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The Journal of the
TEXTILE INSTITUTE

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THE TEXTILE INSTITUTE
ST. MARY'S PARSONAGE MANCHESTER

CONTENTS FOR FEBRUARY 1931

THE JOURNAL OF THE
TEXTILE INSTITUTE

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PROCEEDINGS

London Section

Lecture at the Institute Rooms, Newgate Street, London, Wednesday, 3rd December 1930; Mr. A. Mason in the chair.

NEW MOTIVES FOR TEXTILE DESIGNS

This meeting took the form of an address and a demonstration of crystallisations seen through the microscope by polarised light. The speaker was Mr. F. G. Wood, who said he was glad of an opportunity to show his work to a textile gathering. The beauties of crystallisation in some of its many forms had of course long been known, whilst through the microscope many people had become familiar with the less common crystals. His investigations had been directed not only towards a means of making these lovely forms and colours available to designers and other interested, but to enhance their value and beauty by the use of polarised light. He did not think crystal forms seen thus had been explored as a source of designs and colour schemes. He also pointed out that the slides exhibited were those of his own choice and might embody colour schemes not acceptable to all. In addition it was to be noted that it was difficult to provide a large audience with a projected image big enough for all to see and yet sufficiently defined to retain the delicate shades the smaller projections revealed. A smaller downward projection of 15 in. diameter was available for use after the lecture. The lecturer then showed three series of slides, the first being those of substances upon which he first began to work, then those of substances specially compounded by himself for this purpose and finally a series designed to exhibit the range of variation possible upon any chosen theme. After the demonstration Mr. Wood was cordially thanked for his services.

Lancashire Section

Meeting at the Institute, Wednesday, 10th December 1930; Mr. W. T. Boothman in the chair.

TRANSPORT IN RELATION TO THE TEXTILE INDUSTRY

The lecturer, Mr. A. J. Green, of the Calico Printers' Association, was introduced by the Chairman, who said that he felt sure those present would have a valuable lecture, as Mr. Green was a practical man and well qualified to deal with this subject.

Mr. Green pointed out first how much time cotton, either as raw material, yarn, or cloth, spent in transit from one place to another, from spinner to manufacturer, and thence to finisher and finally to merchant and consumer. No other material known to industry passed over such long distances during manufacture and sale. He then turned to the question of transport within this country and exhibited figures for the transport, by rail, of one ton of cotton from point to point until finally it reached London as finished goods. On a broad average these charges worked out at about 4d. a piece of 30 yards. The next aspect to be treated was the growth of direct cotton importation to Manchester since the opening of the Manchester Ship Canal. This was shown to have increased tenfold since 1894, whilst the tonnage of raw cotton sent inland by rail from Manchester had more than doubled in the past seven years. But, the lecturer pointed out, the difference was more marked if the road transport figures were considered and showed tables of comparison with Liverpool indicating the turn over from rail to road and from Liverpool to Manchester. The lecturer then compared and contrasted road and rail transport, giving at the outset a comparison of the obligations imposed upon a railway company and those upon a haulier which were entirely in favour of the latter. A table of present day railway rates on raw cotton from Liverpool was shown in which comparison was made with those in force in December 1927, and pre-war rates; it was noteworthy that present day rates in every case were lower than pre-war rates. Credit for these reductions in rates had to be assigned, said Mr. Green, to the Cotton and Allied Trades Transport Committee. An outline was then given of the domestic transport system of the Calico Printers' Association as being typical of the transport systems of other large combines. The motor-fleet system on a properly organised basis could be run, at rates which compared very favourably with railway rates, at any rate within a radius of 40 miles from Manchester. The actual costing figures quoted by Mr. Green, showed that the inclusive cost by road was better than that by rail by margins as high as 5s. 3d. in some cases and as low as 1s. 5d. in others, whilst in special instances rail charges were better than road charges to the extent of 1s. 10d. On the whole the balance was in favour of road transport on cost, whilst on speed and convenience the advantage appeared to be overwhelmingly on the side of road transport. Two further aspects of the transport problem were touched upon by Mr. Green, the use of horse transport, and the use of the Fordson tractor. The margin of cost, said the lecturer, was well on the side of the one-horse vehicle, and had this not been so, no amount of sentiment would keep the horse on the road. The heavier loads conveyed by two horses cost about 34s. a day, whilst the Fordson tractor returned a cost of 36s. a day. But the amount of work done by the tractor was much greater and the real balance was in its favour. In conclusion, Mr. Green referred briefly to the handicap under which British exporters suffer by reason of the lower freight rates from Continental ports than from Liverpool or London. He described effects made to secure amelioration of these conditions but said he feared he could suggest no immediate remedy. Cheaper Continental working conditions and geographical advantages were insuperable barriers.

Discussion

The discussion was opened by a representative of one of the railway companies, who said that he appreciated the way in which Mr. Green had dealt with his subject. The railway companies would not have contributed by reducing their rates to the help of the cotton industry unless there had been such an organisation as the one to which the lecturer referred. The Chairman had referred to traffic by road between Bolton and Oldham and he would like to remind everyone that as the railway traffic system was organised at present, goods had to be sent by night. An inter-day service might be given by joining forces with the road companies. There was also the question of expensive packing of goods for export which hitherto was thought to be most necessary and was exceedingly well done. But cheaper methods could now be taken advantage of, as some of the shipping firms supplied containers for removing goods to the docks. The railway companies were prepared to supply containers which were not handled again until they got to the ship side. In his motor charges he wondered if Mr. Green had covered overhead charges. The Road Act would increase the costs of motor transport and this would bring the scale nearer to that of the railway companies.

The Lecturer, in reply, said that he had included nothing in his figures for overhead charges in regard to motor transport. Simply the cost of running the motor.

Another speaker said that he also had very much appreciated the lecture; he never missed an opportunity of listening to Mr. Green. Referring to the sheet of rates provided by the lecturer, Mr. Tomlinson said that in the raw cotton figures there was a comparison per ton between pre-war and present day, but they only extended to 1925, could this not be extended ? He understood that this would cover the horse rates and wondered if there had been a return to railway traffic from the road because of the reduced rates. He did not think that the road traffic could actually compete with the railway, but the latter often failed because they could not state a charge immediately.

A further speaker said that he endorsed the two previous statements of opinion. The railway companies' rates were not flexible enough and not sufficiently on-the-spot. They could help industry and he thought they were now realising the fact. Mill towns could now get exceptional rates and terms where formally all goods had to be sent at rates as from Manchester. He thought that great saving of time could be made by co-operation between such bodies as the Calico Printers' Association and the mills. For instance, cloth could be delivered direct from the mills to the C.P.A. works without having to come to Manchester first. This aspect of transport might usefully form the basis of a discussion on some future occasion.

The Chairman said he was particularly interested in the question of direct transport from the mills to the various finishing works. He thought that the difficulty in this direction lay in the fact that there was always too much secrecy in trade.

Mr. F. Wright said he had enjoyed the lecture very much indeed and it would enable him to look into one or two points. He thought that the railway companies were now "going through the mill" so that those in industry need not be too hard on them since, after all, the railways were indispensable.

Mr. Green said that the question of abolishing the system of cloth coming into Manchester for forwarding was debated some years ago but no decision was reached as they were up against the vested interests of the cotton trade.

A hearty vote of thanks was accorded to the lecturer.

Meeting at Harris Technical Institute, Preston, 23rd January 1931;
Mr. R. Houghton, J.P., presiding.

Mr. James Smeaton, F.T.I., of the Manchester Chamber of Commerce Testing House, contributed a paper on "Specifications for Textile Materials."* The author referred to the growth of the practice of placing of orders in terms of specifications, submitted a number of typical forms of specifications, and explained the customary tolerances involved.

Several questions were asked and replied to. In answer to the Chairman, the lecturer said they had no experience of terms of specification covering down-proof material.

On the motion of Mr. David Atkinson, seconded by Mr. Fletcher Chadwick, a hearty vote of thanks was accorded the lecturer and chairman.

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*The full text of this paper will be published in the March issue of this *Journal*.—EDITOR.

Yorkshire Section

Joint meeting with the Halifax Textile Society at the White Swan Hotel, Halifax, on Wednesday, 14th January 1931.

THE RATIONALISATION OF INDUSTRY

This title was used by Mr. A. Saville, who lectured to the joint meeting held as described above. He postulated that the problems brought by inevitable change were part of human life; we could resist changes and endeavour to preserve the present state or we might prepare for and accept changes as they came. Exaggerated conservatism, however, would not work; the methods of Cato had long been discredited. To meet change it was necessary, now and again, to sit down to take stock. In taking stock we should find some things and methods obviously antiquated and now useless. It was easy to scrap these; it was not so easy to decide which must be restored or reconstructed for continued use. In his view, said the lecturer, it was possible, by action on a reasoned policy, to control the production and distribution of food, clothing, and shelter in such a way as to overcome the tide of difficulties now confronting us—it was possible to survive. The rights and privileges of individuals—only sanctioned by the community—must not impede our action; a new system seemed inevitable, based, perhaps, upon individual sacrifices. Turning to British industry, Mr. Saville said he would take stock therefore in so far as he would enumerate some of the causes which were assigned the present state of affairs; these were—The passing of a trade-cycle; the world-war disturbance; national self-determination; restriction of industrial credits; obsolete monetary policy; increasing burdens of rates and taxes; labour policies; and many which could be summed up as internal administrative and technical inefficiencies.

It was not his intention, said the lecturer, to enlarge upon all these "causes"; his views upon the "internal" causes he had already voiced. He proposed to consider some of those "external" factors of change which it was difficult and perhaps impossible and unwise to withstand. Of the trade cycle he would suggest that those who looked for such a cycle to bring us back to normal activity and prosperity, should bear in mind cycles may vary in intensity and may become less pronounced in upward movement. It was necessary to look up and beyond the cycle to discover and anticipate tendencies and tastes. Many people, said the lecturer, blamed the Great War for all our troubles. To the extent that the disturbed world would include in its reconstruction the latest and best in machinery, plant, and organisation, so far did the war contribute to those changes in external conditions which had had their undoubted effect upon our own industries. We could and must learn that our affairs were but part of a wider world and we must not confine our vision to our own geographical boundaries. We had reached a period in history when the unit in world affairs is the nation and amid international instability a desire for national security was natural and inevitable. There was danger in "waiting for something to turn up" and it would appear that history repeated itself in that defeated countries tended to recover rapidly. We, too, would have to reorganise to meet new conditions.

The existing relations between finance and industry, said Mr. Saville, would have to be examined. At this time of economic crisis greater flexibility of finance was needed; it would appear that money and banking had not shared our losses equally with trade and industry. The heavy calls of national and local taxation were a serious burden upon industry, and prevented the building up of reserves for expansion and development. Turning to labour questions, the lecturer said that the ultimate issue was of the utmost importance. If labour, as it appeared to, demanded a partnership in industry, it was necessary to resist at all costs or to adjust our system so as to make it possible. It appeared to him that the second alternative was the only possible course to pursue, but this did not necessarily mean nationalisation. Indeed, in the lecturer's opinion, even if public ownership of industry did come, it would, as inevitably pass away again before the march of events.

Dealing with education, Mr. Saville urged that only by offering adequate opportunities could industry appeal to the educated youth. Some form of attraction, either in the form of pay, security of tenure, etc., must be offered and in this respect the larger organisation or the combine was the better placed to make adequate openings. In regard to distribution, the lecturer said that probably none of the important industries was as far out of line with the organisation of distribution as was the woollen industry. The closest link possible between producer and consumer was to be aimed at and one of the most important of present-day problems was to find a way to balance production and public demand. If British textiles were ever to occupy the important position in the world's markets they once held and which it was desired to recover, that position would be secured only by superiority both in product, in selling policy, and publicity.

In conclusion, the lecturer said, "The world of to-day presents us with certain problems old and new. Of the new and difficult situations which confront us I have briefly outlined a number. These present a three-fold aspect. They are international (over which only the internationalist financier has control). They are national and over these the industrialist, the economist, and the financier could have, and ought to have, wider control. Finally they are local, concerned with domestic administration. Over these we have and ought to exercise full responsibility. Whether we will or not these problems must be faced, and if we will they may be faced with a forward active policy. This policy must be based, if it is to be successful, upon a common agreement and goodwill and upon a common interest for all parties concerned, an interest consisting in the welfare of industry (distinguished from that of private individuals or particular firms) which is ultimately the welfare of society."

Midlands Section

VISIT TO Messrs. WOLSEY LIMITED, ABBEY MEADOW MILLS LEICESTER

On Thursday, 22nd January, a party of 25 members representing five Midland counties paid a visit to the dyeing and finishing section of the Wolsey combine. The members were cordially received by Mr. Sidney Tyler, Mr. Breward, and Mr. Salt, Directors of Messrs. Wolsey Ltd.

The members were shown the various operations required to complete for sale the innumerable types of knitted garments made by the company. The works not only handle the whole of the Wolsey products, but also act as dyers and finishers to the trade. The processes of scouring, milling, unshrinking, dyeing, brushing, pressing, and calendering, etc., were fully demonstrated, thanks to the able directing of Mr. Cattell, Dr. Trotman—who is head of the Research Department—and others. The members, some of whom had not seen this phase of the industry before, were greatly impressed by the efficiency of the organisation in dealing with such an immense quantity of small articles.

Afterwards, tea was kindly provided by the Company and Mr. T. Morley, Chairman of the Section, proposed a hearty vote of thanks to the firm. Mr. Morley stated that he fully recognised the importance of finishing and also that he realised how easily expensive goods might be damaged or spoilt. For that reason, he was quite prepared to remain content to manufacture and allow other firms to finish his goods. Mr. Breward replied that it gave him great pleasure to come in contact with the Institute's members, and trusted that they had enjoyed their visit.

Irish Section

Meeting in the Municipal College of Technology, Belfast, on Thursday, 22nd January 1931; *Mr. W. H. Webb (Randalstown) in the chair.*

SCIENTIFIC DEVELOPMENT IN THE LINEN TRADE

The Chairman said that he had had a great deal to do with the inauguration of linen research. He had been close to the work and was astonished at how much had been accomplished. In these times we had to be modern and up-to-date. Any industry that was not, or any section of the industry that was not, was a drag on progress, and was bound to go out sooner or later. The world was moving quickly, it did not wait for the laggards; it just brushed them aside. We had to see to it that the linen industry, on which the prosperity of Northern Ireland depended was in the forefront of scientific progress, not only in technique, but in administration and in selling. He was glad to call upon Dr. W. H. Gibson, Director of the Linen Industry Research Association to deliver the lecture.

In opening, the lecturer stated that although the linen trade belonged to the group of industries in the pre-war period in which scientific research was an external interest, it was one of the first industries in the United Kingdom to establish a research association. The work of framing a policy for the conduct of research was essentially difficult. At that time the post-war trend of the trade was unknown, but it was accepted not without reason that after the exceptional trade conditions during the war a steady demand for linen would return and trade would soon settle down to pre-war normality. Under these circumstances problems of production were given places of priority in the programme of research drawn up which, had it been possible to visualise the post-war conditions accurately, might have been given to problems of distribution. As a result of the research work undertaken on the raw material side, science has not only accomplished the task of assuring to the trade its supplies of flax in the guise of new pedigree strains, but it has got ahead of the full use that can be made of its work owing to the present economic condition of arable farming. At the present time, assistance to the farmer towards more profitable utilisation of pedigree strains is having the close attention of the Research Institute and a full-scale investigation of retting and scutching has been undertaken. It is hoped that systematic work in the flax factory, built and operated by means of a special Government grant, will establish the value of alternative methods of fibre production and so enable the successful growing of flax to be linked up with the provision of suitable flax fibre for the spinner at an economic price. The object of research on spinning has been to produce the best possible yarn with the minimum of waste. Much information has been gathered which indicates that slight adjustments or modifications in machines and skilful distribution among the series of machines used of the work to be done in breaking down the fibre strands into finer elements may result in better yarn and improved yield. In alterations resulting from research such as the introduction of satisfactory alternative machinery the total effect rather than the intermediate has to be regarded as the deciding factor, owing to the dependence of one process on the other. In the weaving process, as in spinning, scientific development appears likely to take the line of building up upon the sound foundation already laid rather than that of making sweeping alterations. Improvements are being introduced which result in cloths of greater perfection and durability. The bleachers and finishers as a whole have fully realised that their somewhat delicate operations need the strictest scientific control and the result is that they have reached an unprecedented high standard for speed, safety, and economy. The lecturer considered that the linen trade has good reason to congratulate itself upon the scientific manner in which it has investigated its market and the requirements of its customers. The trade does not dictate to the users the form of style of linen with which they can be supplied, but by means of such organisations as the Irish and Scottish Linen Guild consults the good taste of its customers, listens to their suggestions and does its best to satisfy their requirements. Policies of this kind mean plenty of research work, either for the individual firm or the research associations or both and are now general among the members of the linen industry. In fact it can be seen that the view-point of the industry has been completely changed as a result of the trend of trade during the last ten years. Research work now should really originate at the selling end with the requirements of the user, and it is for members of the Association to bring the requirements of consumers before the Research Association, when steps can be taken to give them the utmost satisfaction.

Although the necessary organisation for co-operative and individual research is now well established, it is felt that in order to reap full advantage from scientific development, the application of scientific method to management problems and a sustained effort to apply analysis, experiment, and measurement to the problems of industrial control are necessary. This fact has been driven home by the report of the Irish and Scottish Linen Industry Delegation on their visit to the U.S.A. and Canada in 1929. It was clearly pointed out that a special type of standardisation was necessary to the industry which would not be carried to such lengths as to destroy the elasticity of the processes and the individuality characteristic of linen goods. The work of the stylist regarded as necessary by the delegation is of the research type and should be undertaken with some appreciation of scientific method. The subject of technical education is also one of very considerable importance. Scientific technical education has been greatly encouraged by the Textile Institute and it is expected that the policy adopted by this Institute will increase the proportion of suitably trained men in the linen and other textile industries. The training of salesmen has not been neglected by the linen trade and courses of instructions have been arranged on salesmanship and on manufacture. The problem of training young men for positions of responsibility in the industry has yet to be solved and in this the help of the Queen's University Commerce Faculty ought to be secured.

The full advantage of scientific development in the linen industry or any other industry cannot be obtained unless scientific method is used in matters beyond its control. Ten years have been spent in the scientific development of most of the industries of the country as individual units, but it has been taken for granted by those responsible that the general framework of industry was perfect before the dislocation of war. A research association for the application of science to banking and exchange would appear to be necessary to train bankers to meet present-day conditions. A scientific investigation of the supply of gold in relation to the volume of transactions financed over a considerable period of years might give some indication of a way to keep the fluctuation of price measured in terms of gold within more reasonable limits. The lecturer likened the gold standard to a concertina which is pushed in and out to the accompaniment of howls of agony from capital and labour alike. The advantage to the linen trade of fitting a decimalised pound-florin currency to the dollar-cent currency by adjustment of the value of the pound was pointed out. The lecturer summed up by saying that the linen trade is now well organised for scientific development upon the technical side and that upon its administrative and commercial side it is approaching its many problems in a sensible and scientific spirit. If external economic conditions are made more favourable as a result of the efforts of the State and other outside organisations the linen trade can go forward confidently to a deserved prosperity.

A lengthy discussion followed and on the proposition of Mr. Campbell a hearty vote of thanks was passed to the lecturer.

NOTES AND NOTICES

Institute Employment Register

A list of members offering their services for employment appeared in our October issue. Further registrations have since been effected, and full particulars of qualifications and experience of candidates for posts may be obtained by interested employers on application to the Institute, quoting the registered numbers. The following announcements refer to the additional registrations—

No. 49—A.T.I., age 29, seeks appointment as Cotton Mill Manager or Assistant-Manager. Several years' experience as Head Mule and Ring Overlooker.

No. 51—Experienced Manager, age 37, 20 years' experience, winding, spooling, balling, pirning, and cop machines—for sewing yarns, etc. Technical knowledge of testing and analysis of textiles. Desires change.

No. 52—Spinning Overlooker, age 26 years, desires progressive position as Head Spinning Overlooker or Spinning Master. Mules and ring frames. All qualities from soft wefts to crêpe yarns.

No. 53—Cotton Spinning Mill Manager seeks post; 21 years' experience on the Continent. Knowledge of Russian, German, Polish, and French.

Textile Institute Diplomas

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

FELLOWSHIP

MASON, Herbert (Dresden, Germany).

ASSOCIATESHIPS

GEE, Norman Cecil (Shipley).
WATSON, David Alexander (Paisley).
WALKER, Eric (Nottingham).
HILTON, Frank (Chorley).
PATTERSON, George Scott (Matlock).
BRUNSKILL, Joseph Haighton (Burnley).
WHITTLE, John (Bolton).
CANTRELL, Harold (Bingley).
JACKSON, Roy (Stalybridge).

Institute Membership

At the January meeting of the Council, the following were elected to Membership of the Institute—A. E. Aspinall, 4 Cumberland Street, Manchester (Textile Machinist); W. N. Bacon, Sindall & Bacon, 27 Walbrook, London E.C.4 (Consulting Chemist); S. C. Carse, 5 Ashfield Crescent, Glandore Avenue, Belfast (Linen, Dept. Manager); E. Denham, 393 Shaw Road, Oldham (Stripper and Grinder); G. Dowling, 198 Cromwell Road, Patricroft, near Manchester (Apprentice Textile Fitter); C. W. Ewing, 60 Manor Road E., Toronto, Ontario, Canada (Chemical Engineer); H. Franks, 11 Hainworth Road, Woodhouse, Keighley (Weaver's Company ,Scholar); H. Livingston, jun., 65 Queen Street, Lurgan, N. Ireland (Linen Factory Manager); W. A. Marsden, 12 Rydal Terrace, Jeremy Lane, Heckmondwike (Manager's Clerk, Carpet Yarn Manufacture).

Membership of the Institute

When it was decided to issue a preliminary announcement in regard to the Coming-of-Age Celebrations, it was agreed that the importance of securing a substantial increase in membership of the Institute during this particular year should be emphasised. The "Majority" year of the Institute falls at a time of great economic strain, but this circumstance only makes it the more necessary that every possible effort should be put forth to promote the advancement of the organisation both in status and numerical strength. The fact has to be admitted and deplored that the Institute has already suffered some loss in membership as a direct result of the conditions of industrial depression, but it is nevertheless quite remarkable how the increase of membership has been maintained over many months past. At each meeting of the Council of late the list of applications for membership has been persistently extensive. The scheme of qualification of members by election to Associateship or Fellowship has produced substantial results. Whilst the continental increment of new members is satisfactory, nevertheless it is felt that at no time has the urgency for extended membership been so great as during the present year.

