1 for approximate results. A neutral tint wedge is employed to vary the intensity of the light from the lamp.—B. C. I. R. A.

Cotton-Dusting Machinery. F. Johnson, S. T. Howard and B. R. Coad. *U.S. Dept. Agric Farmers' Bull.*, No. 1319, 1923.

A general account of successful and economical machinery for dusting cotton plants with calcium arsenate and the selection of machinery suited to the conditions and needs of individual farms. The operation and maintenance of dusting machinery is discussed. —B. C. I. R. A.

Carbohydrates: Fermentation. R. Falck and S. N. Kapur *Ber.*, 1924, **57**, 920-923.

The authors have isolated, and identified as gluconic acid, the first oxidation product in the formation of citric acid from carbohydrates by fungi of the genus *Aspergillus*. Gluconic acid is also the first oxidation product in the degradation of carbohydrates by the strongly acid-forming fungi of the genus *Citromyces*. —B. C. I. R. A.

Viscometer; A Simple, for Solutions of Resins &c. K. Albert. *Chem. Zeitung*, 1924, **48**, p. 181.

Defects are pointed out in existing viscometers, especially in cases where the viscosity of unusually thick and dark liquids is required. The instrument described is on the principle of the falling sphere apparatus. A brass ball hangs over a wheel by means of a very thin thread of gut, at the other end of which is a balance-pan. The wheel is held in a fork which is clamped to a retort stand on which is fixed a cm. scale with two marks. A cylinder containing the liquid to be tested and of a diameter at least three times that of the ball is placed under the ball. To make the determination, suitable weights depending on the viscosity of the liquid are placed on the balance-pan. The two marks on the scale are arranged in such a way that the balance-pan passes the first mark only when the ball has fallen some cms. in the liquid. The time required for the pan to pass between the two marks is measured by means of a stop-watch, and the results expressed in cms. per second. With this apparatus determinations are quickly made, and the parts can be readily cleaned, since the brass ball and gut only are affected.

—B. C. I. R. A.

Fungus Mycelium: Isoelectric Point. J. Robbins. *Chem. Zentr.*, 1924, **i.**, 1943 (from *J. Gen. Physiol.*, 1924, **6**, 259-271).

According to determinations with acidic and basic indicators, the mycelium of *Rhizopus nigricans* corresponds to an amphoteric colloid with an isoelectric point in the neighbourhood of *p*H%5·0. Slight variations are found, according to the nutrient medium; on potato-dextrose-agar the iso-electric point is about 5·2, on potato-dextrose bread it is between 5·2 and 4·9; in 0·01-molecular buffer solutions of phosphoric acid and sodium hydroxide of *p*H 4·1-6·3 the reaction was generally strongly alkaline. The mycelium of *Fusarium lyopersici* corresponds to an amphoteric colloid with an isoelectric point in the neighbourhood of 5·5.
—B. C. I. R. A.

Strength Testing Apparatus. Cesare d' Alfonso. *Faserstoffe u. Spinnpflanzen*, 1924, **6**, 54-55.

A paper on some characters of horse hair, with regard to its industrial application, in which an apparatus is described for determining the breaking load and extensibility of the single hairs. The instrument comprises a stand carrying a vertical board in which is a groove about 30 cms. long. A stud slides in the groove and by means of a screw can be adjusted at any height corresponding to the length of the hair. The other end of the hair is attached to a screw which is situated at one corner of a parallelogram system of levers. The apparatus is loaded by pouring mercury or lead-shot into a container carried on a small platform forming part of the lever system, this weight being equalised by hanging a weight on the short arm of one of the levers. The strength of the hair is determined by the weight required to break it. To determine the extensibility the hair is fixed at both ends and passed round a graduated screw which rotates as the hair is loaded. When the hair breaks the screw is automatically fixed in its position. The screw is so graduated that every degree corresponds to an increase in length of 1 mm. —B. C. I. R. A.

Comber Waste Balance. H. Brüggemann. *Textilberichte*, 1924, **5**, 221-224.

The mathematics of four types of comber waste balances, in which the ratios of the lengths of the levers are respectively 1:1, 1:2, 1:3 and 3:7 are discussed.
—B. C. I. R. A.

Recording Cloth Dynamometer. S. Dezsö. *Textilberichte*, 1924, **5**, 258-260.

A description of the Rejtö dynamometer. The dynamometer is of the constant load type and has means for recording the stretch as well as the breaking load. The cloth is held between two movable clamps one of which is pulled by means of an electric motor, the other being held by a special two-armed spring. A series of springs is provided for fabrics of different strengths and each spring can be calibrated by loading it with weights and holding a strip of metal between the clamps. One arm of the spring carries a special recording device which traces a curve on a revolving drum of paper. To calculate the results, a perpendicular is dropped from the highest point of the curve to the line of zero strength, the perpendicular and stretch are measured and the area enclosed between these two lines and the curve is measured with a planimeter. The method of deducing the durability and quality from these values is indicated. —B. C. I. R. A.