Coming-of-Age Celebrations

Although many members of the Institute have not, up to the time of writing, forwarded intimation as to the probability of their attendance at the Institute Coming-of-Age Celebrations (22nd to 25th April), yet the number of acknowledgments received may be said to be indicative of a satisfactory response. It is to be remembered that the circular already issued to members was only in the nature of a preliminary canvass, and it is fully expected that on the issue of the final circular a really substantial measure of acceptance will result. Approximately £40 had been received within ten days of the issue of the preliminary circular in favour of the special Celebrations Fund. The Committee is most hopeful that many members will yet assist the fund. It is hoped, indeed, that a sum of about £150 will be secured. A large number of invitations to representatives of various organisations will be necessary on an occasion of this kind, and it is in order to meet the expense of hospitality that the special fund has been opened. It has been decided not to issue any list of donations in order that members generally may be free to remit even quite small donations.

REVIEWS

The Preparation and Weaving of Artificial Silk or Rayon. By T. Woodhouse. Published by Sir Isaac Pitman & Sons Ltd. (10s. 6d. nett, 231 pages.)

The author, in his introduction, emphasises the importance of well-made knots in rayon yarn and recommends the use of mechanical knotters. It is practically impossible to produce a well-woven rayon fabric from yarns which contain a large number of badly made knots and it is fitting that this subject be introduced in the first chapter of the book. Chapter 2 deals with the reeling of yarn into hanks and also with the production of folded yarns. Chapters 3, 4, 5, and 6 are devoted to winding from hanks into various packages. Some good illustrations of the latest type of swift are introduced, followed by descriptions of modern machines for winding from hanks to bobbins, cheeses, and cones. Some 85 pages of the book are filled with information on the process of section warping and the subsequent beaming. These operations are described in detail, with calculations showing methods of dividing the warp into sections. Detailed descriptions of British and Continental machines are given with calculations on wheel gearing. Much practical information is included and this part of the book will be of interest to those actually engaged in the operation of warping. In Chapter 12, the author discusses the properties of rayon in relation to sizing and gives a general idea of the substances used. Some good micro-photographic illustrations of sized and unsized yarn are included. The various methods of sizing rayon yarns are briefly described, but a whole chapter is devoted to the process of sizing from beam to beam, this being regarded as the most important system. Three types of machine are described in detail. In the chapter on weft winding, three of the latest pirn winding machines are described. The last chapter, dealing with the actual weaving of artificial silk, is limited to 24 pages, describing briefly a few of the latest looms. These descriptions serve a useful purpose in showing on what lines these special looms are constructed. Considering the importance of weaving, the space devoted to it is small compared with, say, 85 pages on warping and beaming. The author might, with advantage, have introduced some matter on the general principles to be observed in weaving rayon, as compared with cotton, worsted, etc. The book is well illustrated with photographs and line drawings, but it is felt that the average reader would prefer simple diagrams of machinery to intricate scale drawings, which are often difficult to follow. The machinery employed in the preparation of artificial silk yarns for warp differs from that used for cotton and as few firms engaged in the weaving of cotton and rayon fabrics possess the necessary plant, it is desirable that those engaged in the weaving of rayon should have at least a general idea of the machines and processes involved in the preparation of such yarns. This book supplies such information, its price is reasonable, and it should also be of value as a students' text book. J.S.

The Manufacture of Artificial Silk. E. Wheeler. Chapman & Hall. 2nd edition. (12s. 6d.)

In the foreword Sir Wm. H. Pope suggests that the development of artificial silk has been retarded by the meagre scope of our chemical knowledge of the various forms of cellulose and that progress has been achieved largely through means of the trial and error type. Whatever methods may have been used seem to be fully justified by the great strides which have been made in the manufacture of artificial silk during the past ten years. Artificial silk has been produced in such a degree of fineness of filament that no silkworm or spider could compete with and of such a high strength as to surpass real silk and compare with high quality steel. In the first chapter the history of artificial silk is dealt with, a short account being given of developments up to fairly recent date. Chapter II gives a concise account of the chemistry of cellulose so far as it relates to artificial silk, but contains no information of more recent date than that given in the first edition. Chapter III gives a clear but concise account of the practical methods of making viscose, with several new illustrations, and also describes methods for recovery of caustic soda by dialysing processes. Chapter IV deals with the spinning of viscose silk and describes plant and machinery employed for the purpose. The composition of spinning baths as described in a few important patents is given. Chapter V describes plant machinery and methods used for the production of ordinary grades of artificial silk from viscose. Chapter VI gives a concise account of the cuprammonium process for spinning artificial silk by the ordinary and the stretch-spinning process and gives sketches of plant used whilst Chapter VII deals with the nitrocellulose process and Chapter VIII with the wet and dry spinning of cellulose acetate silk, including illustrations of modern plant. Chapter IX gives a short account of other processes of interest but not of much practical importance. Chapter X deals with the lustre, colour, and optical properties of various kinds of fibres with various illustrations showing the cross section of fibres, including that of hollow silk. The importance of softness and suppleness is explained. A table is given showing the strength of elasticity of artificial silks, including the so-called Lilienfeld silk. The chemical properties of the various kinds of artificial silk in relation to water, alkalies, acids, and salts are enumerated and a short account of Herzog's current views on the action of water on artificial silk is given. Chapter XI deals with the dyeing of the various kinds of artificial silk in a concise manner and gives recent information published by Courtaulds on the level dyeing of viscose. Chapter XII describes the various uses to which artificial silk is put and Chapter XIII the manufacture of miscellaneous products such as staple fibre, hollow fibres, and artificial wool. Chapter XIV deals with the economies of the industry and gives statistics of production up to 1929. In the appendix useful information concerning methods of analysis is given. The new edition contains various additions to the subject matter and illustrations. A good collection of references is given, with each chapter, to the literature available on the subject of artificial silk. W.H.

Theory and Electrical Drive of the Loom. R. H. Wilmot, M.Sc., A.M.I.E.E., Assoc. A.I.E.E. Published by Sir Isaac Pitman & Sons Ltd. (144 pp. 8s. 6d.)

This book is based to a large extent on three papers published in the *Journal* of the Textile Institute for January 1928, June 1928, and October 1929, but the analysis given in these papers has been extended and completed in this book. The author claims to have developed, both mathematically and experimentally, a general mathematical theory of the loom. This is a somewhat exaggerated statement, since such important loom actions as shedding and letting-off are not considered, the book dealing only with the parts which are mainly responsible for the consumption of power. The first six chapters are devoted to working out mathematical formulæ for the power required to drive the loom, the motions of the sley and shuttle being analysed with this end in view. The calculated time for starting up the loom and the calculated speed variation during normal running are the subjects of the next two chapters, whilst the last contains a brief description of present-day practice in the electrical drive of the loom. It is a pity that the book is marred, on the one hand, by a somewhat superficial knowledge of the loom and, on the other, by the use of incorrect assumptions and inaccurate data in the mathematical part of the work. The first is perhaps natural, since the author is an electrical engineer, but it probably leads him to consider the loom more as a machine to be driven than as one for producing cloth. He claims, for example, on page 111 that the reduced speed variation of the loom when individually driven by electric motor results in an appreciable increase in the loom output, as compared with a lineshaft driven loom. It does not necessarily follow that the loom with the lowest speed variation will have the greatest production, or turn out the best cloth. Again, it is difficult to excuse the statement on page 46, in the mathematical analysis of shuttle motion, that "the shuttle is accelerated by the pressing back of a strap at the end of the shuttle arm which is released suddenly when tight, thus catapulting the shuttle across the loom." The other fault is a more serious one. A typical example of how the author is led astray at times by wrong assumptions can be seen in Chapter III, dealing with shuttle motion. On page 54 he assumes that the acceleration of the shuttle takes place between 90 and 120 degrees after beating up. On page 58 he assumes also 30 degrees of crankshaft movement during shuttle retardation. The result is that the distances moved by the shuttle of a loom of 120 inches reed space during acceleration and retardation (Tables XX and XXII) work out to 1·898 and 1·768 feet respectively. The total length of sley, allowing for pickers, etc., would be at least 185 inches, whereas in practice the sley length would be about 172 inches only. The period of 30 degrees for acceleration is far too high for wide looms. As a result, the calculated values of shuttle acceleration are too low for wide looms and since the calculations of power for the shuttle are directly dependent on these values, the power values are inaccurate. The power for the shuttle is one of the main factors in determining the size of driving motor required and this error probably explains why the size of motor calculated by the author, 1·10 h.p. (Table XXXIII) would generally be replaced in practice (see page 126) by a motor of about 1·5 h.p.

The effect of using inaccurate dimensions and weights is seen in the calculated acceleration time for a loom in Chapter V. On page 95 the effective weight of the moving parts of a loom of 100 inches reed space is taken as 8 lb. This would be too low for a loom of only 40 inches reed space. The result is that the calculated acceleration period of 83 degrees of crank movement is certainly too low; it would probably be at least double this calculated value. The values of speed variation calculated in Chapter VI are similarly of very doubtful accuracy. It is true that the author states on page 89 that his values "do not necessarily hold good for *all* looms of the reed space given and that each specific case should be considered individually." But he does claim to have based his calculations on average plain cotton looms of average dimensions and weights of loom parts.

The mathematical part of the work is extremely well carried out, and for that reason the book is valuable. The treatment is advanced and will be beyond the scope of most students of textiles, but it should prove of use to the designers of loom motors and to loom designers. The author is on sound ground in the final chapter, dealing with the different types of motors and the methods of transmitting the power from motor to loom and it is this chapter that will appeal most to the textile reader. The book is well illustrated with diagrams, but the price seems high considering the size of the book. W.H.

Mikroskopische und machanisch-technische Textiluntersuchungen. Von P. Heermann and A. Herzog. Pp. 451, viii, 314 figures. Third edition, 1931. Julius Springer, Berlin (32 Marks).

A striking peculiarity of this book is the lack of reference to the work and publications of other countries besides Germany. This is perhaps less inconvenient to an English than to a German reader, but it has the effect of reducing the value of the book as a work of reference. The book is divided into two parts that are so distinct that it is surprising that they should have been combined at all. Though the intention has apparently been to write a book that shall cover all the work carried out in the "physical" laboratory of a works or institution devoted to textiles, it would probably have been better to issue the book in two parts, having regard to the cost of the book as a whole. The first part of the book is similar to A. Herzog's "Die Mikroskopische Untersuchung der Seide und der Kunstseide," except that the scope is much wider, dealing as it does with all the various textile fibres. There is, nevertheless, a certain lack of balance in the treatment. For instance, much space is devoted to the embedding of fibres for section cutting, but only scant notice is given to the actual cutting operations. Yet the latter is quite as important as the former, and is never adequately treated in the current literature while embedding methods are frequently described in detail. Again the methods of top lighting which are so useful in examining the surfaces of fabrics for faults are dealt with very summarily. However, there is much useful data on the morphological and micro-chemical properties of fibres summarised in the tables, and the photomicrographs used in illustration are of the highest quality and are very well reproduced. The second part of the book deals with a miscellaneous collection of tests applicable to textiles, which can only be briefly described by an omnibus title such as that given by the authors. The subjects treated range from relative humidity measurements to periodicity determinations with the "Lunometer" and include descriptions of tensile tests, fibre diameter and staple length, fabric analysis, porosity, waterproofness, and other similar tests, together with useful diagrams and data relating to these tests. Though there is a good subject index, there is, unfortunately, no author index. However, the book can be recommended as a convenient reference work to the current German practice and literature, for many of the references are not readily accessible to English readers in the original publications, and, within its limits, the subject matter is clearly and accurately stated. J.M.P.

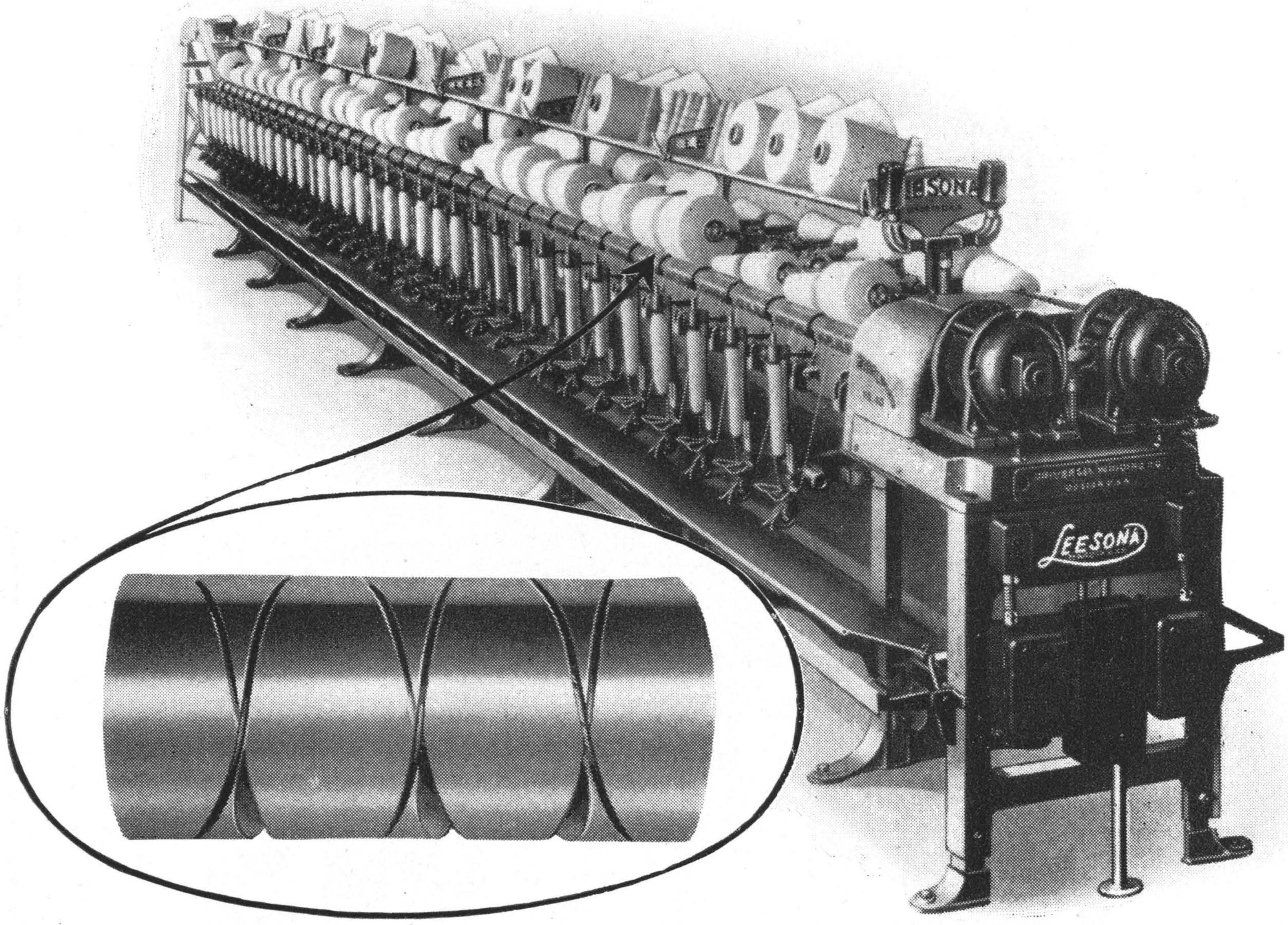
The Woad Plant and its Dye. By J. B. Hurry, M.A., M.D. Published by the Oxford University Press, 1930 (pp. xxviii, 328. 21s.).

The late Dr. J. B. Hurry, according to a memoir which prefaces this book, was a physician of Reading possessing wide and varied interests, amongst others, in medical and economic botany. He cultivated in his garden many plants of economic value, including the woad plant. This circumstance, combined with the fact that Dr. Hurry was also a historian and student of economics, accounts for the compilation of this work which is a study from an international point of view of the woad industry.

The woad plant as a dye is now of no practical value to dyers, although it is interesting to notice that a very small demand still exists for its use in the woad fermentation vat when dyeing indigo. Dr. Hurry, however, does not confine himself to the use of woad in dyeing, but has endeavoured to survey the subject from as many points of view as possible. He deals with the plant from its botanical aspect and in considerable detail with its cultivation and with the manufacture of the woad, whilst the woad vat and its chemistry is only dealt with briefly. The use of woad in the fine arts, in herbals, in therapeutics and the philological study of the word "woad" all have their separate chapters.

It is, however, to the economic history of the woad plant, to the laws and decrees of the ancient crafts and guilds and to the study of the conditions of trade and industry existing in the Europe of the Middle Ages that the author pays the most attention. A most interesting tale he has to tell of the rise, prosperity, and decline of a one-time great and important industry. We are shown the conditions of trade in all the chief countries of Europe, we follow the great trade routes of the Middle Ages across the Continent, study the laws, regulations, and conditions of trade of many lands for nearly two thousand years, from Cæsar's commentary on the woad stain used by the ancient Britons to Napoleon's decree that woad was to be cultivated over the whole of France.

This one time prosperous Continental industry is now but a memory kept alive by two surviving woad farms in England. There is a lesson and a warning here, for although far removed from the Middle Ages we are still governed by the continually changing conditions of progress and the birth of a new idea to-day may sound the death knell of a great industry to-morrow. L.G.L.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TRANSACTIONS

5—RANDOM AND SYSTEMATIC SELECTIONS OF WARP SPECIMENS IN CLOTH SAMPLING

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SUMMARY

This note discusses the relative merits of systematic and random methods of selecting warp specimens from a sample of fabric, when both selections are made on the Latin-square principle. Reasons are given for the belief that the distribution of specimens in the fabric itself is already random, so that the random selection would only show to advantage in the particular case of the random distribution where the specimens were arranged periodically, and where, moreover, the periodical selection by the systematic method happened to coincide with the periodical arrangement. A comparison of the methods of sampling is made in the case of three fabrics—two cottons and one linen; from each of these fabrics 256 warp specimens had been taken, 16 from each of 16 adjacent warp strips, and tested for strength; an analysis of the strength-values shows that, for these three fabric samples, the random selection does not lead to any better results than the systematic, thus supporting the conclusion arrived at from purely general considerations. At the same time it is recognised that from a purely theoretical point of view the random method of selection retains its superiority, and that it is therefore better to adopt the random method unless there are cogent practical reasons for adopting the systematic method.

I—INTRODUCTION

In the course of his valuable paper on the application of modern statistical methods to textile research, Tippett criticises a sampling arrangement used by myself in the determination of the strengths of fabrics at different humidities. Tippett maintains that "the question of the sampling of cloths . . . . is analogous to the problem of arranging experimental plots for agricultural field trials . . . . . *it is to be expected that there will be systematic regional variations of strength,** on which will be superimposed the smaller random variations, and that by a suitable arrangement, only these random variations will contribute to the inaccuracy of the comparisons."[1] He asserts that systematic arrangements, such as that used by me, "violate one of the conditions that must be satisfied if reliable estimates of probable errors or variances are to be made—the treatments are not randomly distributed within the restrictions imposed to eliminate regional variations."[1] He points out that the best arrangement, if circumstances permit, is that of a Latin square combined with a random distribution of specimens within the square. He admits that "there are disadvantages to the method, however, and precautions are necessary . . . . . Mistakes are more liable to be made in random than in systematic arrangements, but within the restrictions imposed randomness is essential if accurate estimates of the errors of sampling are to be made; *regular arrangements of treatments may often coincide with some uneliminated trend in the cloth.*"*[2]

With reference to this criticism I may point out that, as explained in my paper,[3] the experimental work was mostly carried out in 1918, so that the sampling was necessarily done some years before the publication of

*Italics are mine—A.J.T.

Fisher's work in which he explains the Latin-square method of sampling and the importance of randomness therein.[4] Nevertheless, the criticism holds good of course, if its basis is sound. But while it may be indisputable that the random Latin-square method of selection is theoretically superior, it may be questioned whether the matter is really of any great practical importance in the case of comparatively small samples of textile fabrics, and whether it is legitimate to draw an analogy between cloth-sampling and agricultural field-trials. As to the latter, Fisher refers to the effect of "some physical feature of the field such as the ploughman's 'lands,' which often produce a characteristic periodicity in fertility due to variations in depth of soil, drainage, and such factors."[5] Tippett similarly maintains that "regular arrangements of treatments may often coincide with some uneliminated trend in the cloth."[2] What is the justification for this statement ? Is it a conclusion based on experimental facts or does it rank merely as an hypothesis ? And are we to infer that my method of sampling was such that my test-results, and the conclusions drawn from them, are to be regarded as untrustworthy ?

As it happens, when arranging for the sampling in my series of tests, I did consider certain alternatives before adopting my particular arrangement, though all the alternatives were of a semi-systematic type. I finally adopted my particular semi-systematic arrangement because I could see no reason from a practical standpoint why any one of the alternatives would be likely to give a more satisfactory distribution. Now, before proceeding further, it must be made perfectly clear what is the particular danger to be apprehended in the systematic selection of test-specimens. In its extreme form it is this—that there may be some *periodically-occurring* strong or weak places in the fabric, and that the systematic periodical selection of test-specimens may happen just to coincide with the periodical distribution of the strong or weak places; a *systematic fall or rise* in the strength either across or along the warp would not cause the systematic arrangement of test-specimens to give any worse result than the random arrangement. It should be noted that even if there should be a *periodic* occurrence of strong or weak places, it would not affect the result unless the periodic selection of test-specimens coincided in some measure with this periodicity. Looking at the method statistically, therefore, we may ask two questions—first, what are the chances of occurrence of a periodic distribution of strong or weak places; and secondly, what are the chances that the periodic systematic selection of test-specimens will coincide with the periodic distribution of strong or weak places ? To answer these questions we will first consider how the warp of a fabric is prepared, and afterwards we will see what light is thrown on them by some test results for three different fabrics.

II—GENERAL THEORETICAL CONSIDERATIONS

(i) Correlation between Parallel Warp Strips

Normally, the yarn is wound from a number of cops or bobbins successively on to a warper's bobbin; a number of these warper's bobbins are placed in a creel and the yarn drawn off from them to form the warp. It is evident, therefore, that the arrangement of the thick and thin places in contiguous portions of the neighbouring yarns is as nearly random as could be imagined. In a warp consisting of some 3000 or 4000 threads there is no reason to expect the strong or the weak places to come together in neighbouring yarns, except in the degree that would be expected from a random arrangement. This is not to say that strong and weak areas will not occasionally be met with; on the contrary, a random selection of variable elements such as yarns must inevitably lead to the existence of such areas, but they will not occur periodically more often than would be expected from a random arrangement. Evidently, therefore, the arrangement across the warp is an ideal random arrangement, and no correlation should exist between the strengths of contiguous portions of neighbouring warp strips.

(ii) Correlation along Individual Warp Strips

Along the warp the situation is rather more complicated owing to the correlation that exists between the strengths of successive short lengths of a single yarn. If strong and weak lengths alternated regularly, then the strength of specimens in a warp strip would repeat at intervals; if the periods were the same for each yarn, then the periodicity for the strength of the warp strips would be the same as for any of the yarns; but if the periodicities of the various yarns were different, the periodicity of the warp strip would be equal to the lowest common multiple of the periods of the several yarns. Whether the strengths of successive lengths of a warp strip will be correlated with one another turns therefore on the regularity and the length of the period in the yarns. Seeing that the length of test-specimen of the warp strip used in my tests was 9 inches, it is clear that we can omit from consideration any periodicities in the yarn of less than this length; moreover, we may use test-results on successive yarn-specimens of 12 inches length as a guide to the occurrence of periodicities in the yarn. On examining such test results we find that even in a single yarn the maxima and minima strengths occur at very irregular intervals. It follows, therefore, that when a number of such yarns are combined together to form a warp strip, we should not expect any regular periodicity in the occurrence of maxima and minima values in the strengths of successive lengths of this strip; moreover, it follows that there should be but little correlation between the strengths of successive short lengths of a warp strip. It is of course conceivable that under exceptional circumstances a yarn may be spun which has a regular periodicity in the occurrence of strong and weak places. But the probability of such a yarn occurring, and of a large number of bobbins of such a yarn being spun, must be very small indeed; and if we refer to the second question, viz. the chances that the periodic systematic selection of test-specimens will coincide with the periodic distribution of strong or weak places, we must conclude that the chances of this coincidence are so remote as to have been negligible in my tests, for in these tests only two test-specimens of each kind were selected from each warp strip. These two specimens were at $4\frac{1}{2}$-feet intervals, so that the only danger to be apprehended is that all the yarns in the strip had a regular periodicity of $4\frac{1}{2}$, $2\frac{1}{4}$, or $1\frac{1}{8}$ feet. Even if this happened it would only mean that each of the specimens in a warp strip was duplicated in the same strip; there would still remain a random distribution of specimens of each kind in the 10 different strips. In these circumstances it appears that the probability of strong and weak places having occurred with a periodicity which coincided with the periodic selection of test-specimens by the given systematic method may be regarded as having been so small as to be absorbed in the ordinary chances of random sampling.

(iii) Cards Analogy

It appears therefore that the arrangement of warp specimens in a fabric may be likened to the random selection of cards with different numbers written on them, the numbers on the cards representing the strengths of individual specimens; the cards may be arranged in order of selection to form rows and columns, thus representing the arrangement of specimens of different strengths. If we now arrange the cards in any given number of heaps, say four, it will not matter how we select them if we do it without regard to the numbers written on them, and the original selection was unbiassed. The "systematic" and "random" methods of selection will both be secondary selections, and, so far as the original material is concerned, both will be random selections. The sampling might be made more complex by filling up rows and columns at random on selecting cards at random from the original material; and if they now be made into four heaps by "systematic" and "random" selections, they will both be tertiary selections, and both will be random as far as the original material is concerned.

Alternatively we may regard the matter as analogous to the shuffling of a series of cards. If the cards are well shuffled, they will be in a random order; and a second or third shuffle, while it will lead to a different order, will not improve the randomness. And to insist that it is wrong to make a systematic selection of test-specimens from what I believe to be a randomly arranged group of specimens in a sample of fabric, is like a card-player insisting that in the dealing of a hand the cards should be dealt to the four players not in rotation, but at random.

III—EXPERIMENTAL RESULTS

(i) Material and Testing

In view of the importance of the sampling, and of the desirability of testing practically the different methods of selecting the specimens, during the same year that the humidity-strength tests were carried out I had some sampling tests made on the three fabrics which were most exhaustively studied in the humidity-strength tests. The three fabrics in question were the cotton fabrics E^6 and F^6, and the linen fabric P^7; all three fabrics were 4 oz. fabrics, E being a plain-scoured cotton, F a plain mercerised cotton from twofold yarns, and P a plain unbleached linen. Full details of these fabrics are given in the original paper. Each of these fabrics was over 36 inches wide and was divided so as to yield 16 warp strips each 2 in. wide after fraying down the edges; each of these warp strips was 3 yards long, so that it yielded 16 specimens each 9 inches long. Each specimen was marked so as to show the exact position in the fabric from which it had been taken. All specimens were then tested wet after immersion in water for a long period so as to ensure complete saturation.

(ii) Results of Tests

The results obtained for the strengths of the specimens of the three fabrics are given in Tables I, II, and III, in which the strength of each 2-inch specimen is given in pounds and shown in the table in the position occupied by the specimen.

(iii) Distribution of Strong and Weak Places

We will first consider certain simple methods of treating the results given in Tables I, II, and III. Below each original square A are given, in B, the results when combined in successive pairs in any one warp strip; in this way the 16 values in each warp strip are reduced to 8 values, each of which represents a successive pair in the original. We may now repeat the process and thus obtain, in C, 4 values for each strip, each of which therefore represents the sum of the values of four successive specimens in the original strip. Repeating the process once more we obtain, in D, 2 values one of which represents the sum of the values of the 8 specimens in the first half of the strip, and the other represents the sum of the values of the 8 specimens in the second half of the strip. Lastly, by combining these two values we obtain, in E, the sum total of the values of the 16 specimens comprising the warp strip. By inspection of the totals in the last line of each table it is a simple matter to compare the strengths of each warp strip taken as a whole; and by working upwards from the bottom line it is easy to locate the position of the particularly strong or weak specimens in each strip. Thus section D helps us to see whether the weak specimens are in the top half or in the bottom half of the strip; and then proceeding to section C we can note whether the weak specimens are in any particular quarter of the strip and so on, until we arrive at the original results, from which we can appreciate the influence of the individual specimens.

If instead of combining the results of successive specimens as in proceeding from section B to section C, we combine the results for adjacent specimens, we then obtain the square F. By combining the results in this square in sets of four, taking adjacent and successive pairs together, we obtain square G; again combining the results of square G in sets of four, taking adjacent and successive pairs together, we obtain square H; and adding together the four results in square H we get the grand total of all the observations.

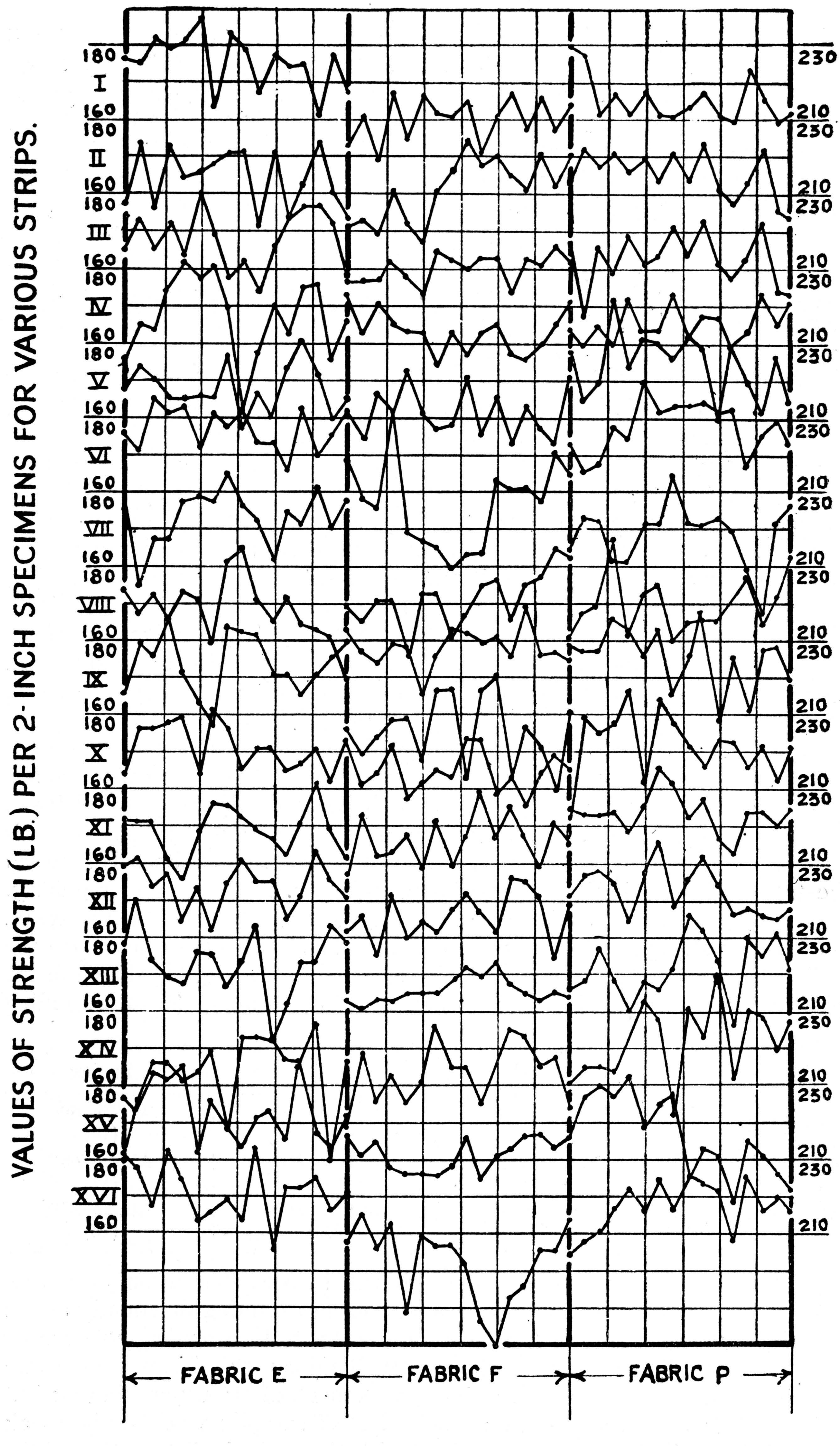
If these tables be examined, it will be found that the results are in fact irregularly distributed; there appears to be no regular periodicity either across the strips or along the strips. The absence of any regular periodicity is also apparent from Figs. 1 and 2, in which are plotted the original values, showing the variation of strength along and across the warp strips of each of the three fabrics.

If we next refer to the various reduced squares we find that there are marked differences between the different plots in each square; this of course is to be expected as a consequence of the irregularity of the material itself. But as we pass from the smaller squares to the larger squares there is nothing to show that the differences between the plots, and ultimately between the test-results for individual specimens, repeat periodically and regularly.

In each of the 8-side squares (F) the results have been classified as weak, medium, or strong. The limits which have been applied to designate the different regions of the fabrics as weak, medium, or strong, are shown in the table below, the figure in brackets indicating the number of values falling in the given class.

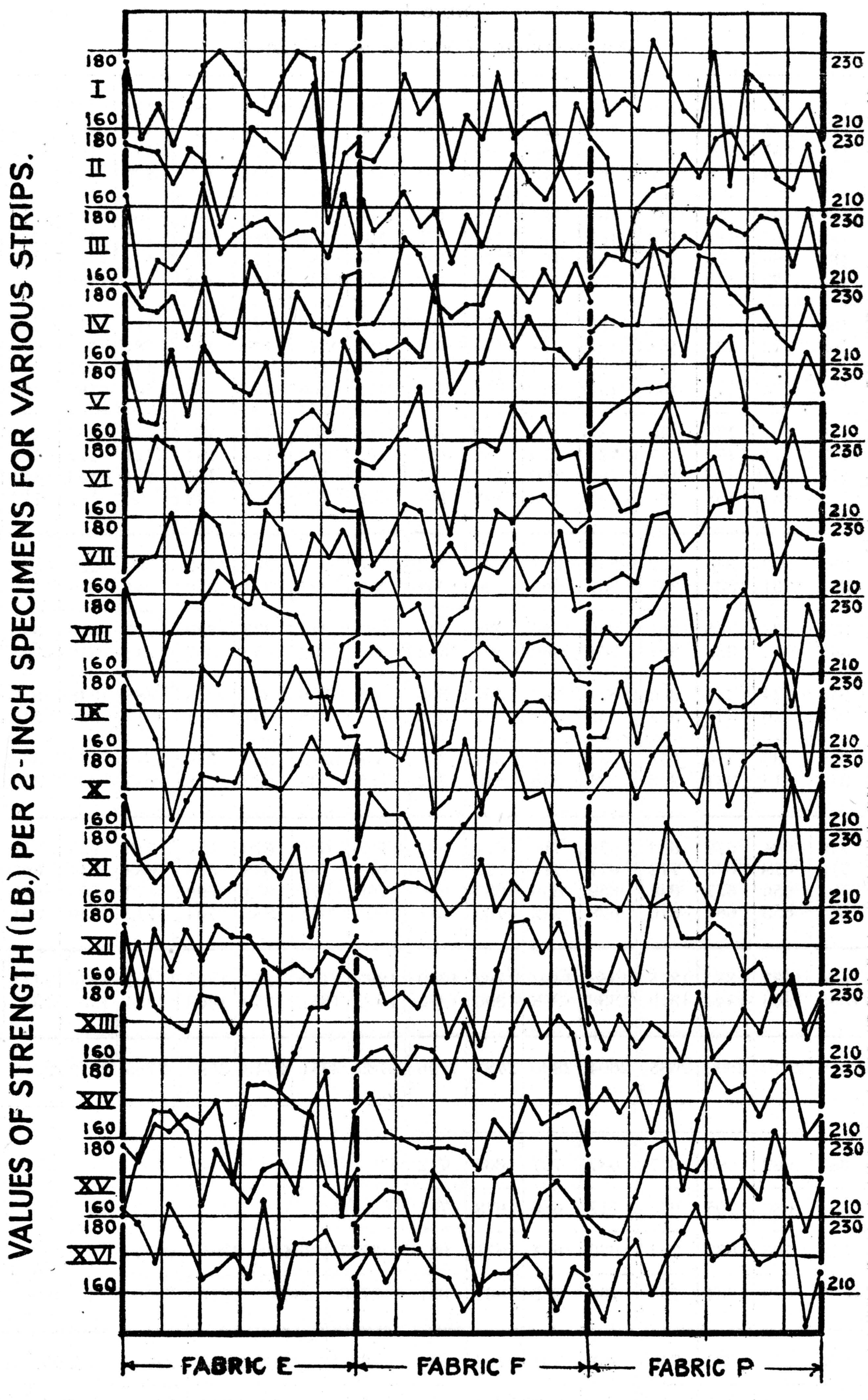
	Weak	Medium	Strong
Fabric E	Below 678 (10)	678 to 699 (35)	Above 699 (19)
Fabric F	Below 631 (15)	631 to 659 (32)	Above 659 (17)
Fabric P	Below 861 (11)	861 to 899 (37)	Above 899 (16)

If the 8-side squares be examined, it will be seen that in only one case is there any semblance of strong or weak patches running diagonally across the fabric; this is for fabric E, where there seems to be a tendency for strong patches to run diagonally from the top left-hand corner. In such a case we get what corresponds to a periodic arrangement of strong specimens; but even in this case the systematic selection of samples would only break down if the periodic selection coincided with the periodic distribution of the samples. Moreover, a further condition would have to be satisfied, viz.



VARIATION OF STRENGTH ALONG WARP STRIPS.

FIG. 1



VARIATION OF WARP STRENGTH ACROSS WARP.

FIG. 2

Table I

Warp-strength Values of Fabric E

A	177	158	166	156	167	176	180	174	166	164	173	180	178	140	178	182
	176	175	174	166	175	172	155	168	180	177	172	182	191	156	174	178
	183	157	166	164	171	186	168	173	176	177	172	174	174	167	184	168
	180	174	173	177	166	182	168	166	186	178	162	178	170	167	182	183
	182	165	164	183	166	184	178	174	172	180	156	165	168	162	186	175
	188	167	181	178	167	172	180	172	164	164	169	174	177	164	162	164
	164	169	170	181	166	182	178	160	158	182	177	162	176	170	177	166
	184	172	158	170	178	178	186	182	185	178	176	175	167	148	168	170
	180	172	163	142	157	182	177	186	183	166	173	182	174	174	164	164
	168	152	154	158	167	174	173	172	182	172	170	176	184	174	172	184
	178	172	166	171	161	174	162	166	172	172	168	176	152	172	174	156
	175	154	174	163	174	166	175	172	172	166	163	165	162	168	166	173
	176	163	178	176	182	184	172	165	166	168	171	172	174	166	187	173
	162	175	178	177	172	170	182	164	172	172	182	184	174	177	168	176
	178	161	173	156	160	166	171	162	176	162	170	176	184	140	164	167
	168	154	158	167	165	182	178	150	179	173	162	172	180	167	172	170
B	353	333	340	322	342	348	335	342	346	341	345	362	369	296	352	360
	363	331	339	341	337	368	336	339	362	355	334	352	344	334	366	351
	370	332	345	361	333	356	358	346	336	344	325	339	345	326	348	339
	348	341	328	351	344	360	364	342	343	360	353	337	343	318	345	336
	348	324	317	300	324	356	350	358	365	338	343	358	358	348	336	348
	353	326	340	334	335	340	337	338	344	338	331	341	314	340	340	329
	338	338	356	353	354	354	354	329	338	340	353	356	348	343	355	349
	346	315	331	323	325	348	349	312	355	335	332	348	364	307	336	337
C	716	664	679	663	679	716	671	681	708	696	679	714	713	630	718	711
	718	673	673	712	677	716	722	688	679	704	678	676	688	644	693	675
	701	650	657	634	659	696	687	696	709	676	674	699	672	688	676	677
	684	653	687	676	679	702	703	641	693	675	685	704	712	650	691	686
D	1434	1337	1352	1375	1356	1432	1393	1369	1387	1400	1357	1390	1401	1274	1411	1386
	1385	1303	1344	1310	1338	1398	1390	1337	1402	1351	1359	1403	1384	1338	1367	1363
E	2819	2640	2696	2685	2694	2830	2783	2706	2789	2751	2716	2793	2785	2612	2778	2749

F	686	662	690	677	687	707	665	712
	694	680	705	675	717	686	678	717
	702	706	689	704	680	664	671	687
	689	679	704	706	703	690	661	681
	672	617	680	708	703	701	706	684
	679	674	675	675	682	672	654	669
	676	709	708	683	678	709	691	704
	661	654	673	661	690	680	671	673

2722	2747	2797	2772
2776	2803	2737	2700
2642	2738	2758	2713
2700	2725	2757	2739

G

11048	11006
10805	10967

H

Table II

Warp-strength Values of Fabric F

A	153	152	158	174	164	170	150	164	158	174	158	162	164	150	167	158
	162	154	158	164	155	159	146	158	150	162	174	167	162	170	162	166
	150	150	158	172	168	156	152	155	155	165	162	156	164	156	166	156
	168	162	163	166	162	182	152	160	160	173	164	172	164	164	159	164
	155	153	158	164	174	150	136	158	160	158	169	161	166	156	157	140
	168	148	154	164	162	148	154	146	148	162	159	165	166	161	157	160
	163	162	166	155	158	146	154	157	168	166	172	162	166	177	157	158
	162	167	163	164	159	140	142	164	168	164	160	168	169	166	159	158
	166	176	161	158	172	144	148	163	144	175	168	173	173	166	167	152
	152	169	164	164	156	144	156	161	167	174	180	168	170	156	156	138
	162	171	164	166	166	164	158	162	172	159	167	162	174	166	162	130
	168	166	155	158	154	162	146	156	144	164	176	177	168	176	164	144
	158	162	164	157	164	163	156	170	158	156	168	176	166	174	167	147
	167	172	162	160	158	158	158	157	152	165	159	171	164	166	168	156
	158	163	167	166	154	172	166	158	140	170	172	155	166	169	164	156
	165	172	163	172	172	166	164	156	162	166	166	170	165	156	167	164
B	315	306	316	338	319	329	296	322	308	341	332	329	326	324	329	324
	318	312	321	338	330	338	304	315	315	338	326	328	328	320	325	320
	323	301	312	328	336	298	290	304	308	320	328	326	332	317	314	300
	325	329	329	319	317	286	296	321	336	330	332	330	335	343	316	316
	318	345	325	322	328	288	304	324	311	349	348	341	343	322	323	290
	330	337	319	324	320	326	304	318	316	323	343	339	342	342	326	274
	325	334	326	317	322	321	314	327	310	321	327	347	330	340	335	303
	323	335	330	338	326	338	330	314	302	336	338	325	331	325	331	320
C	633	618	637	676	649	667	600	637	623	679	658	657	654	644	654	644
	648	630	641	647	653	584	586	625	644	650	660	656	667	660	630	616
	648	682	644	646	648	614	608	642	627	672	691	680	685	664	649	564
	648	669	656	655	648	659	644	641	612	657	665	672	661	665	666	623
D	1281	1248	1278	1323	1302	1251	1186	1262	1267	1329	1318	1313	1321	1304	1284	1260
	1296	1351	1300	1301	1296	1273	1252	1283	1239	1329	1356	1352	1346	1329	1315	1187
E	2577	2599	2578	2624	2598	2524	2438	2545	2506	2658	2674	2665	2667	2633	2599	2447

F	621	654	648	618	649	661	650	653
	630	659	668	619	653	654	648	645
	624	640	634	594	628	654	649	614
	654	648	603	617	666	662	678	632
	663	647	616	628	660	689	665	613
	667	643	646	622	639	682	684	600
	659	643	643	641	631	674	670	638
	658	668	664	644	638	663	656	651

G	2564	2553	2617	2596	H	
	2566	2448	2610	2573	10131	10396
	2620	2512	2670	2562	10352	10453
	2628	2592	2606	2615		

Table III

Warp-strength Values of Fabric P

A	231	214	218	215	233	224	215	211	230	196	225	222	216	211	217	205
	228	223	198	210	215	216	224	218	228	230	223	227	218	215	227	208
	212	218	217	215	220	218	223	220	228	225	223	228	227	215	230	210
	218	222	210	210	242	228	212	238	237	228	224	225	218	214	227	217
	212	217	220	223	224	225	212	211	232	237	218	214	210	223	233	222
	218	220	212	214	232	240	222	223	226	212	226	226	218	233	218	216
	212	214	216	214	231	232	222	226	234	235	236	236	216	228	225	225
	212	222	218	224	226	234	236	210	216	228	232	218	221	202	228	216
	214	214	228	212	232	234	222	215	226	222	222	226	236	231	204	226
	218	224	230	218	229	235	222	217	239	216	228	232	232	223	213	224
	212	212	209	218	210	232	224	216	208	224	217	224	224	240	211	222
	210	208	220	210	230	233	222	222	226	223	212	216	206	212	198	208
	224	213	222	214	220	217	210	228	211	216	224	218	230	231	216	226
	216	223	217	224	212	226	197	215	228	222	224	216	225	229	211	216
	210	206	204	215	228	230	223	222	229	212	220	215	232	219	206	220
	212	204	218	224	210	220	226	233	219	222	225	218	220	229	202	216
B	459	437	416	425	448	440	439	429	458	426	448	449	434	426	444	413
	430	440	427	425	462	446	435	458	465	453	447	453	445	429	457	427
	430	437	432	437	456	465	434	434	458	449	444	440	428	456	451	438
	424	436	434	438	457	466	458	436	450	463	468	454	437	430	453	441
	432	438	458	430	461	469	444	432	465	438	450	458	468	454	417	450
	422	420	429	428	440	465	446	438	434	447	429	440	430	452	409	430
	440	436	439	438	432	443	407	443	439	438	448	434	455	460	427	442
	422	410	422	439	438	450	449	455	448	434	445	433	452	448	408	436
C	889	877	843	850	910	886	874	887	923	879	895	902	879	855	901	840
	854	873	866	875	913	931	892	870	908	912	912	894	865	886	904	879
	854	858	887	858	901	934	890	870	899	885	879	898	898	906	826	880
	862	846	861	877	870	893	856	898	887	872	893	867	907	908	835	878
D	1743	1750	1709	1725	1823	1817	1766	1757	1831	1791	1807	1796	1744	1741	1805	1719
	1716	1704	1748	1735	1771	1827	1746	1768	1786	1757	1772	1765	1805	1814	1661	1758
E	3459	3454	3457	3460	3594	3644	3512	3525	3617	3548	3579	3561	3549	3555	3466	3477

F	896	841	888	868	884	897	860	857
	870	852	908	893	918	900	874	884
	867	869	921	868	907	884	884	889
	860	872	923	894	913	922	867	894
	870	888	930	876	903	908	922	867
	842	857	905	884	881	869	882	839
	876	877	875	850	877	882	915	869
	832	861	888	904	882	878	900	844

3459	3557	3599	3475
3468	3606	3626	3534
3457	3595	3561	3510
3446	3517	3519	3528

G

14090	14234
14015	14118

H

that the strong patch would not be sufficiently extensive to provide specimens for the whole set required for each of the different conditions of testing. Neither of these conditions is actually fulfilled by fabric E, for the diagonal arrangement is in fact decidedly irregular, and moreover, in almost every case the strong patch is sufficient to provide at least 6 warp specimens both across and along the warp.