Penetrometer. N. N. Wosnessensky. *Textilberichte*, 1924, **5**, 260, and 322-323.

The instrument was designed for measuring the water-tightness of fabrics. It comprises a copper cylinder which on one side communicates with a glass manometer tube and on the other with a rubber bulb. The fabric is held between two rings, one of which is soldered to the brim of the copper cylinder. The cylinder is filled with water and the manometer is adjusted to zero. The water pressure is increased by squeezing the bulb until the water penetrates the fabric. The pressure at which the first drop of water appears on the surface of the fabric is read from the manometer scale. A modified apparatus, provided with inlet and outlet taps, is described for use when fabrics impreganted by different methods are to be tested, since, in the first apparatus, the water is seldom changed and subsequent results might be influenced by substances dissolved from any of the fabrics tested.
—B. C. I. R. A.

Automatic Cloth Feeder. C. G. Haubold, A-G. *Textilberichte*, 1924, **5**, 379-381.

An automatic, pneumatic cloth-feeder with selvedge controls is illustrated.
—B. C. I. R. A.

Lambrecht Telehygrometer. H. Bongards. *Textilberichte*, 1924, **5**, 377-379.

The relative value of the psychrometer and the hair hygrometer as distant-reading hygrometers for use in the textile industry is discussed. The hair hygrometer is shown to be the better instrument. It gives results accurate to within 4%, whilst the psychrometer shows much wider deviations. A suitable form of Lambrecht's hair hygrometer, for accessible and inaccessible places, is described. —B. C. I. R. A.

X-Ray Goniometer. K. Weissenberg. *Z. Physik*, 1924, **23**, 229-238.

A new instrument is described and also its application to the elucidation of the structure and plastic deformation of crystals. —B. C. I. R. A.

Absolute reliance can be placed in our

TEMPLES & SPRINGS

LET US TELL YOU MORE ABOUT THEM

Send your enquiries to **LUPTON BROS LTD** *ACCRINGTON*

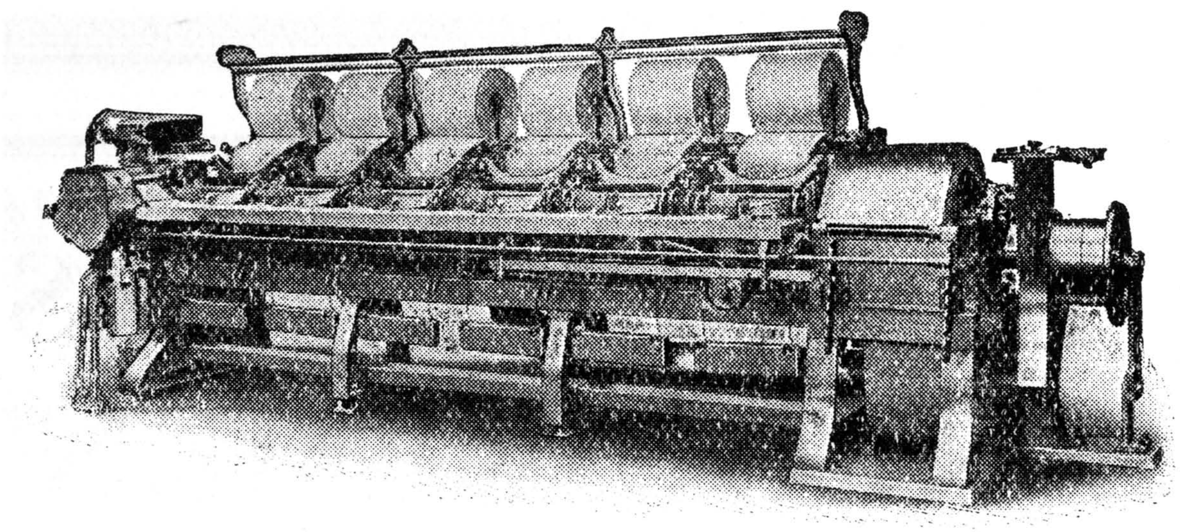
(Incorporating Jas. Blezard & Sons *Guy Foundry* Padiham)

Established 1869 *Telephones*—2115-2116 (2 lines)

ASA LEES & CO. LTD

Soho Iron Works, Oldham

MAKERS OF **TEXTILE MACHINERY**



IMPROVED ÇOMBER (NASMITH TYPE)

Telephone—777
Telegrams—"ASA OLDHAM"