(iv) Correlation of Strengths of Successive Specimens in Warp Strips

We will next ascertain how far there exists any correlation between the strengths of successive specimens in any one warp strip. By comparing the strength-value of each specimen in a strip with that of the succeeding specimen, we obtain 15 pairs of values from which to find the correlation-coefficient for the particular warp strip. Table IV shows the correlation-coefficients for each of the 16 warp strips of the fabrics E, F, and P.

Table IV
Correlation-Coefficients for each of the 16 Warp Strips of the Fabrics E, F, and P

Warp Strip	Fabric E	Fabric F	Fabric P
1	−0·207	−0·538	0·228
2	−0·298	0·571	0·032
3	0·203	0·018	−0·018
4	0·301	0·207	−0·254
5	−0·029	−0·432	−0·208
6	−0·109	0·355	0·364
7	0·094	0·289	0·227
8	0·308	−0·002	−0·177
9	0·170	−0·244	−0·223
10	−0·108	−0·065	−0·268
11	0·327	−0·347	0·280
12	0·052	−0·112	0·203
13	0·128	0·641	0·139
14	−0·127	−0·061	−0·167
15	−0·029	0·361	0·507
16	−0·252	0·393	0·166

Evidently these correlation-coefficients are exceedingly variable. If the correlations were not real but merely a consequence of sampling fluctuations, out of many samples of 15 pairs we should expect one in 10 to have a correlation as high as 0·4409, 1 in 20 as high as 0·5139, 1 in 50 as high as 0·5923, and 1 in 100 as high as 0·6411. Hence, out of 16 correlation-coefficients for each fabric, we should expect one—and only one—to be as high as 0·5. In actual fact, this does occur for fabric P, but for fabric E not one of the values is so high, while for fabric F three of the values attain this magnitude. The discrepancies in the last two cases may be traced to the correlation-coefficients being few in number, for we cannot expect the distribution of 16 correlation-coefficients to be exactly the same as that of a very much larger number. But if we consider the 48 results together, we see that the numbers of correlation-coefficients of the higher values almost exactly correspond with those expected from the odds applicable in each case. That the distribution of the correlation-coefficients is that of chance, is further borne out by the fact that the coefficients are equally positive and negative (8 of each) in the case of fabrics E and F, and practically so (9 positive and 7 negative) in the case of fabric P. Hence we may conclude that there is no reason to fear that, in these fabrics, systematic sampling of warp strips will be vitiated by the occurrence of a regular wave-form distribution of strength within the strips.

(v) Comparison of Means of Random and Systematic Latin-square Arrangements for Four Treatments

We will now imagine that we select sets of specimens according to some particular system of sampling, as we would do in order to investigate the effect of different conditions of humidity. But instead of testing these sets under different conditions, we actually tested them all under the same conditions, so that we can ascertain what errors would have been present in the means owing to the sampling alone. It will be observed that for each of the three fabrics the number of specimens was 16 both across and along the warp; thus their strength values form a square of side 16, and this square can be divided into four squares containing 64 values each, or into 16 squares containing 16 values each. They thus form very suitable material for selecting specimens by the Latin-square method, and we will accordingly use it by comparing the results given by Latin-square selections which are completely randomised with those which are completely systematic.

In the first place we will confine our attention to four sets of conditions, for which we therefore select four groups each containing 64 specimens. We will denote the different conditions by A, B, C, and D, and we will apply these letters respectively to the four sets of specimens to be tested under the conditions represented by the respective letters. Now a Latin-square appropriate for four conditions of testing will contain 16 individual specimens. Hence, in arranging for the selection of our samples according to the random Latin-square arrangement, we need 16 different Latin-squares to include the whole 256 values for each fabric. We will also imagine that the samples are selected according to a completely systematic Latin-square arrangement with the same systematic arrangement repeated 16 times; we will then compare the results obtained by the two different methods of selection. The random Latin-square arrangement finally adopted is that shown in Fig. 4, and the systematic arrangement in Fig. 3. When all the samples were selected in this way the results given in Table V were obtained for the mean values of the different sets by the two methods of sampling for the different fabrics.

Table V

Set	Fabric E		Fabric F		Fabric P	
	Systematic	Random	Systematic	Random	Systematic	Random
A	171·7	170·6	162·7	161·5	220·6	219·6
B	170·3	171·7	159·9	161·6	221·0	221·8
C	171·0	170·7	161·3	160·9	220·8	220·9
D	171·9	171·8	161·9	161·8	219·7	219·9
Mean of A–D ...	171·2	171·2	161·4	161·4	220·5	220·5
Standard deviation of A–D ...	0·63	0·55	1·02	0·33	0·63	0·85

It will be noticed that from these results there is little to choose between the random and the systematic arrangements. Seeing that A, B, C, and D only nominally represent different treatments or conditions, and that they have actually all been subjected to the same treatment and conditions of testing, it follows that with perfect sampling and a very large number of tests the mean result for each set—A, B, C, and D—should be the same. In point of fact, the results by each method of sampling do agree quite closely; for fabric E, the maximum difference between any pair is 0·9% (systematic), and 0·7% (random); for fabric F, 1·7% (systematic), and 0·6% (random); and for fabric P, 0·6% (systematic), and 1·0% (random). Obviously, there is little to choose between the results obtained by the two methods of selecting the specimens.

A B C D	A B C D	A B C D	A B C D
B C D A	B C D A	B C D A	B C D A
C D A B	C D A B	C D A B	C D A B
D A B C	D A B C	D A B C	D A B C
A B C D	A B C D	A B C D	A B C D
B C D A	B C D A	B C D A	B C D A
C D A B	C D A B	C D A B	C D A B
D A B C	D A B C	D A B C	D A B C
A B C D	A B C D	A B C D	A B C D
B C D A	B C D A	B C D A	B C D A
C D A B	C D A B	C D A B	C D A B
D A B C	D A B C	D A B C	D A B C
A B C D	A B C D	A B C D	A B C D
B C D A	B C D A	B C D A	B C D A
C D A B	C D A B	C D A B	C D A B
D A B C	D A B C	D A B C	D A B C

FIG. 3—Systematic Latin Squares for 4 Treatments

C D B A	B A D C	D B A C	A C B D
B C A D	C D A B	A C D B	B D A C
A B D C	A B C D	C A B D	D B C A
D A C B	D C B A	B D C A	C A D B
C B A D	D A C B	B A C D	A D B C
A C D B	B C A D	C D A B	D C A B
D A B C	A D B C	A B D C	C B D A
B D C A	C B D A	D C B A	B A C D
D A C B	B D A C	C A B D	A B D C
A B D C	C A B D	B C D A	C D B A
B C A D	D B C A	D B A C	B A C D
C D B A	A C D B	A D C B	D C A B
B C D A	D C A B	A B C D	C B D A
A D C B	C B D A	C D B A	D A B C
C B A D	B A C D	B A D C	B C A D
D A B C	A D B C	D C A B	A D C B

FIG. 4—Random Latin Squares for 4 Treatments.

We may use the results of these tests in another way. We may divide the whole sample of each fabric into four equal sections each containing 64 test-values; this may be done in two ways, first parallel to the warp, and secondly, parallel to the weft; the sections obtained by the former method we shall call "warp sections" and those obtained by the latter method "weft sections." We may now test the difference between the two methods of selection by comparing the four mean values (A, B, C, and D) obtained from each of the four sections in each case. Each mean value is the mean of 16 test-values. The means for the different warp and weft sections are given for each fabric in Table VI.

Table VI

Fabric Selection	Section No.	Warp Sections				Weft Sections			
		A	B	C	D	A	B	C	D
E Systematic	I	170·2	167·9	170·0	169·4	173·3	170·2	174·1	172·2
	II	170·9	173·4	170·2	173·7	172·1	171·5	169·5	175·4
	III	174·1	170·4	170·6	175·4	169·2	171·4	167·8	169·7
	IV	171·6	169·6	173·0	168·6	172·1	168·1	172·4	169·8
E Random	I	169·5	168·2	170·7	169·1	171·9	174·2	172·2	171·6
	II	171·1	170·9	171·6	174·7	170·6	174·1	169·9	173·9
	III	171·6	174·9	171·3	172·7	171·1	167·8	170·8	168·4
	IV	170·1	172·8	169·2	170·7	168·8	170·7	169·8	173·3
F Systematic	I	162·9	161·2	161·1	162·5	163·3	159·7	161·4	161·2
	II	161·0	155·9	155·1	159·6	161·0	157·3	159·2	159·7
	III	164·4	161·3	165·8	164·9	162·8	160·4	162·2	162·2
	IV	162·5	160·1	163·2	160·9	163·7	161·9	162·2	164·7
F Random	I	163·1	160·6	161·3	163·7	161·2	161·1	162·1	161·2
	II	158·4	158·6	158·4	156·1	161·1	160·8	155·6	159·7
	III	163·6	163·1	161·7	168·0	159·6	162·7	163·7	161·8
	IV	161·0	164·0	162·1	159·5	164·2	161·7	162·2	164·4
P Systematic	I	215·6	216·6	218·2	213·9	222·4	217·5	221·0	219·7
	II	224·3	223·0	223·0	221·9	221·4	225·7	221·8	220·8
	III	224·8	224·2	221·6	223·4	221·0	221·9	217·7	222·0
	IV	217·8	220·1	220·4	219·7	217·7	218·8	222·6	216·4
P Random	I	213·2	217·1	217·2	216·9	220·2	219·1	220·4	220·9
	II	222·6	224·7	222·9	221·9	220·9	223·8	223·4	221·5
	III	223·7	224·7	223·7	221·9	221·8	222·1	220·5	218·3
	IV	218·8	220·7	219·6	218·8	215·5	222·3	219·1	218·7

The four mean values for A, B, C, and D respectively, in any one section, do not differ very much from one another. The mean of A, B, C, and D, represents of course the mean of the 64 specimens in any one section, so that the mean of A, B, C, and D, of any one section is necessarily the same for that section whether obtained from the systematic or from the random method of selection. In order to indicate the variabilities of the means of A, B, C, and D, in any one section according to the two methods of selection, Table VII has been compiled; in this table are given the grand mean for each section, and the standard deviations of the mean values of A, B, C, and D, from this grand mean, as obtained by the two methods of selection.

Obviously, since A, B, C, and D represent four sets of 16 specimens each, which have been tested under similar conditions, with a sufficiently large

Table VII

Fabric	Section No.	Warp Sections			Weft Sections		
		Grand Mean	Standard Deviation of Group Means		Grand Mean	Standard Deviation of Group Means	
			Systematic	Random		Systematic	Random
E	I	169·4	0·90	0·90	172·4	1·46	1·02
	II	172·1	1·52	1·69	172·1	2·04	1·89
	III	172·6	2·18	1·41	169·5	1·29	1·45
	IV	170·7	1·71	1·32	170·6	1·76	1·67
F	I	162·2	0·67	1·27	161·4	1·28	0·41
	II	157·9	2·46	1·03	159·3	1·33	2·19
	III	164·1	1·69	2·35	161·9	0·90	1·51
	IV	161·7	1·23	1·64	163·1	1·14	1·19
P	I	216·1	1·56	1·68	220·1	1·80	0·21
	II	223·0	0·85	1·03	222·4	1·92	1·22
	III	223·5	1·20	1·01	220·7	1·75	1·51
	IV	219·5	1·01	0·77	218·9	2·12	2·51

number of tests and perfect sampling the mean values of A, B, C, and D should be the same. The mean values of Table VI represent only 16 values each, but the number is the same in each case and we may proceed to compare the variabilities of the two methods of sampling by reference to the standard deviations given in Table VII. It will be observed that the standard deviation varies considerably for each set of four sections, warp or weft, of any one fabric; sometimes the standard deviation is less for the systematic than for the random sampling, and sometimes *vice versa*. For fabric E, in two cases the systematic gives a less value than the random and in five cases a greater value; in one case the two methods give equal values. For fabric F, the systematic gives a less value than the random in six cases and a greater

A	B	C	D	E	F	G	H	A	B	C	D	E	F	G	H
B	C	D	E	F	G	H	A	B	C	D	E	F	G	H	A
C	D	E	F	G	H	A	B	C	D	E	F	G	H	A	B
D	E	F	G	H	A	B	C	D	E	F	G	H	A	B	C
E	F	G	H	A	B	C	D	E	F	G	H	A	B	C	D
F	G	H	A	B	C	D	E	F	G	H	A	B	C	D	E
G	H	A	B	C	D	E	F	G	H	A	B	C	D	E	F
H	A	B	C	D	E	F	G	H	A	B	C	D	E	F	G
A	B	C	D	E	F	G	H	A	B	C	D	E	F	G	H
B	C	D	E	F	G	H	A	B	C	D	E	F	G	H	A
C	D	E	F	G	H	A	B	C	D	E	F	G	H	A	B
D	E	F	G	H	A	B	C	D	E	F	G	H	A	B	C
E	F	G	H	A	B	C	D	E	F	G	H	A	B	C	D
F	G	H	A	B	C	D	E	F	G	H	A	B	C	D	E
G	H	A	B	C	D	E	F	G	H	A	B	C	D	E	F
H	A	B	C	D	E	F	G	H	A	B	C	D	E	F	G

FIG. 5—Systematic Latin Squares for 8 Treatments

value in two cases. For fabric P, the systematic gives a less value than the random in three cases and a greater value in five cases. Putting all these results together we find that the systematic gives a less value than the random method in 11 cases and a greater value in 12 cases; in one case the two methods give identical values. It therefore appears that there is practically nothing to choose between the two methods of sampling so far as relates to these three fabrics.

E	H	C	B	D	F	A	G	B	G	H	F	C	E	A	D
B	A	F	G	C	E	H	D	C	A	D	E	H	B	F	G
H	G	E	D	A	C	B	F	D	E	A	B	F	G	H	C
A	F	B	H	G	D	E	C	F	C	G	H	A	D	B	E
D	C	H	A	B	G	F	E	H	B	E	D	G	F	C	A
F	E	G	C	H	A	D	B	G	H	F	A	D	C	E	B
G	B	D	E	F	H	C	A	E	F	C	G	B	A	D	H
C	D	A	F	E	B	G	H	A	D	B	C	E	H	G	F
D	C	H	E	A	B	F	G	A	G	E	F	H	D	C	B
B	A	F	G	E	C	H	D	D	C	F	B	A	G	H	E
G	H	E	C	D	F	A	B	G	E	A	H	D	C	B	F
F	D	B	A	H	G	E	C	B	D	C	G	E	H	F	A
A	F	C	D	G	E	B	H	H	F	B	A	C	E	D	G
H	B	G	F	C	A	D	E	E	H	G	C	B	F	A	D
C	E	D	B	F	H	G	A	F	A	H	D	G	B	E	C
E	G	A	H	B	D	C	F	C	B	D	E	F	A	G	H

FIG. 6—Random Latin Squares for 8 Treatments

(vi) Comparison of Means of Random and Systematic Latin-square Arrangements for Eight Treatments

We will now consider the results when selected so as to represent eight different conditions of testing, for which a Latin square must contain 64 individual specimens; for the whole 256 values we require four different 64-fold Latin squares, as shown in Fig. 6; we compare the results by this method of selection with those obtained by a systematic Latin-square arrangement repeated four times, as shown in Fig. 5. These two methods of selection gave the following mean values of the different sets for the different fabrics.

Table VIII

Treatment	Fabric E		Fabric F		Fabric P	
	Systematic	Random	Systematic	Random	Systematic	Random
A	173·4	170·5	163·8	161·4	220·6	221·8
B	169·8	169·8	159·8	160·4	220·1	222·0
C	172·8	174·2	160·4	162·1	222·5	221·0
D	170·3	172·9	162·8	163·7	220·2	218·6
E	170·0	168·8	161·6	159·9	220·7	218·7
F	170·8	171·9	159·8	159·6	221·9	222·6
G	169·1	171·0	162·0	161·8	219·1	218·9
H	173·3	170·4	161·2	162·4	219·3	220·8
Mean A–H ...	171·2	171·2	161·4	161·4	220·55	220·55
Standard deviation A–H ...	1·60	1·63	1·33	1·30	1·16	1·50

As in the case of the four treatments, so in the case of the eight treatments represented by the letters A–H, the results by each method of sampling agree to a very close degree of approximation. For fabrics E and F the standard deviations from the grand mean are almost identical for the systematic and random treatments, but for fabric P the standard deviation for the random selection is distinctly greater than that for the systematic selection.

If the results for eight treatments are divided into warp and weft strips as in the case of the four treatments, we obtain two warp sections and two weft sections; we may test the difference between the two methods of selection by comparing the eight mean-values A–H (obtained from each of the two sections in each case.) .Each mean value is again the mean of 16 test-values. The means for the different warp and weft sections are given for each fabric in Table IX; Table X shows the grand mean for each section, and the standard deviations of the mean values of A–H from this grand mean, as obtained by the two methods of selection.

It will be observed that the standard deviation varies considerably for each pair of sections warp or weft, of any one fabric. For fabric E, the standard deviation is less for the systematic selection than for the random in two cases, equal in a third case, and greater in the fourth. For fabric F the systematic is less than the random in one case, equal in the second case, and greater in the other two cases; for fabric P the systematic is less than the random in three cases and greater in one case. Putting all these results together, we find that the systematic gives a less value for the standard deviation than the random method in six cases, a greater value in four cases, and an equal value in two cases. Again, therefore, the random selection yields no better results than the systematic.

(vii) Comparison of Random and Systematic Latin-square Arrangements by the Analysis of Variance

We will finally compare the different methods of sampling by analysing the sources of variance by Fisher's method,[8] as given by Tippett[9] in his paper. The superiority of this method lies in its revealing how the variation due to the treatment compares with the variation that occurs in the absence of any treatment, and in providing us with a criterion to measure the significance of any difference observed. The results of the analysis are given in Table XI. In this table is included not only the analysis of the variance for the four treatments A, B, C, and D, with the whole bulk of the material arranged in the sixteen 16-fold Latin squares as in Figs. 3 and 4, but also the analysis for 8 different treatments (A to H), with the whole bulk divided up into four 64-fold Latin squares as in Figs. 5 and 6.

Now as no treatments have actually been given to the different sets it follows that in every case the variance of the "treatments" should not be significantly different from that of the residuals, apart from discrepancies arising from the sampling errors. By mere inspection of the mean variances for the different "treatments" and the residuals in each case, it is easy to see that in general no greater accuracy can be claimed for the random than for the systematic method of selection. A more sensitive test is provided by the z method of Fisher,[10] where z is the difference between the natural logarithms of the standard deviations of treatments and residuals respectively. Fisher gives a table showing the levels of significance of different values of z for different numbers of degrees of freedom; the values of z have been

Table IX

Fabric Selection	Section	Warp Sections								Weft Sections							
		A	B	C	D	E	F	G	H	A	B	C	D	E	F	G	H
E Systematic	I	171·7	169·8	169·4	168·9	169·4	171·6	170·8	174·3	173·3	171·0	174·1	173·1	172·1	170·8	169·4	174·5
	II	175·1	169·9	176·3	171·6	170·5	170·1	167·4	172·4	173·5	168·7	171·5	167·4	167·8	170·9	168·8	172·2
E Random	I	167·4	169·5	174·6	172·8	169·4	170·6	171·9	169·4	173·8	170·8	175·3	173·7	169·3	174·8	169·4	171·5
	II	173·6	169·9	173·8	173·1	168·1	173·3	170·1	171·5	167·3	168·9	173·1	172·2	168·3	169·1	172·6	169·4
F Systematic	I	164·1	158·6	157·3	162·5	159·8	159·5	158·9	159·6	164·8	158·4	157·4	160·7	159·5	158·4	162·9	160·3
	II	163·5	161·1	163·6	163·1	163·4	160·0	165·1	162·7	162·8	161·3	163·4	164·9	163·7	161·1	161·1	162·1
F Random	I	160·4	159·5	159·3	164·1	157·1	159·2	160·3	160·4	161·1	160·0	160·2	163·7	159·4	159·9	159·0	159·3
	II	162·5	161·3	164·9	163·4	162·6	160·1	163·4	164·4	161·8	160·8	164·0	163·9	160·3	159·4	164·6	165·6
P Systematic	I	219·8	218·4	223·3	216·8	220·1	221·2	218·0	219·0	222·4	220·8	224·9	221·0	221·4	222·4	217·9	219·5
	II	221·4	221·7	221·8	223·5	221·2	222·6	220·1	219·6	218·8	219·3	220·2	219·3	219·9	221·4	220·2	219·1
P Random	I	222·7	219·8	219·6	215·6	216·8	221·3	219·3	221·5	222·7	223·3	222·3	220·1	219·9	222·6	219·3	220·2
	II	220·8	224·1	222·4	221·5	220·6	223·8	218·5	220·2	220·8	220·7	219·8	217·1	217·6	222·5	218·4	221·5

Table X

Fabric Section	Warp Sections			Weft Sections		
	Grand Mean A–H	Standard Deviation of Group Means		Grand Mean A–H	Standard Deviation of Group Means	
		Systematic	Random		Systematic	Random
E I	170·73	1·666	2·126	172·30	1·663	2·263
E II	171·66	2·714	1·979	170·09	2·086	2·052
F I	160·03	2·060	1·837	160·30	2·330	1·412
F II	162·81	1·484	1·473	162·54	1·296	2·123
P I	219·57	1·895	2·238	221·28	1·953	1·469
P II	221·50	1·173	1·762	219·79	0·781	1·806

Table XI
Analysis of Variance for Fabrics E, F, and P

Fabric	Source of Variance	Systematic arrangement (16-fold)			Random arrangement (16-fold)			Systematic arrangement (64-fold)			Random arrangement (64-fold)		
		Sum of Squares	Degrees of Freedom	Mean Variance	Sum of Squares	Degrees of Freedom	Mean Variance	Sum of Squares	Degrees of Freedom	Mean Variance	Sum of Squares	Degrees of Freedom	Mean Variance
E	Rows	3955·00	48	82·40	3955·00	48	82·40	2372·78	28	84·74	2372·78	28	84·74
	Columns	6086·00	48	126·79	6086·00	48	126·79	4486·78	28	160·24	4486·78	28	160·24
	Treatment ...	88·83	3	29·61	81·77	3	27·26	668·30	7	95·47	686·05	7	98·01
	Residual	7992·67	141	56·69	7999·73	141	56·74	11582·92	189	61·29	11565·17	189	61·19
	Total within blocks	18122·50	240	75·51	18122·50	240	75·51	19110·78	252	75·84	19110·78	252	75·84
	Between blocks ...	1517·73	15	101·18	1517·73	15	101·18	529·45	3	176·48	529·45	3	176·48
	Grand total ...	19640·23	255	77·02	19640·23	255	77·02	19640·23	255	77·02	19640·23	255	77·02
F	Rows	1991·31	48	41·49	1991·31	48	41·49	1417·45	28	50·62	1417·45	28	50·62
	Columns	7020·31	48	146·26	7020·31	48	146·26	5997·70	28	214·20	5997·70	28	214·20
	Treatments ...	296·26	3	98·75	39·45	3	13·15	454·93	7	64·99	434·12	7	62·02
	Residual	5995·18	141	42·52	6251·99	141	44·34	8994·75	189	47·59	9015·56	189	47·70
	Total within blocks	15303·06	240	63·76	15303·06	240	63·76	16864·83	252	66·92	16864·83	252	66·92
	Between blocks ...	2475·22	15	165·01	2475·22	15	165·01	913·45	3	304·48	913·45	3	304·48
	Grand total ...	17778·28	255	69·72	17778·28	255	69·72	17778·28	255	69·72	17778·28	255	69·72
P	Rows	4202·44	48	87·55	4202·44	48	87·55	2490·17	28	88·93	2490·17	28	88·93
	Columns	5321·94	48	110·87	5321·94	48	110·87	5991·67	28	213·99	5991·67	28	213·99
	Treatments ...	58·85	3	19·62	195·76	3	65·25	317·21	7	45·32	572·78	7	81·83
	Residual	6371·46	141	45·19	6234·55	141	44·22	9933·25	189	52·56	9677·68	189	51·20
	Total within blocks	15954·69	240	66·48	15954·69	240	66·48	18732·30	252	74·33	18732·30	252	74·33
	Between blocks ...	3164·99	15	211·00	3164·99	15	211·00	387·38	3	129·13	387·38	3	129·13
	Grand total ...	19119·68	255	74·98	19119·68	255	74·98	19119·68	255	74·98	19119·68	255	74·98

calculated in every case (for the three different fabrics, four and eight treatments, systematic and random selections), and it was found that even the most extreme differences between the variances of treatments and residuals could not be regarded as significant when this test was applied. Hence we are once more led to the conclusion that for these three fabrics we cannot regard the random arrangement as leading to any better result than the systematic.

In comparing the results of the random and systematic methods of selection we have confined our attention to periods repeating for four or eight specimens. It is of course possible that although there is no repeat with these numbers of specimens there may be with some other number such as 5, 6, or 7. The results could be utilised to test the occurrence of such periods by selecting a portion of the material for the purpose; thus, for a repeat with five specimens we could consider a 15-side square, which could be divided into nine five-side Latin squares, and comprise 225 observations out of the whole 256 available; with six specimens we could use four six-side Latin squares, utilising 144 values; with a repeat for every seven specimens we could use four seven-side Latin squares utilising 196 of the test results. However, from the irregular nature of the curves in Figs. 1 and 2 it is hardly likely that such periods actually occur. Instead of looking for the results of periodicities in this way we could of course analyse the original results across and along the warp to this end; unfortunately, a series of 16 results is far too small to be subjected to periodogram analysis.

IV—CONCLUSIONS

It seems legitimate from all the considerations that have been advanced above to conclude that the test-results of these three fabrics would not have been vitiated by making a systematic instead of a random selection of test-specimens; and further, that so far as my humidity-strength tests were concerned the test-results are not likely to have been seriously aberrant and that the conclusions drawn therefrom must stand. And from the general considerations advanced on pages T78–T80 it appears likely that the same is true for the other fabrics and materials which formed the subject of my tests.

I may add that quite apart from the question of sampling, we have certain other considerations to guide us when judging the reliability of the test-results. In the first place, we have the fact that the strength was determined at a number of different humidities for a number of different fabrics of each class. Now if the test-results had been vitiated by the occurrence of periodicity of strength in the fabric coinciding with the periodicity of the selection of the specimens, it is most unlikely that the relation between strength and humidity would be of a regular nature, not only in one fabric but also in a number of fabrics of the same type. It is true that a few irregularities were in fact found to exist in the strength-humidity curves, but seeing that, in all, 142 such curves were obtained, a certain amount of irregularity in some of these curves must be expected, however perfect the sampling. Another reason for the belief that the results and conclusions are substantially correct is that in the case of each of the unweathered fabrics two sets of specimens were tested under the same set of conditions and, except in four cases out of 56, the results for the two sets were well within the limits which might be expected from the values of the probable errors. It is hardly conceivable therefore that if periodicity had existed, both the first and the second set of specimens tested under the same conditions would have almost invariably given mean-strength results which were not significantly different from each other.

In all that has been said above it is not implied that the systematic method of selection can in any circumstances be regarded as theoretically superior to the random method of selection; and there can be no question but that the random selection is theoretically the more satisfactory, because it ensures that even if periodicity does occur in a fabric its effects are bound to be avoided. The only question is whether periodicity does in fact occur sufficiently often as to necessitate the taking of special precautions to avoid any disturbance that it might cause. My own belief, based on the reasons previously mentioned, is that the likelihood of such a disturbance is exceedingly small. For simplicity in marking out a fabric there is no doubt that the systematic method has the advantage; the chances of mistakes being made and overlooked in marking out by this method are certainly less than by the random method. It is on practical grounds that Engledow and Yule[11] prefer a systematic arrangement in certain agricultural field trials. But the same practical difficulties are not met with in marking out textile fabrics, and I accordingly conclude that, although it is possible to exaggerate the superiority of the random over the systematic method of selecting fabric test-specimens, yet, unless there are cogent practical reasons for adopting the systematic method, it is better to adopt the random method, and so "make assurance doubly sure."

My thanks are due to Mr. R. Krishna Iyer for his assistance in the considerable arithmetical labour required for this paper.

REFERENCES

[1] Tippett, L. H. C. J. Text. Inst., XXI, 1930, T116.
[2] Tippett, L. H. C. *Ibid.*, T119.
[3] Turner, A. J. J. Text. Inst., XIX, 1928, T112.
[4] Fisher, R. A. Statistical Methods for Research Workers, London, 1925.
[5] Fisher, R. A. *Ibid.*, Second Edition, 1928, 236.
[6] Turner, A. J. J. Text. Inst., XIX, 1928, T106, Table I.
[7] Turner, A. J. *Ibid.*, T108, Table II.
[8] Fisher, R. A. Statistical Methods for Research Workers, London, 1928, 235.
[9] Tippett, L. H. C. J. Text. Inst., XXI, 1930, T118.
[10] Fisher, R. A. Statistical Methods for Research Workers, London, 1925, First Edition, 195.
[11] Engledow, F. L. and Yule, G. U. Emp. Cott. Grow. Rev., III., 1926.

Technological Laboratory, Bombay
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6—MONTHLY WOOL GROWTH OF RAMBOUILLET EWES

By Robert H. Burns, M.S.

INTRODUCTION

The physiological phenomena of wool growth are directly related to the commercial utility of a fleece, for length of fleece is an important character in commercial grading of wool.

For many years the law of diminishing returns (i.e. wool attains two-thirds of its length during its first six months of growth, and the growth steadily diminishes from that point on), has been applied to wool growth, and accepted generally as an accurate statement of fact.

In a study of measurable fleece characteristics in a cross-breeding experiment at the Wyoming Experiment Station, it was observed that fleece characters, length, fineness, and density, were regular rather than spasmodic in their development, if environment and disease were regulated.

Keeping in mind the regularity of development in these fleece characters, it seemed a necessary and logical step to initiate a study of monthly wool growth in various types and breeds of sheep, in order to confirm or contest the idea that wool grows as much as two-thirds of its yearly length during the first six months after shearing.

Consequently, in the spring of 1926, a study of monthly wool growth was inaugurated and carried on for the following four years, using in each breed test six ewes of the following breeds—Rambouillet, Hampshire, Oxford, Corriedale, and Lincoln. All of the common types of wool were represented by these five breeds.

The writer, now studying animal breeding and wool research at Edinburgh University, wishes to express his appreciation for the opportunities and courtesies afforded by the Animal Breeding Research Department during the preparation of this paper. The writer wishes particularly to acknowledge the advice and encouragement extended by Professor F. A. E. Crew, Director of this Department.

REVIEW OF LITERATURE

Rohde, Stohmann, Heyne, Gartner, and Zorn all reported that the growth of wool was much greater during the first six months after shearing than in the succeeding six-month period. These writers' results would uphold the theory of diminishing returns, in that they reported practically no growth during the last two months of the yearly growth, and around two-thirds of its yearly growth attained during the first six months after shearing.

Nordmeyer, in a wool growth experiment with mutton merinos, reported a more or less uniform growth throughout the year, with slightly more growth during those months when green feed was available, and less growth when the ewes were suckling lambs.

Hardy and Tennyson, who studied the influence of wool growth upon wool fineness, gave an illustration of a "tied" lock, showing proportionate monthly growths of wool, but no data were given. From a visual inspection of the "actual size" illustration it would appear that the monthly wool growth was more or less uniform throughout the year.

A recent publication by Hackedorn and Sotola gives the monthly wool growth in Rambouillet ewes and wethers. In these results there was no marked difference in monthly wool growth between wethers whose wool was allowed to grow for four years and in those which were shorn every twelve months.

A wether's fleece of 48 months' growth weighed 62 lb. and attained a length of 10 in. There was no difference in winter and summer wool growth, and the last 12 months' wool growth was just as long as that of any previous twelve months.

EXPERIMENTAL PROCEDURE

Animals Used

Five or six ewes were used in each test, the number depending on mortality and sales. No substitutions were made during the year, but each spring at shearing time young ewes were added so as to have as many ages represented as possible, and to have as near as possible six ewes for each breed in the test.

An inspection of the ear tag numbers of the individual sheep will show the distribution of ages once one is acquainted with the system of numbering. All lambs born in 1921 were numbered from 100 to 199; all those born in 1922 were numbered from 200 to 299; and so on up to 1930, when the lambs were numbered from 0 to 99. In this system an animal with the same number appears once in ten years, but as sheep rarely are kept in the flock for that length of time, this system of numbering is quite simple and practical and is widely used.

The ewes in this experiment were run with the rest of the Rambouillet ewes of the Wyoming Experiment Station flock. This experiment station is located at an elevation of 7,200 ft. and has little pasture land. Consequently the sheep are kept under shelter the greater part of the year, and are fed on alfalfa hay, a grain mixture consisting of barley, oats, and bran, and occasionally some sunflower silage or cabbage.

During the summer months they are turned out during the day on pasture and obtain some green feed, but are returned to the sheep barn in the evening. Some seasons they are fed on green oats as a "soiling crop" during the summer months.

EXPERIMENTAL PROCEDURE

Sampling Methods

The right mid-shoulder area was chosen as the area on which the wool growth studies would be conducted. Three methods of sampling were tried out—

(1) Length of staple on the sheep.
(2) Growth clippings of each month's growth.
(3) Individual staples tied each month and the distance between "ties" measured.

DESCRIPTION OF SAMPLING METHODS

(1) The fleece was parted in the mid-shoulder region and a steel rule inserted with the zero point resting on the surface of the skin. The fleece was then allowed to fall back on the rule, and an average reading of the length of staple in the fleece recorded. Each month this procedure was followed, and the difference between staple lengths represented the growth during the intervening time.

(2) At the beginning of the test a small area of about 2 sq. in. in extent was clipped close to the skin. This area was located in the mid-shoulder region. In order to clip the wool fibres off as close to the skin as possible, a special type of shears were obtained. These were surgeon's shears (8 in. size) with blades angled at 30° on the flat. By pulling the wool fibres up tightly against the blades of the shears, the fibres were cut as close to the skin as would be the case had the area been shaved.

Each month a growth clipping sample was taken from the middle of the area, and the remaining portion of the small area was cleared so that no long fibres could be accidentally included in the following month's growth clipping.

(3) At the beginning of the test a small staple the size of one's little finger was selected and tied with dental floss (similar to surgeon's silk ligature) using a surgeon's knot to counteract any tendency of the knot to slip. The loose ends of the floss were clipped off close to the knot, so that these ends would not catch and pull the "tie" off the staple. Each month a "tie" was made on the same staple, as close to the skin as possible, and at the end of the year's growth each month's growth was plainly marked by the ties.

METHODS OF MEASUREMENT

Staple length on the sheep and the growth as represented by the distance between the "ties" were measured directly by the use of a steel rule graduated in tenths of an inch.

The small sample of monthly growth clippings, when laid out, naturally arranged itself in the form of a thin "sheaf," and as both the proximal and distal ends were cut off at the surface of the skin, the sample would be in the shape of a parallelogram, and a measurement of the average length of the growth clipping was easily taken to the nearest tenth of an inch. In all cases two readings out of three taken were identical, and in over 90% of the cases all three readings were identical.

It was thought advisable to analyse the length of the individual fibres when stretched taut, so as to know whether it would be best to get a frequency table of length of a number of fibres making up a staple or growth clipping "sheaf" or take the average measurement on the entire staple or clipping "sheaf" as one unit.

The old method of clamping each fibre in the jaws of a testing apparatus was thought to be entirely too tedious and slow, and an attempt was made to devise a simpler and faster method.

The following method of measuring individual stretched fibre length has been worked out—

A NEW METHOD OF MEASURING STRETCHED (TAUT) FIBRE LENGTH

A black chenille rug swatch (12 × 18 in. in size), with a deep "pile" (1 in. deep), and a pair of cork or rubber-tipped tweezers, make up the equipment used in this simple method. The deep "pile" of the chenille rug partially holds the individual wool fibres when they are pressed down into it. A steel rule, graduated in tenths of an inch, is laid on the rug in front of the fibre which has been pressed down into the "pile" of the rug. The end of the fibre on the right-hand side is grasped near its end by the cork-tipped tweezers, and the thumb nail of the left hand is placed over the fibre so that the thumb nail is even with the zero point on the rule. Thus when the fibre is drawn taut it pulls along under the thumb nail, but only very gradually as it is gently held by the deep "pile" of the rug in which it is embedded. The tip of the tweezers makes a good pointer, and as the unattached end of the fibre slips out from under the thumb nail, the tension on the fibre as held by the "pile" of the rug is sufficient, so that there is no tendency for the tip of the tweezers to "jump," and an accurate length reading can be made.

The whole "set-up" is shown in illustration Fig. 1. Either 25 or 50 fibres were measured for stretched length, according to the length of the fibres. The growth clippings were much shorter and showed less variation

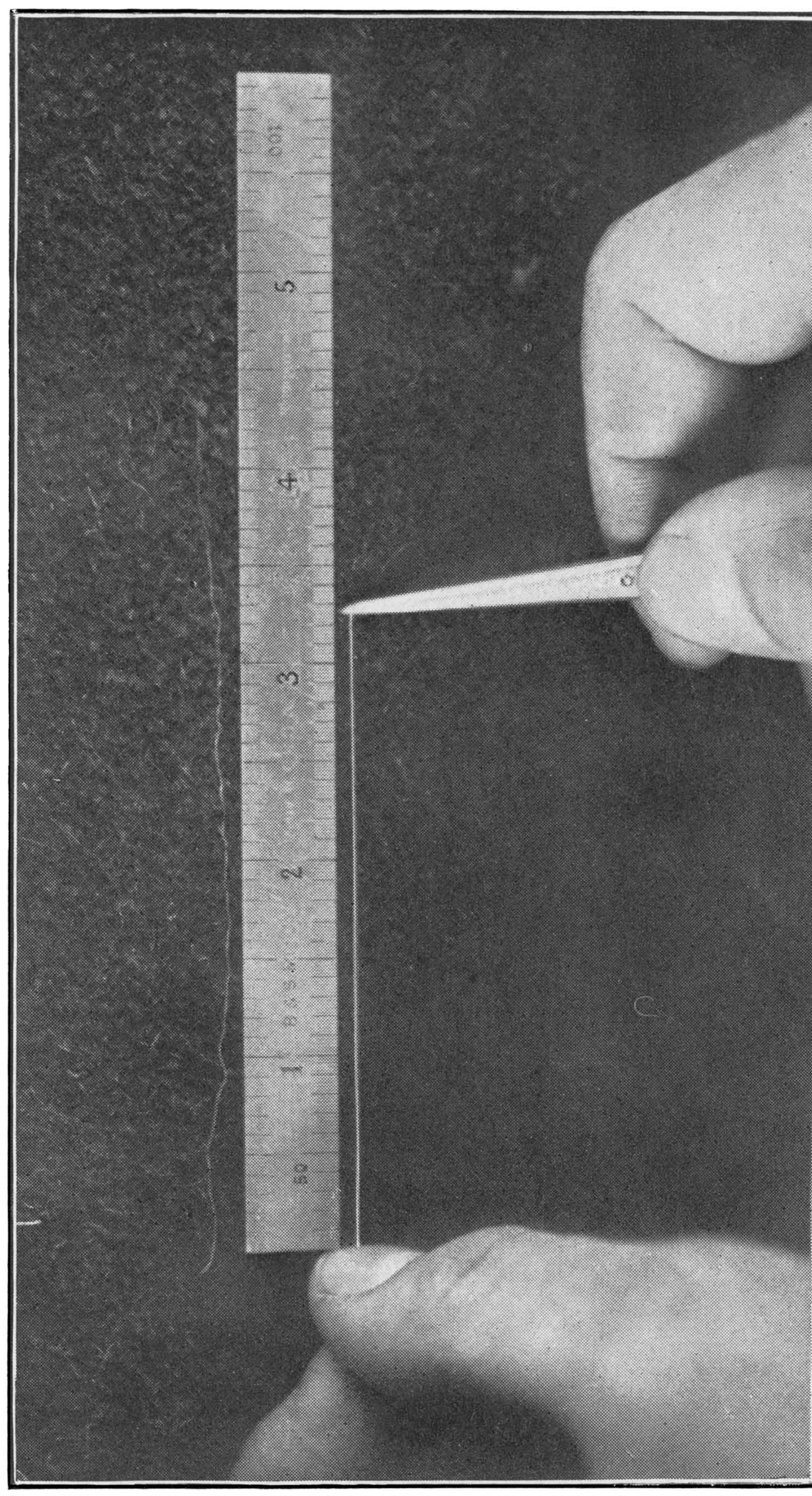


Fig. 1

than the staple samples, and hence 25 fibres were measured from the former and 50 fibres from the latter.

A test was made to find out how many fibres should be measured out of a staple to ensure reasonable accuracy. Six samples were used from the following breeds—F_1 Crossbred (Hampshire × Rambouillet), Rambouillet, Lincoln, Corriedale, Oxford, and Hampshire. All samples were from the 1925 fleeces, which were a full 12 months growth. One hundred fibres were measured for stretched (taut) length from each sample, using the chenille rug method previously described. The measurements were taken to the nearest tenth of an inch, and grouped in units with five fibres in each unit.