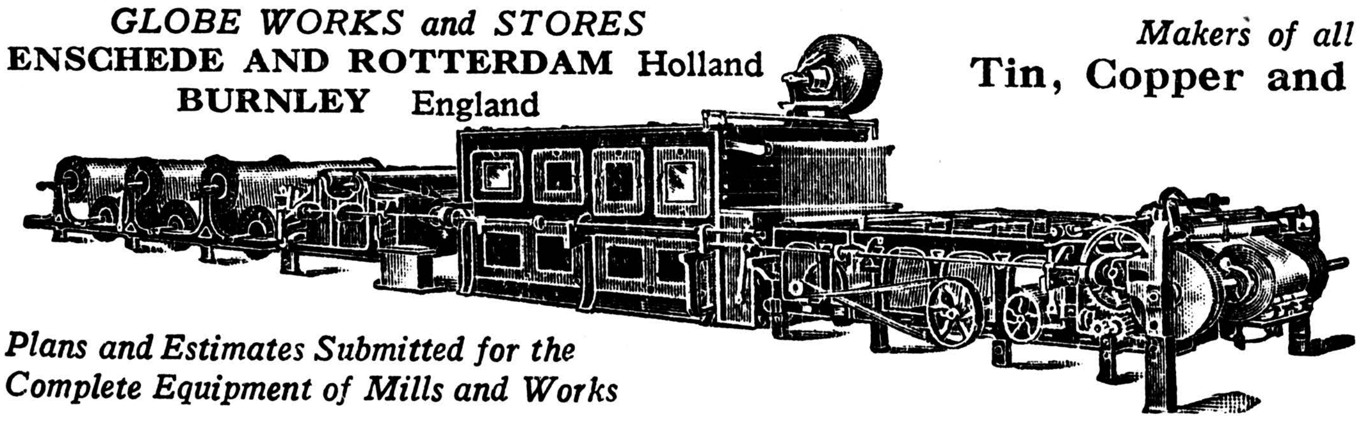
Codes used—A1, A B C (4th & 5th Editions), Atlantic, Bentleys

---

TATTERSALL & HOLDSWORTH'S

GLOBE WORKS and STORES
ENSCHEDE AND ROTTERDAM Holland
BURNLEY England

Makers of all kinds of
Tin, Copper and Brass Goods
used in the Textile Trades
including
Steam & Water Fittings
Taps, Valves
Pumps, Fans
&c.



Plans and Estimates Submitted for the Complete Equipment of Mills and Works

Makers of all kinds of **MACHINERY** *used in* SIZING, DYEING, WASHING, FINISHING AND DRYING

TRAGASOL

For Cotton, Linen, Silk, and Woollen Manufacturers, Sizers and Dressers, Calico Printers, Dyers and Finishers

TRAGASOL—as a soluble powder—GUM TRAGON

An interesting booklet
"TRAGASOL AND ITS USES" will be sent on application.

SIZING
Finest results only obtained by its use.

DYEING
The perfect restrainer — ensures level dyeing.

CALICO PRINTING
The best printing paste is TRAGASOL.

FINISHING
TRAGASOL gives the "feel" and "finish" which sells.

HARDMAN INGHAM & DAWSON LTD

"DIAMOND" COTTON DRIVING ROPES

Made on new principle and as near stretchless as possible

"Try Double Diamond Stretchless Driving Rope for Ring Frames, a Proved Success."

COTTON PARCELLING TWINES
in Ball, Crosswound Spool,
Cheese or Reel, with cardboard end.

Cotton Mill Banding

TUBULAR BAND FOR
MULE AND RING SPINDLES

Works: **BANKSIDE MILL OLDHAM** *and* **"Diamond" Rope Works, ROYTON**

Telephones—Oldham 1313 & 43
Cables—"Excel, Oldham"

Alphabetical Index to Advertisements

The Journal of the **Textile Institute**

BACK NUMBERS OF THIS JOURNAL URGENTLY REQUIRED

Members who can spare copies of any of the following issues of this Journal are asked to send them to the Institute

Year	Volume	Issues Wanted
1910 ...	I	... No. 1
1913 ...	IV	... No. 2
1914 ...	V	... Nos. 1, 2, 3, 4
1916 ...	VII	... No. 2
1919 ...	X	... May & June
1920 ...	XI	... April, May, June, August. Sept., Oct., and Nov.
1921 ...	XII	... Jan., Feb., March, April, July & Nov.
1922 ...	XIII	... Aug. & Nov.
1923 ...	XIV	... April & May

Printed and Published for the Textile Institute (Offices: 16 St. Mary's Parsonage, Manchester) by Chorley & Pickersgill Ltd. The Electric Press Leeds & London