Number of Fibres to be Measured to Determine Stretched (Taut) Fibre Length
Length of Stretched (Taut) Fibre in Inches

Number of Fibres Measured	F_1 Crossbred (Hampshire × Rambouillet)		Rambouillet		Lincoln		Corriedale		Oxford		Hampshire		All Six Samples	
	Mean length	Variation from 100	Mean length	Variation from 100	Mean length	Variation from 100	Mean length	Variation from 100	Mean length	Variation from 100	Mean length	Variation from 100	Mean length	Variation from 100
5	4·70	·49	3·46	·05	6·54	·11	3·50	·15	6·66	·14	4·04	·23	4·82	·20
10	4·64	·43	3·47	·06	6·57	·14	3·45	·10	6·89	·37	4·11	·30	4·86	·24
15	4·51	·30	3·47	·06	6·65	·22	3·41	·06	6·95	·43	4·08	·27	4·85	·23
20	4·38	·17	3·48	·07	6·69	·26	3·39	·04	6·85	·33	4·06	·25	4·81	·19
25	4·31	·10	3·47	·06	6·74	·31	3·40	·05	6·80	·28	4·05	·24	4·80	·18
30	4·25	·04	3·45	·04	6·83	·40	3·38	·03	6·67	·15	4·00	·19	4·76	·14
35	4·23	·02	3·45	·04	6·75	·32	3·36	·01	6·68	·16	3·98	·17	4·74	·12
40	4·19	·02	3·44	·03	6·74	·31	3·41	·06	6·65	·13	3·96	·15	4·73	·11
45	4·19	·02	3·44	·03	6·75	·32	3·39	·04	6·62	·10	3·91	·10	4·72	·10
50	4·20	·01	3·44	·03	6·71	·28	3·37	·02	6·59	·07	3·93	·12	4·71	·09
55	4·18	·03	3·42	·01	6·68	·25	3·39	·04	6·55	·03	3·89	·08	4·69	·07
60	4·18	·03	3·40	·01	6·63	·20	3·38	·03	6·55	·03	3·89	·08	4·67	·05
65	4·17	·04	3·39	·02	6·53	·10	3·36	·01	6·59	·07	3·87	·06	4·65	·03
70	4·17	·04	3·40	·01	6·54	·11	3·37	·02	6·59	·07	3·86	·05	4·66	·04
75	4·20	·01	3·40	·01	6·55	·12	3·36	·01	6·61	·09	3·86	·05	4·66	·04
80	4·20	·01	3·39	·02	6·50	·07	3·36	·01	6·57	·05	3·86	·05	4·65	·03
85	4·23	·02	3·41	none	6·48	·05	3·35	none	6·55	·03	3·84	·03	4·64	·02
90	4·22	·01	3·41	none	6·43	none	3·35	none	6·53	·01	3·82	·01	4·63	·01
95	4·21	none	3·42	·01	6·45	·02	3·36	·01	6·52	none	3·83	·02	4·63	·01
100	4·21	—	3·41	—	6·43	—	3·35	—	6·52	—	3·81	—	4·62	—
Error of mean of 100	·032	—	·017	—	·066	—	·020	—	·046	—	·035	—	·040	—
3 Times prob. error	—	·096	—	·051	—	·198	—	·060	—	·138	—	·105	—	·120

When comparing the variation of differences from the mean of the entire 100 fibres, it will be noted that in some samples the measurement of 35 fibres was sufficient, while in others as many as 60 fibres should be measured before the difference was less than three times the probable error of the mean length of 100 fibres. The point of accuracy in all the samples seemed to be when around 50 fibres had been measured, so this number was chosen as a standard number of fibres to be measured from each sample.

EXPERIMENTAL PROCEDURE

Comparison of Sampling Methods

"Tied" Staple Method Compared with Growth Clipping Method—It was found impossible, in spite of all precautions, to keep the "ties" on the staples during the first two months after shearing, for all "ties" made in this period were lost. After that period of time was past the "ties" held, with a few

exceptions, and the resulting growth figures agreed closely with those obtained with monthly growth clippings from the same animals.

However, because of the loss of the first two or three "ties" made after shearing, and the strong possibility of later "ties" slipping, the "tie" method was discarded as not comparable to the growth clipping method in accuracy, as one method is positive and the other doubtful in the results obtained.

COMPARISON OF SAMPLING METHODS

Average Staple Length Difference Method, compared with Average Growth Clipping Length Method—In 161 growth determinations with individuals from four different breeds (Rambouillet, Oxford, Hampshire, and Corriedale), the following frequency distribution of monthly wool growth was obtained—

Twelve Months Period of Growth, April 1926 to April 1927
Frequency Distribution

Monthly Growth in tenths of an inch	Staple Length Difference Method					Growth Clipping Length Method Average Length of "Sheaf"				
	Breeds*				All four breeds	Breeds*				All four breeds
	R	O	H	C		R	O	H	C	
Loss	1	0	2	7	10	0	0	0	0	0
0	7	5	5	0	17	0	0	0	0	0
1	10	8	5	2	25	0	0	0	0	0
2	12	7	9	4	32	32	1	12	7	52
3	11	4	2	5	22	15	15	16	11	57
4	7	7	7	2	23	4	10	8	7	29
5	1	4	2	5	12	3	10	3	2	18
6	0	3	3	0	6	0	4	0	0	4
7	3	1	0	0	4	0	0	0	1	1
8	1	1	1	2	5	0	0	0	0	0
9	1	0	1	0	2	0	0	0	0	0
10	0	0	0	1	1	0	0	0	0	0
11	0	0	2	0	2	0	0	0	0	0
Total	54	40	39	28	161	54	40	39	28	161
Mean length ...	·256	·288	·318	·300	·286	·259	·403	·305	·329	·318
†P. E. of mean ...	·019	·022	·031	·034	·128	·008	·011	·010	·014	·060
Coef. of Variability ...	81	73	91	88	84	33	26	30	34	35
‡P. E. of Coef. of Variability ...	8	8	11	13	5	2	2	2	3	1

* Breeds— R=Rambouillet; O=Oxford; H=Hampshire; C=Corriedale.
† P. E.=Probable error.
‡ Coef. of Variability=Coefficient of Variability or per cent. Standard Deviation.

It will be noticed that the staple length method recorded 27 cases or 16·75% of the total with a loss or no growth, a fact which in itself was enough to condemn the method. However, the extreme variability of 84% as compared with 35% is the final convincing argument of the futility of using the staple length difference method.

At no time during the test was there any similarity between measurements by the two methods of sampling, and the violent fluctuations of the figures obtained by the staple length difference method did not show any regularity in their occurrence. The inter-relationship of breeds is interesting. As would be expected, the breeds with longer wool gave the greatest error in the average growth by staple length difference method. However, the tendency was practically the same in all breeds, and the futility of using staple length differences for ascertaining wool growth is quite apparent.

COMPARISON OF MEASUREMENT METHODS

Stretched (Taut) Fibre Length of Staple compared with Average Length of the Growth Clippings—In this test an area of some four or five square inches in extent was cleared, and a staple of wool taken from this area at the end of each month of growth. It was hoped that by the use of this method of sampling a cumulative "stair-step" perspective of wool growth could be obtained. As the experience with using average staple length differences for growth determination had given extremely unreliable results, the measuring of average staple length was discarded, and a measurement of 50 individaul stretched (taut) fibres was substituted.

The results of 86 growth determinations with three breeds (Corriedale, Hampshire, and Rambouillet) over a period of six months in the 1928–29 growth test gave the following frequency distribution.

Frequency Distribution

Monthly Growth in tenths of an inch	Staple Length Method. Mean stretched fibre length of 50 fibres				Growth Clipping Method. Average Length of "Sheaf"			
	Breeds*			All three breeds	Breeds*			All three breeds
	C	H	R		C	H	R	
Loss	0	0	2	2	0	0	0	0
0	0	0	0	0	0	0	0	0
1	2	0	3	5	0	0	0	0
2	4	4	6	14	12	4	28	44
3	6	2	5	13	12	9	3	24
4	6	5	6	17	6	6	3	15
5	6	3	6	15	1	2	0	3
6	3	5	4	12	0	0	0	0
7	4	1	2	7	0	0	0	0
8	0	1	0	1	0	0	0	0
Total	31	21	34	86	31	21	34	86
Mean length	·413	·448	·359	·400	·287	·329	·226	·273
P. E. of mean ...	·021	·025	·022	·013	·010	·013	·007	·006
Coef. of Variability ...	42	38	54	46	29	26	27	32
P. E. of Coef. of Variability ...	4	4	6	3	3	3	2	2

*Breeds—C=Corriedale; H=Hampshire; R=Rambouillet.

Again the extreme variation of the length of stretched (taut) fibres in the staple makes itself evident, and although the stretched fibre length gave better results than the staple length difference, still it was not as accurate and uniform as the average length of clipping ("sheaf.") Either by inspection of the distribution data or by comparison of the coefficients of variability, the marked superiority of the average length of the clipping method of measurement is apparent.

Stretched (Taut) Fibre Length of Growth Clippings compared with Average Length of Growth Clippings—Only the growth clipping method has stood out as most reliable in the series of tests thus far reported. It was thought advisable to compare the two methods of measuring the growth clippings.

In 258 growth determinations with four breeds (Corriedale, Hampshire, Rambouillet, and Lincoln), over a period of 14 months from March 1929, to May 1930, the following frequency distribution was obtained—

Frequency Distribution

Monthly Growth in tenths of an inch	Growth Clipping Method. Average Length of "Sheaf"					Growth Clipping Method. Mean Stretched Fibre Length of 25 Fibres				
	Breeds*				All four breeds	Breeds*				All four breeds
	C	H	R	L		C	H	R	L	
2	7	7	19	0	33	0	3	16	0	19
3	20	24	43	1	88	13	22	42	0	77
4	24	30	4	2	60	31	31	5	3	70
5	16	4	1	13	34	21	8	1	20	50
6	1	0	0	13	14	3	0	1	11	15
7	0	0	0	13	13	0	1	1	7	9
8	0	0	0	7	7	0	0	1	7	8
9	0	0	0	5	5	0	0	0	7	7
10	0	0	0	2	2	0	0	0	2	2
11	0	0	0	0	0	0	0	0	1	1
12	0	0	0	2	2	0	0	0	0	0
Total	68	65	67	58	258	68	65	67	58	258
Mean growth length ...	·376	·348	·281	·612	·411	·421	·374	·304	·650	·430
P. E. of length	·008	·006	·005	·016	·008	·006	·007	·009	·016	·007
Coefficient of Variability ...	26	22	21	27	44	19	22	35	27	40
P. E. of Coefficient Variability	2	1	1	2	2	1	1	2	1	1

*Breeds—C=Corriedale; H=Hampshire; R=Rambouillet; L=Lincoln.

As would be expected, the stretched fibre method gave a slightly larger figure than average length of "sheaf."

COMPARISON OF MEASUREMENT METHODS

The difference between the two systems of measuring growth clippings was so small as to be negligible. In fact the difference ·19 was smaller than three times the probable error of the mean (·21). The coefficients of variability were also quite close together, and here again the difference was practically the same as the probable error. The tendencies were the same in all four breeds under test.

Thus no particular advantage was gained by measuring individual stretched (taut) fibre lengths of a growth clipping "sheaf" rather than taking an average measurement of the "sheaf" as a whole.

In view of the results of all the tests concerning methods of sampling and measurement, the average length of the growth clipping "sheaf" was used throughout the wool growth studies reported in this paper.

As later results will show, the stimulation of the skin by the shears when taking the growth clipping sample, and clearing the area, was not a factor, and physiologists have confirmed this fact in conversations with the writer.

During the first few months after shearing, there was a stimulation of wool growth.

EXPERIMENTAL RESULTS

A frequency distribution of the data given on page T106 gives the following table—

Monthly Growth in tenths of an inch	Frequency	
1	1	Mean —·25
2	133	P. E. of Mean—·003
3	95	
4	8	
5	3	
Total	240	

Maximum Variation in Monthly Wool Growth Same Ewe; Same Month; Different Years

Sampled	Readings in Tenths of an Inch												No. Months in Test	Total Varia-tion	No.	Avg. Varia-tion
	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.				
Ear Tag Number																
116	1	1	3	2	1	1	0	1	1	1	0	1	33	13	12	1·08
379	0	0	2	1	0	1	1	0	0	1	1	1	43	8	12	·67
447	1	1	2	2	0	1	0	0	1	0	0	1	24	9	12	·75
454	0	0	1	1	0	1	2	1	1	1	1	0	31	9	12	·75
526	0	1	1	1	1	0	1	1	1	0	0	1	31	8	12	·67
703	0	1	1	0	1	1	1	1	1	1	1	–	23	9	11	·82

The average maximum variation of growth in the same ewe during the same month in different years varied from ·067 of an inch to ·108 of an inch, showing a strong tendency for the same individuals to grow wool uniformly throughout a period of 43 months.

WOOL GROWTH BY SEASONS

Two hundred and forty determinations from the Rambouillet growth clipping samples, over the four-year period, gave the following table of growth by seasons—

Season	Actual Wool Growth in inches	Per cent. of Yearly Growth
Spring—March, April, and May	·74	25
Summer—June, July, and August	·79	27
Fall—September, October, and November ...	·74	25
Winter—December, January, and February ...	·70	23
Total growth for the year	2·97	100

The above table shows a remarkable uniformity of growth throughout the four seasons of the year. As would be expected, Fall, Winter, and Spring, those seasons when feed was not so good, and when nourishing the unborn and later the suckling lamb, gave less growth than during the summer months when green feed was available. Thus do the wool growth determinations co-ordinate as would be expected with the physiological and environmental conditions, favourable circumstances increasing, and those which are unfavourable retarding wool growth.

In order to compare these wool growth figures with those reported by a number of investigators in Germany, an arrangement has been made of

Monthly Wool Growth of Rambouillet Ewes 1926-1930. Average Length (Three Readings) of Clipping "Sheaf" in Tenths of an Inch ‡Averages and Variation Figures in Hundredths of an Inch. Right Mid-shoulder Area

Year	1926 to 1927					1927 to 1928					1928 to 1929						1929 to 1930						Total	Number	Avg. Mo. Grwth	Variation*
Ear Tag Number	116	356	379	446	447	116	379	447	454	526	116	379	454	526	618	703	379	454	526	611	703	847				
Sampled May ...	3	4	2	2	3	2	2	2	2	3	2	2	2	3	3	3	2	2	3	3	3	3	56	22	25	none
June ...	3	3	2	2	3	2	2	2	2	3	2	2	2	2	2	2	2	2	2	3	3	2	50	22	23	—·02
July ...	5	5	4	5	4	3	3	2	3	3	2	2	2	2	2	3	3	3	3	3	3	3	67	22	30	+·05
August ...	3	2	2	3	4	3	2	2	2	3	1	2	2	2	2	3	3	3	3	4	3	3	57	22	26	+·01
September	2	3	2	3	2	3	2	2	3	3	2	2	3	2	3	2	2	3	3	4	3	2	56	22	25	none
October ...	2	2	3	2	3	3	2	2	3	3	2	2	2	3	3	2	3	3	3	4	3	3	58	22	26	+·01
November	2	2	2	2	2	2	2	2	2	3	2	2	2	2	2	2	3	4	3	3	3	2	51	22	23	—·02
December ...	2	2	2	2	2	3	2	2	3	3	2	2	2	2	sold	2	sold	sold	sold	2	3	3	41	18	23	—·02
January ...	2	2	2	2	2	3	2	3	3	3	2	2	2	2	–	2	–	–	–	3	3	2	42	18	23	—·02
February ...	3	2	3	3	2	2	2	2	3	2	died	2	2	2	–	2	–	–	–	2	3	3	40	17	24	—·01
March ...	3	2	2	2	2	3	3	2	3	2	–	2	2	2	–	2	–	–	–	3	3	3	41	17	24	—·01
April ...	2	2	2	2	3	3	2	2	3	3	–	–	–	–	–	–	3†	3	2	3	2	3	40	16	25	none
Total Growth ...	32	31	28	30	32	32	26	25	32	34	17	22	23	24	17	24	21	23	22	37	35	32	599	—	—	—
No. Months Growth ...	12	12	12	12	12	12	12	12	12	12	9	11	11	11	7	11	8	8	8	12	12	12	—	240	—	—
‡Avg.M'thly. Growth ...	27	26	23	25	27	27	22	21	27	28	19	20	21	22	24	22	26	29	28	31	29	27	—	—	25	—

*Variation of mean monthly growth by months from average monthly growth for the entire year.

†In 1929 to 1930 all areas were cleared one month sooner than in former years.

The maximum growth occurred in the month of July, while the minimum growth was found in June, November, and January. The difference between the maximum and minimum figures was ·07.

the data showing the wool growth for the first six months, and the following six months after shearing.

As before, there were 240 growth determinations over the period from 1926 to 1930—

	Actual Wool Growth in inches	Per cent. of Yearly Growth
First six months after shearing	1·55	52
Following six months	1·42	48
Total growth for the year	2·97	100

The remarkable uniformity of growth as shown in the four seasons of the year is also apparent when the data are arranged with two growth periods of equal duration from one shearing to the next shearing twelve months later.

THE EFFECT OF SHEARING ON WOOL GROWTH

It has always been a popular idea that wool grows more the first month or two after shearing than during later months. In order to see just how significant the differences would be, the data on five breeds have been arranged so that a comparison could be made of the first and second months independently against the remaining months of the year.

Comparison of First Month's Wool Growth after Shearing with subsequent Growth until the next Shearing

Average Length of Growth Clipping "Sheaf"

Frequency Distribution

Growth in tenths of an inch	First Month's Growth						Subsequent 11 Months' Growth					
	Breeds*					All breeds	Breeds*					All breeds
	L	C	O	H	R		L	C	O	H	R	
1	–	–	–	–	–	–	–	–	–	–	1	1
2	–	1	–	2	11	14	–	27	3	40	122	192
3	–	9	3	9	10	31	4	66	34	83	85	272
4	–	6	2	5	1	14	25	53	22	59	7	166
5	5	2	0	1	–	8	59	24	17	11	3	114
6	8	0	1	1	–	10	73	1	5	0	–	79
7	7	0	3	2	–	12	36	1	0	1	–	38
8	4	1	0	1	–	6	20	–	0	–	–	20
9	1	–	0	–	–	1	11	–	1	–	–	12
10	–	–	1	–	–	1	2	–	–	–	–	2
11	–	–	–	–	–	0	0	–	–	–	–	0
12	–	–	–	–	–	0	2	–	–	–	–	2
Total ...	25	19	10	21	22	97	232	172	82	194	218	898
Mean in inches ...	·652	·374	·540	·400	·255	·441	·603	·347	·390	·323	·249	·388
P. E. of Mean ...	·015	·019	·048	·024	·008	·136	·007	·005	·009	·004	·003	·004
3 Times error of Mean ...	–	–	–	–	–	·408	–	–	–	–	–	·012

*L=Lincoln; C=Corriedale; O=Oxford; H=Hampshire; R=Rambouillet.

The difference between the average growth the first month and the other eleven months shows a greater growth in the first month. The difference ·053 is over twelve times the probable error, and upholds the general idea that wool grows more the first month after shearing. The same tendency is noted in the different breeds.

A similar arrangement of data comparing the second month's growth with the other eleven months shows the second month's growth to be slightly greater, but the difference this time is only ·018, which is four times the probable error of the mean, a significant figure, but not nearly as conclusive a difference as in the first month's growth.

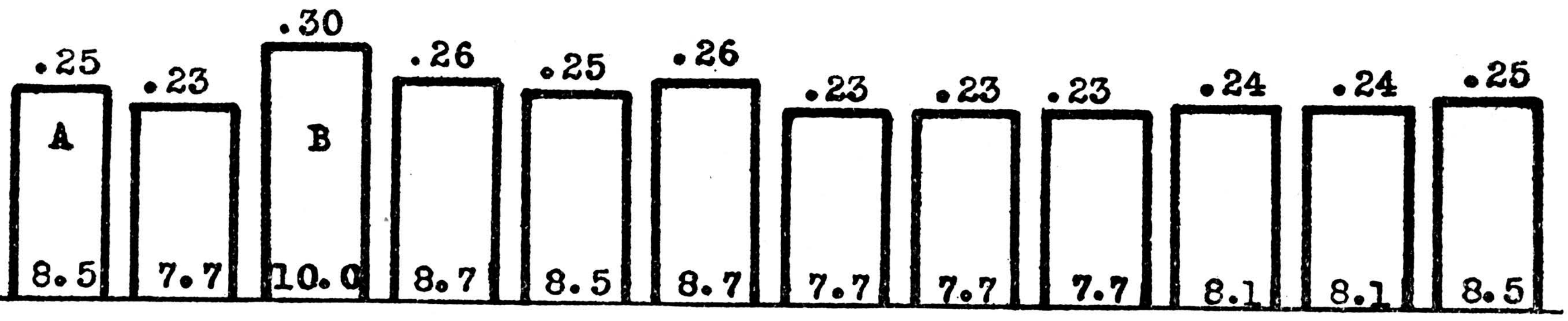
CONCLUSIONS

Rambouillet ewe wool grows more or less uniformly during the year, but is affected slightly during the winter, spring, and summer by the lambing season, and the abundance or lack of green food.

Monthly Wool Growth in Rambouillet Ewes. Growth in hundredths of an inch.
240 Monthly Growth Determinations.
4–6 Ewes, 1926–1930. Sheared on 27th April each year.

Figures on top of columns represent growth in hundredths of an inch.

Figures within columns represent each month's proportionate growth in per cent. of the total growth for the year.



A=First month after shearing. B=Green feed available.

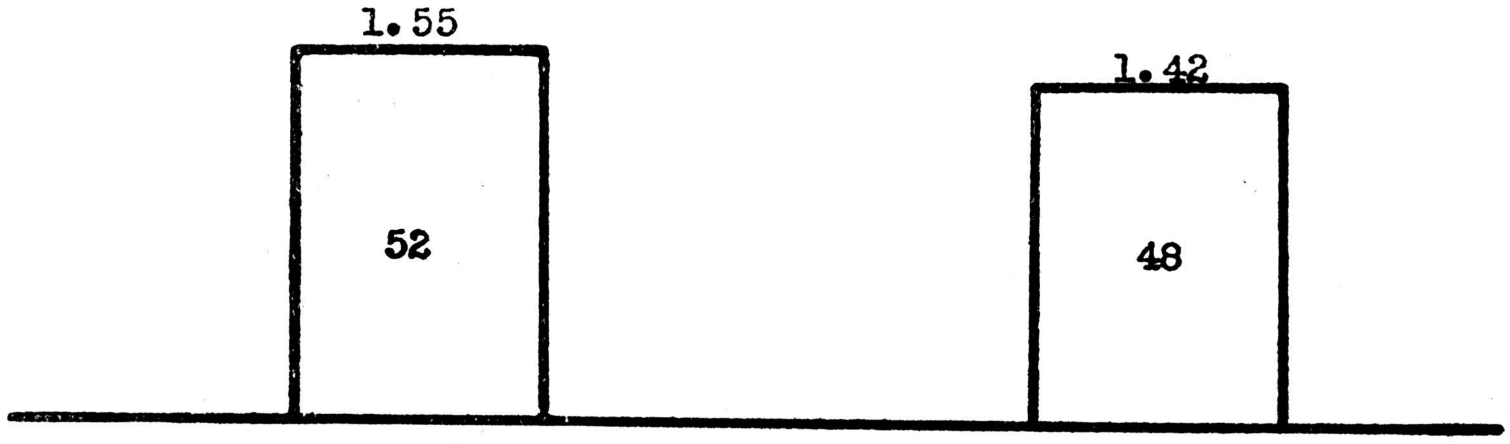
It will be noticed that the monthly wool growth was quite uniform throughout the year, the minimum and maximum monthly growth varying by only ·07 of an inch.

In July only was an abundance of green feed either in the form of green pasture or oat fodder available, and the effect on the wool growth was startling.

If these data are arranged in two periods of six months' growth, they give information which can be compared directly with those reported in the review of literature in this paper.

Comparison of Wool Growth in Rambouillet Ewes by Six-months' Periods, beginning from Shearing Time.

Figures on top of columns are total growth in inches.
Figures within columns are per cent. of yearly growth.



Total Wool Growth First Six Months After Shearing. Total Wool Growth Next Six Months Completing the Year.

The results in the wool growth test at the Wyoming Experiment Station are in direct opposition to those reported by Rohde, Stohmann, Heyene, Gartner, and Zorn, and in agreement with the results reported by Nordmeyer and Hackedorn and Sotola.

Although there was more growth during the first six months after shearing, it was nowhere so great as the differential of $\frac{2}{3}$ to $\frac{1}{3}$ reported by these investigators. The time of shearing would have no appreciable effect for taking place as it did in the spring (April) it included the large growth in July and October in the first six months of growth, thus raising the proportionate ratio of growth of the first six month's period to the following six month period, making up the year.

Physiologically it would seem logical for wool to grow more or less uniformly if nutrition and health are normal. Fluctuations in growth, due to nutrition and health and reproductive processes, occur according to the severity of these factors. However, the monthly growth inter-relationships seem to keep about the same, even though the yearly growth may be considerably less. Ewe No. 116 gives some interesting information on this point. She was getting old, and during the last year of her life she grew considerably less total length of wool, but the variation from month to month was in the same ratio as in other years, and in the same year for other individuals. This relationship is so evident that it can easily be seen by a mere inspection of the detailed table of data for all ewes in all four years.

SUMMARY

(1) Monthly growth clippings proved out the most accurate and practical method of sampling for wool growth.

(2) The average length of the growth clipping "sheaf" gave results which were so very close to those obtained by measuring 25 individual stretched (taut) fibre lengths that the extra labour in measuring the stretched fibre lengths was unwarranted.

(3) The monthly wool growth of Rambouillet ewes was remarkably uniform throughout the year, and in the four different years.

(4) Wool growth during the first six months after shearing was only slightly greater (52%) than during the following six months (48%).

LITERATURE

Gartner, R. Schafzucht; Stuttgart, 1924. Cit. Wollkunde; Frolich, Spottel und Tanzer, Seite 240; Julius Springer, Berlin, 1929.

Hackedorn, H. and Sotola, J. Studies of Wool Growth. Washington College Station Bulletin No. 237, pp. 19, 20, 1929. Cit. Experiment Station Record, Vol. 63, p. 263, 1930.

Hardy, J. I. and Tennyson, J. B. Wool Fineness as Influenced by Rate of Growth. Journal of Agricultural Research, Vol. 40, No. 5, pp. 457-467, 1st Mar. 1930.

Heyne, J. Grosses Handbuch der Schafzucht auf Neuzeitlicher Grundlage, Seite 507. Reichenbach, Leipzig, 1924.

Nordmeyer, H. Untersuchungen uber Entwicklung und Beschaffenheit der Wolle in der Merinofleischschafherde Dubrau Diss.; Berlin, 1927. Cit. Wollkunde; Frolich, Spottel und Tanzer, Seite 240; Julius Springer, Berlin, 1929.

Rohde, O. Beitrage zur Kenntnis des Wollhaares; Berlin, 1857. Cit. Wollkunde; Frolich, Spottel und Tanzer, Seite 240; Julius Springer, Berlin, 1929.

Stohmann, F. Biologische Studien; Braunschweig, 1873. Cit. Wollkunde; Frolich, Spottel und Tanzer, Seite 240; Julius Springer, Berlin, 1929.

Zorn. (Title not given.) Cit. Wollkunde; Frolich, Spottel und Tanzer, Seite 240; Julius Springer, Berlin, 1929.

7—THE IDENTIFICATION OF FUNGI CAUSING MILDEW IN COTTON GOODS

THE GENUS *ASPERGILLUS*—PART II

By George Smith, M.Sc., A.I.C.

In a previous communication[1] descriptions were given of a number of *Aspergilli* which had been isolated from cotton goods. A number of the species had been proved to be the causal agents in actual cases of mildew damage, whilst the remainder had been found as common spore infections of commercial yarns, and were regarded as possible or probable sources of trouble. Descriptions of a few forms which were still awaiting identification were omitted from that paper. These all belonged to two groups—the *A. glaucus* series, and a group intermediate between *A. glaucus* and *A. fumigatus*, having conidia of the type common in the *A. glaucus* series with all other parts of the fruiting organs more akin to *A. fumigatus*. It is proposed to designate this latter series the *Aspergillus penicilloides* group, since it includes *A. penicilloides* Spegazzini, and since most of the strains bear a strong resemblance to certain *Penicillia* of the Monoverticillate group (formerly *Citromyces*). During the last two years a considerable number of strains belonging to these two groups have been isolated from mildewed cloths and yarns. In addition, by courtesy of the B.C.I.R.A., a number of cultures isolated at the Shirley Institute have been added to the collection, and an analysis of the whole series is now offered.

A recent paper by Galloway[2] gives a list of the species of fungi in the B.C.I.R.A. collection, including representatives of all the great groups of *Aspergilli*, excepting only *A. clavatus*. Galloway includes two groups which he designates respectively the *A. glaucus/fumigatus* and the *A. fumigatus/nidulans* groups, but gives no description of either. Typical members of the two groups have been examined. A representative of the *A. glaucus/fumigatus* group was found to be identical with *A. restrictus* n. sp., described below, whilst the *A. fumigatus/nidulans* group also falls in what is here termed the *A. penicilloides* group, and the one strain it has been possible to examine is probably to be identified as *A. gracilis* Bainier. Galloway, in personal communication, states that his placing was based on the production of reduced sporing heads, and that neither two series of sterigmata nor perithecia, characteristic of *A. nidulans*, have been observed. Since reduced conidial heads are common in several other species besides *A. nidulans*, notably in *A. sydowi* and in *A. candidus*, such occurrence alone can hardly be regarded as a sufficiently typical character to justify the alliance with *A. nidulans*, whereas two series of sterigmata are invariably found in *A. nidulans*, even when the spore head is reduced to a form scarcely recognisable as an *Aspergillus*, and they form the chief mark of distinction between *A. fumigatus* and *A. nidulans*.

THE *ASPERGILLUS GLAUCUS* GROUP

With one possible exception, all the strains which have been studied produce ascopores of small dimensions, that is 6μ or less in long axis. Most of the forms have been identified without difficulty, but a few others appear to differ from all the species of which published descriptions are available. Mangin,[3] from a comparative study of 23 strains belonging to this group, recognised five species and one variety, of which three species produce small ascospores, namely, *A. repens* de Bary, *A. chevalieri* n. sp., and *A. amstelodami* n. sp. (all cited as *Eurotium* species in the original). Thom and Church[4] in the main endorse Mangin's classification, but recognise three additional species with ascospores less than 6μ in length—*A. ruber* (Spieckermann and Bremer), *A. sejunctus* Bainier and Sartory, and *A. scheelii* B. and S. Unfortunately they somewhat misquote Mangin in two instances. Regarding *A. repens,* they say, "In contrast to Mangin's restriction of the name to forms with ascospores 4·7 by 3·7μ, Sartory includes the whole series with ascospores from 4 to 5·6μ in long axis under the name." Mangin's diagnosis certainly gives the dimensions of the ascospores as 4·7 by 3·7μ, but he actually studied seven forms which he recognised as *A. repens* and, in his table of ascospore characteristics, gives the dimensions respectively as 4·7 by 3·7μ, 4·7 by 3·7 (5·6 by 4·1)μ, 4·7 by 3·7μ, 5·1 by 4·2μ, 4·7 by 3·7μ, 5·1 by 3·6μ, and 4·7 by 3·7 (4·4 by 3·6)μ. He also admits a certain amount of variation in the markings of the spores. The second instance of misquotation is in the description of *A. amstelodami* for which Thom and Church give "Colonies floccose, tardily green, glaucous or olive green, . . . Perithecia numerous, deeply surrounded by floccose mycelium; ascospores with furrow only, hyaline, smooth, 4·7 by 3·7μ," whereas Mangin's own diagnosis gives "Mycelium white, velvety (formant des gazons ras), slightly floccose at margins, becoming covered with conidiophores, small, crowded, greyish-green then glaucous, and finally olive green. Perithecia occurring amongst the conidiophores, small, numerous, sulphur yellow . . . . Ascospores lenticular, hyaline, small, with definite furrow, 4·7 by 3·7μ," and, in his table of ascospore characteristics, he gives "4·7 by 3·7μ, with clear furrow and rounded crests." In view of the diagnostic importance which Thom and Church attach to the presence or absence of crests or ridges bordering the furrow, it is of interest that Mangin's camera lucida drawings of the ascospores of his *A. amstelodami* (see Fig. 2) show crests quite as definite as those figured for two forms of *A. herbariorum.* Regarding the dimensions of the ascospores Mangin gives 4·7 by 3·7μ for both *A. amstelodami* and *A. chevalieri*, but then he examined only a single strain of each of these two species, and it is reasonable to suppose that, if he had studied a series of cultures from different sources, he would have found and recognised, in both species, variations such as he admitted for *A. repens* and *A. herbariorum.* In this connection Thom and Church state that "occasionally a culture is obtained with ascospores regularly and fairly persistently as small as those described for *A. amstelodami.* In many of the closely related strains, however, occasional ascospores of these particular dimensions are found among many somewhat larger . . . ." It seems to be essential to recognise that, throughout the *A. glaucus* series, the dimensions of the ascospores, though more constant than the dimensions of any other parts, may vary appreciably in any one species. Otherwise, in order to cover all the variations encountered, it becomes necessary to postulate a very large number of species and to separate obviously related forms.

For the present study 34 forms, belonging to this group, isolated from mildewed cloths and yarns, and eight forms received from the B.C.I.R.A. (in the following table given Galloway's numbers preceded by "S."), have been examined in comparative culture. They were grown on wort-agar at a temperature of 25° C. Slides were made and dimensions taken of the conidial apparatus as soon as there was abundant production of conidiophores, and of the ascospores as soon as the perithecia were fully matured. The times taken for the ascospores to ripen varied considerably, from seven to ten days for some forms to six weeks or more for others. All microscopic mounts were made in lacto-phenol. The dimensions and markings of the ascospores are given in the following table—

Table of Ascospore Characteristics

Smooth, without crests, ridges, or furrow		With smooth, shallow furrow. No crests	
Sp. No.	Dimensions μ	Sp. No.	Dimensions μ
A. 13	4·5–5·0 × 3·5–4·0	A. 4	6·0 × 4·5
C. 6	4·7 × 3·7	A. 6	6·0 × 3·7–4·6
C. 11	4·7 × 3·7	A. 23	6·0 × 4·5
C. 12	4·7–5·0 × 3·5–4·0	C. 120	6·0 × 4·2–4·5
C. 13	4·7 × 3·7	C. 130	6·0 × 4·0–4·5
C. 14	4·7–5·1 × 3·7–4·0	C. 140	6·0 × 4·0–4·6
G. 3	4·7 × 3·7	C. 160	6·0 × 4·4
G. 7	5·0 × 3·7–4·0	G. 11	6·0 × 4·0–4·5
G. 13	4·7–5·0 × 3·7–4·0	S. 23	6·0 × 4·0–4·2
G. 16	4·7–5·2 × 3·5–4·0	S. 55	6·0 × 4·2–4·5
C. 5	5·0 × 3·7–4·0		
S. 1	5·0–5·2 × 3·7–4·0		
S. 120	5·1 × 4·0		
S. 129	5·0 × 3·8–4·0		

With furrow and with small rounded crests		With deep furrow and well-marked crests	
Sp. No.	Dimensions μ	Sp. No.	Dimensions μ
A. 75	5·0–5·5 × 4·2	A. 50	4·7 × 3·3
G. 2	5·0–5·5 × 4·0	A. 97	4·7–5·0 × 3·2–3·5
G. 5	5·3–6·0 × 4·0–4·2	G. 1	4·7–5·2 × 3·3–4·0
G. 6	5·0–5·5 × 4·0–4·5	G. 8	5·0 × 3·3–3·7
G. 10	5·0–5·5 × 3·5–4·0	G. 9	5·0–5·2 × 3·5–3·7
G. 12	5·0–5·5 × 4·0–4·2	G. 14	5·0–5·2 × 3·5–4·0
G. 15	4·7–5·2 × 3·5–4·0	S. 89	4·7 × 3·3
G. 17	5·2–5·6 × 4·0	S. 106	5·0 × 3·5
S. 81	5·0–5·5 × 3·8–4·2		
S. 78	5·5–6·2 × 4·5		

The table has been divided into four sections, based on the shape of the ascospores. The different groups are, however, equally well characterised by general appearance of colonies.

Group I—The ascospores varied somewhat in dimensions. In a few strains the spores were remarkably uniform in size, whilst in others there was appreciable variation, but in all cases the spores were quite smooth, without a trace of furrow or crests. In general aspect the colonies of all forms showed an intimate mixture of dirty green conidiophores and yellow to brownish-yellow, with margins floccose or stoloniferous and reverse and medium dark brownish-red. They are all, therefore, regarded as *A. repens* (Corda) Saccardo, of which a sufficiently detailed description has already been given.[1]

Group II—The ascospores of all the forms were very similar in shape and dimensions. In all cases the colonies showed an intense red colour on the surface, due to heavy incrustations of pigment on the hyphæ, and a red to

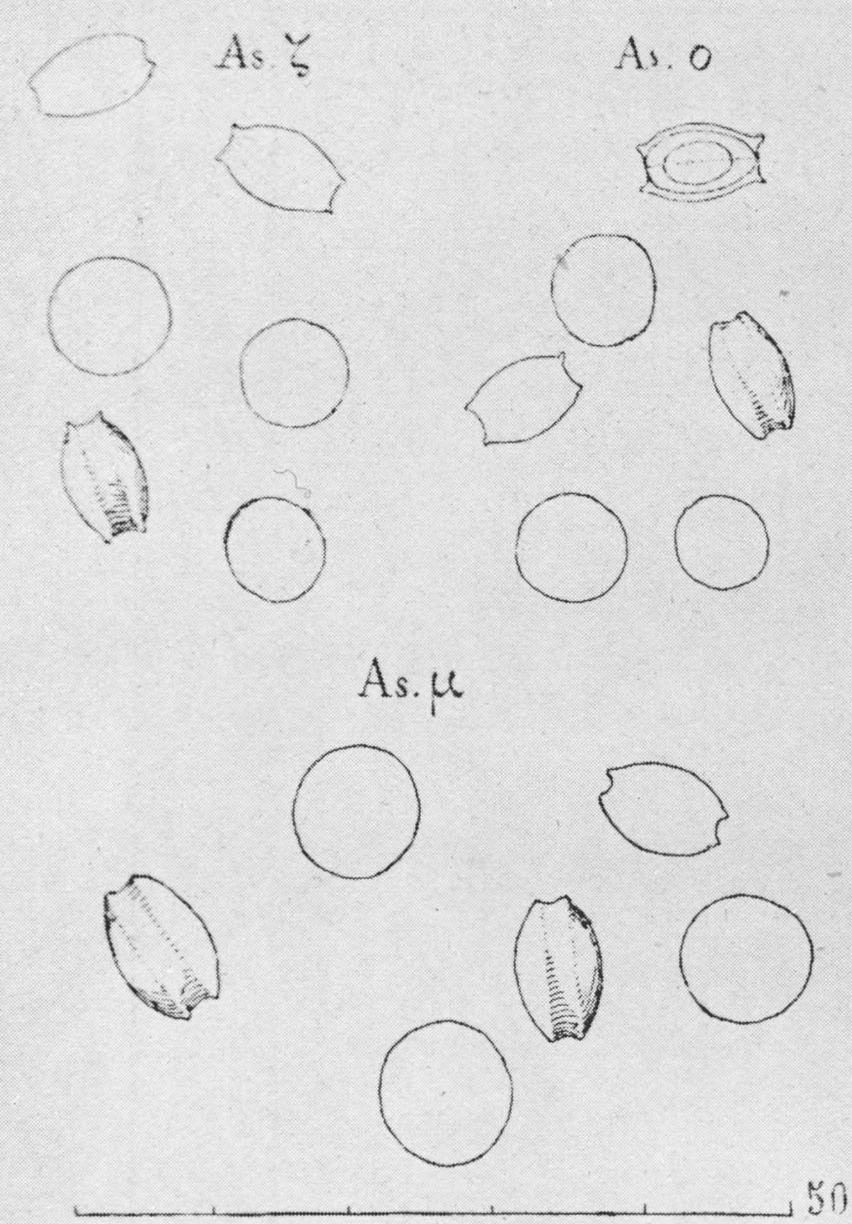


Fig. 8. — Ascospores de diverses formes. *As.* ζ et *As.* ο de dimensions 7 μ 6 × 5 μ 7, vues de face et de profil. *As.* μ, dimensions 9,4 × 6,6. L'une des formes *As.* ο montre la coupe optique d'une ascospore avec la ligne pointillée de moindre résistance.

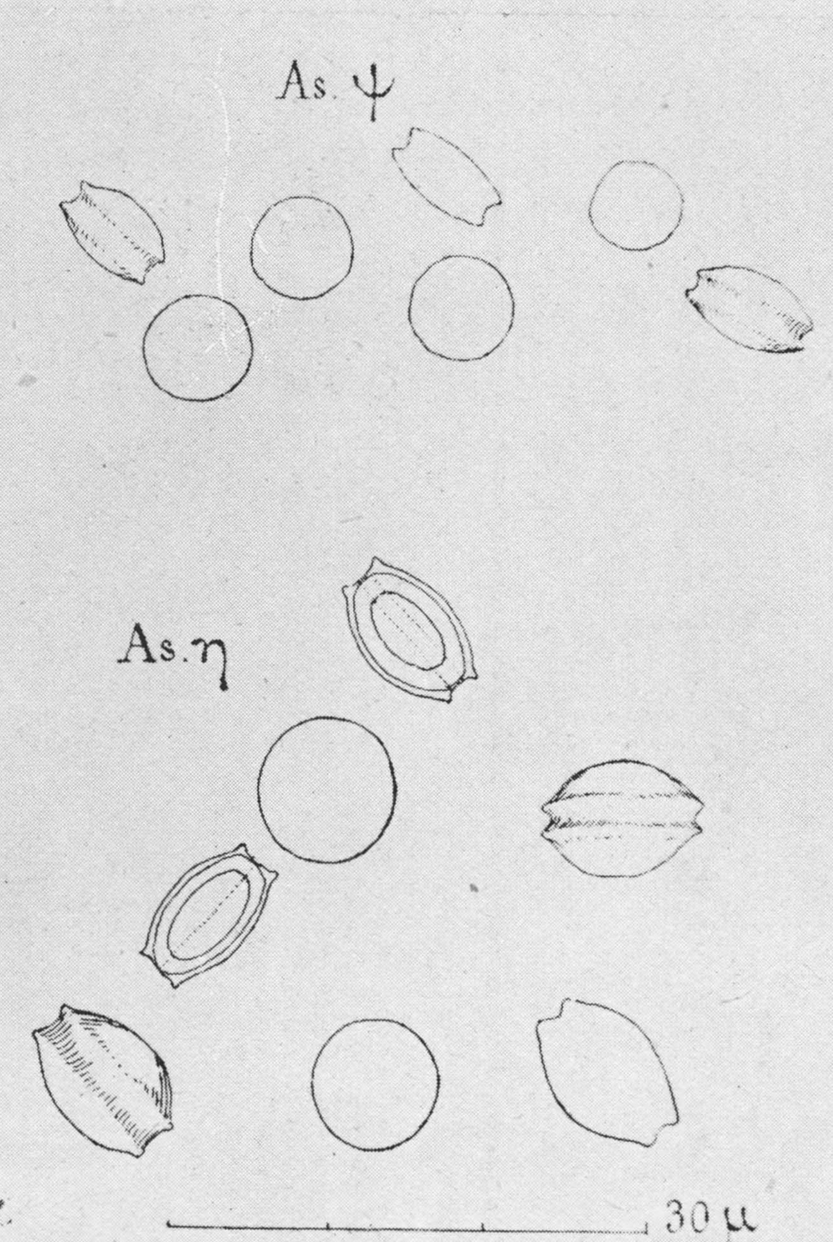


Fig. 9. — *As.* ψ, ascospores de dimensions 7 μ 6 × 5 μ 7. *As.* η, ascospores ayant 9 μ 4 × 6 μ 6. Parmi celles-ci, deux sont vues en coupe optique et montrent la ligne de moindre résistance.

Fig. I

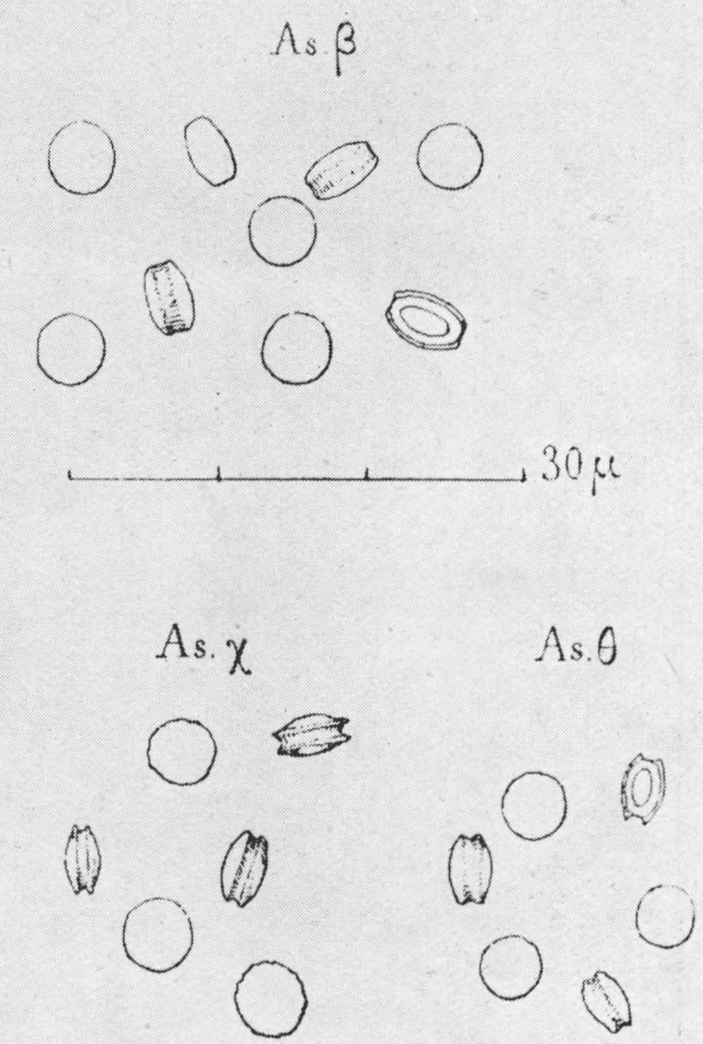


Fig. 7. — Ascospores à petites dimensions 4 μ 7 × 3 μ 7. *As.* β ascospores, vues de face et de profil, ces dernières montrent que la gouttière n'est pas apparente. *As.* χ, ascospores à gouttière très marquée et à crêtes très apparentes. *As.* θ, ascospores à gouttière nette et à crêtes peu saillantes.

Fig. II

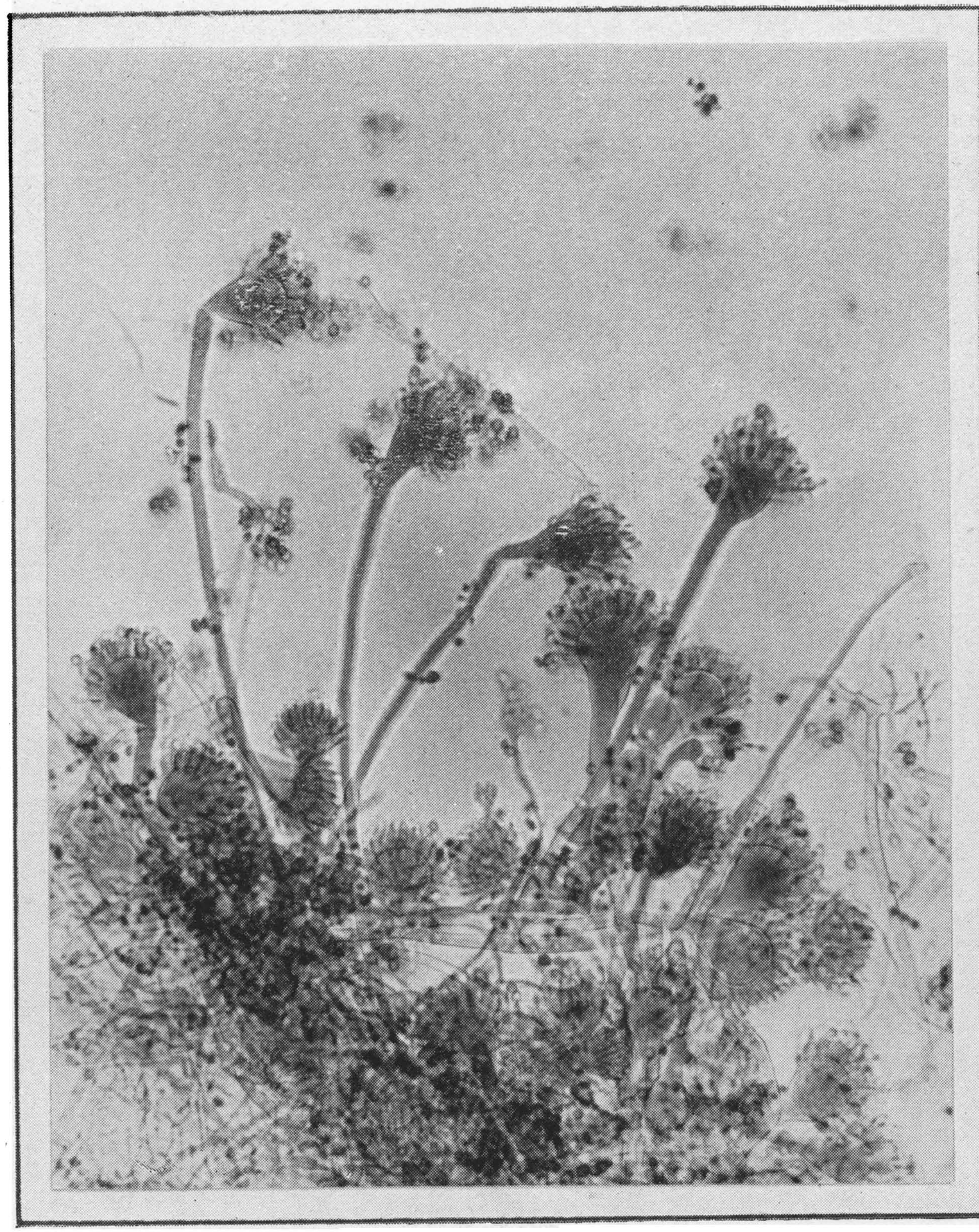


Fig. III

Fig. IV

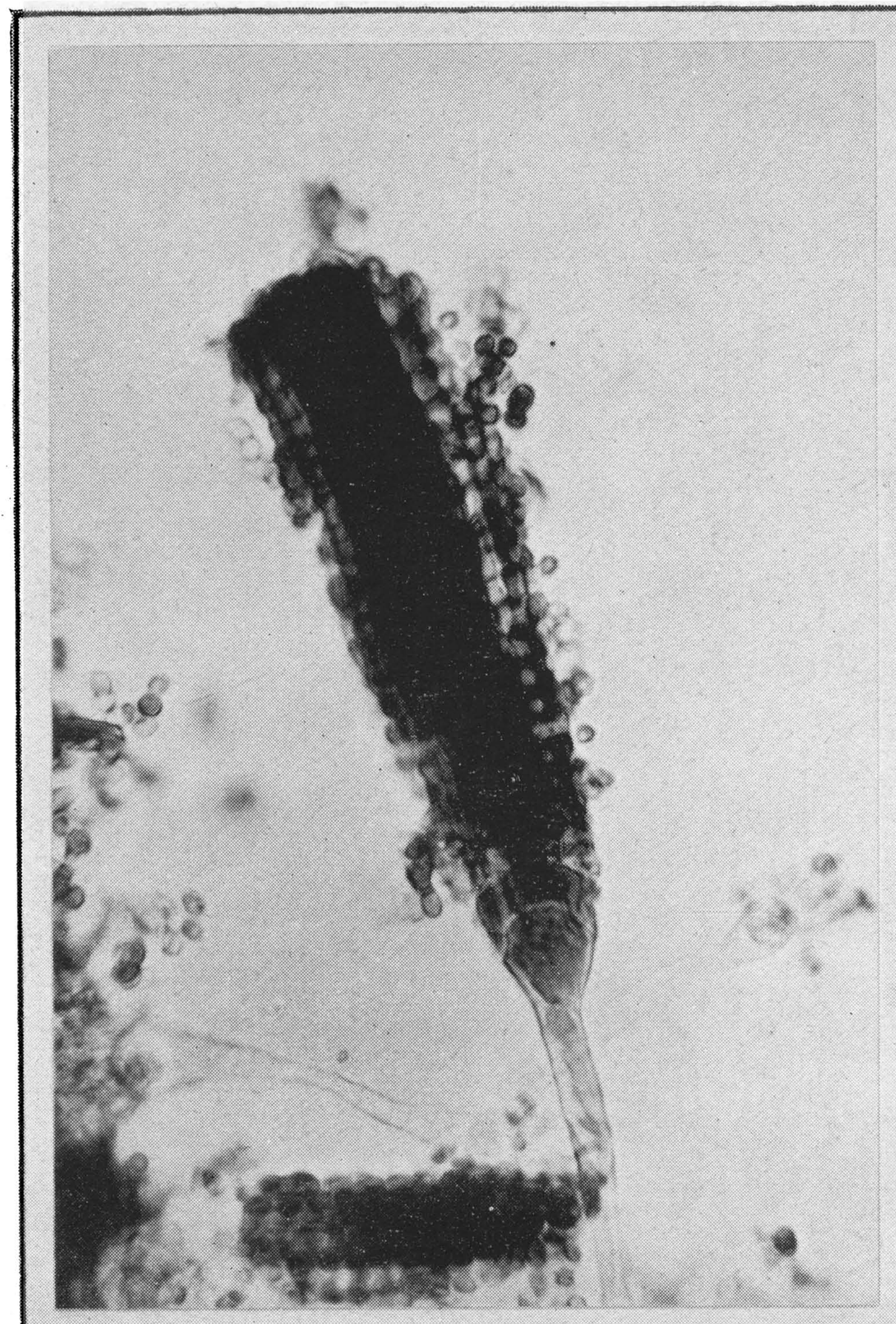


FIG. V

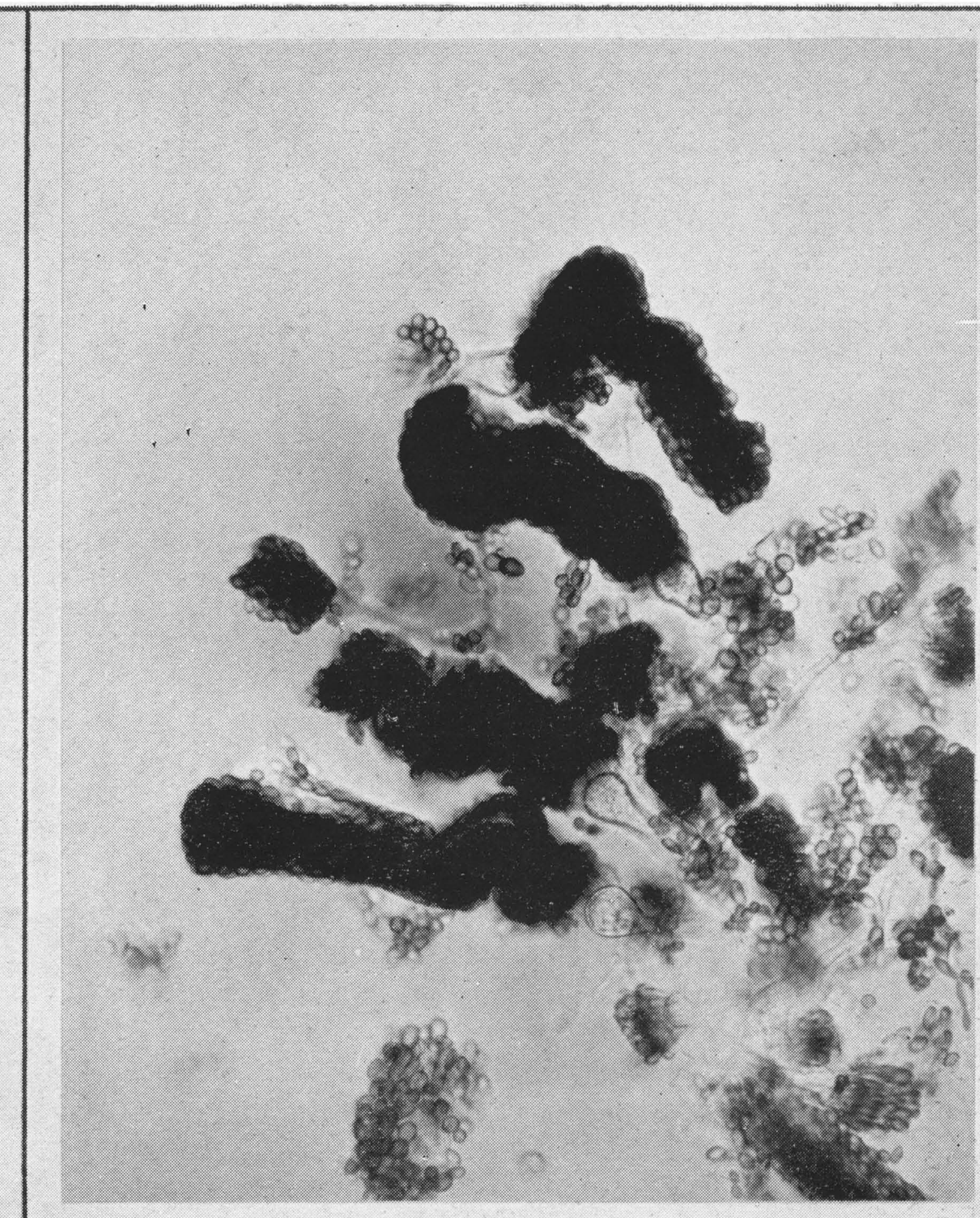


FIG. VI

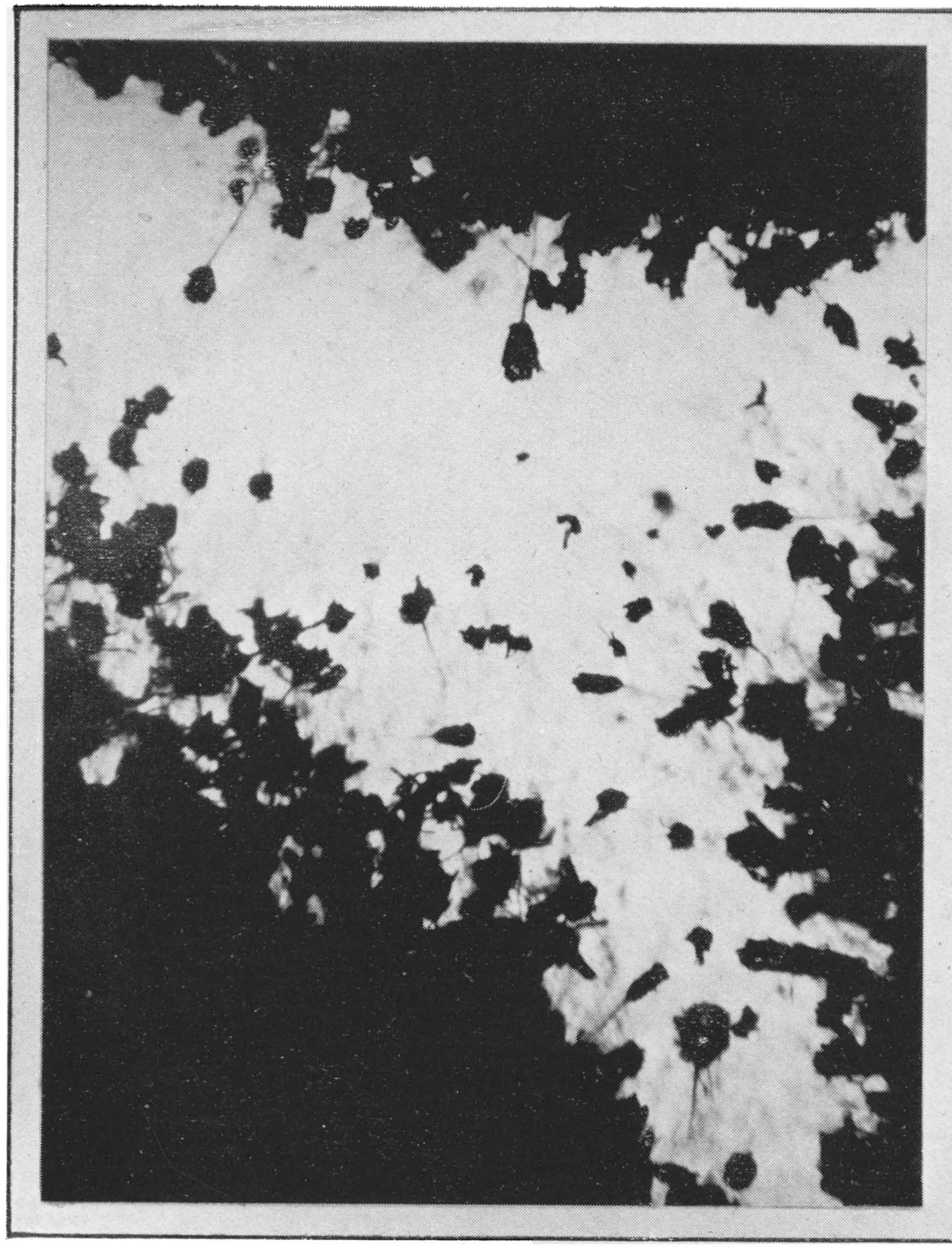


Fig. VII

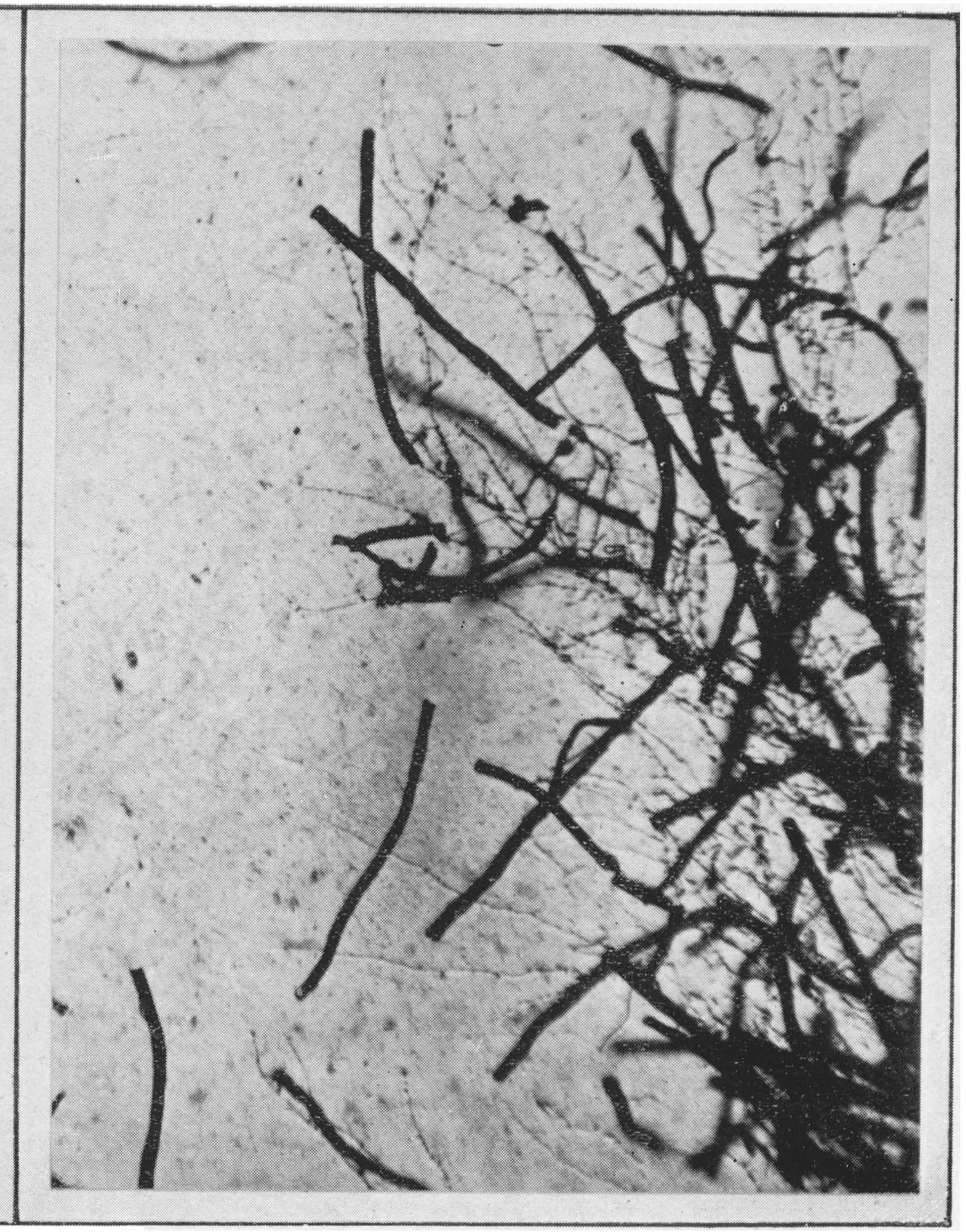


Fig. VIII

almost black colour in reverse. The surface colour was produced rapidly in some strains, tardily in others, but the final appearance was the same. This group belongs clearly with *A. ruber* (Spieckermann and Bremer), which also has been described in the previous paper.

Group III—The general appearance in culture of all the strains in this group, with the exception of S. 78 (see below), was so uniform and characteristic that specific identity is presumed even though the variations in dimensions of the ascospores are somewhat large. They are placed with *A. amstelodami* (Mangin), for which an amended description is here given, sufficiently general to include the whole series of forms, but differing appreciably from Thom and Church's recognition of Mangin's species.

A. amstelodami (Mangin)—Colonies growing well on most common media; on wort-agar at 25° C. growing rapidly, dark bluish or greyish-green thickly speckled with sulphur yellow perithecia, becoming somewhat brown in age; reverse persistently uncoloured; surface velvety with slight floccosity at margins only; stalks arising from substratum, smooth, thin-walled, sometimes septate, brownish, widening upwards, commonly up to 12μ, occasionally more, in diameter; heads hemispherical or sub-globose when young, becoming loosely columnar up to 300μ by 100–150μ; vesicles pear-shaped to nearly globose, fertile over whole surface or over upper two-thirds only, commonly up to 30μ in diameter; sterigmata in one series, mostly 6–9μ by 3·5–4·5μ, varying with temperature of growth and becoming larger and often proliferating to form secondary heads at low temperatures; conidia globose or slightly ovate, rough, 4–6μ in long axis at 20–25° C., becoming slightly larger at lower temperatures; perithecia sulphur yellow, 140μ in diameter; asci 10·5μ in diameter; ascospores with furrow and rounded crests, mostly 5·0–5·5μ by 4·0–4·2μ, occasionally smaller (4·7 × 3·5μ) or larger (6·0 × 4·5μ), with clearness of furrow varying somewhat in different strains but always with definite, though small, crests.

This species is readily distinguished in culture from the remainder of the group under consideration by the striking contrast between the very dark green of the conidiophores and the bright yellow of the perithecia, and by the total lack of colour in the medium.

Form S. 78 was quite distinct from all the other forms studied, in that it produced perithecia only with extreme tardiness. On wort-agar no perithecia have been observed. Sparse ascospore production was induced by growing on media containing a high percentage of cane sugar, such as the sweetened haricot decoction recommended by Mangin. On all media it produced large, dirty-green, conidial heads, with red incrustations on the hyphæ and sometimes a violet colour in the basal felt of mycelium, and with reverse and medium dark dirty-brown. The ascospores, with furrow and small crests, were somewhat larger than those of *A. amstelodami*. The probable place is with *A. herbariorum ser. minor* (Mangin), close to Mangin's "Form ξ," which is described as producing ascospores only under special conditions.

Group IV—Seven of the eight strains, all excepting G. 1, clearly belong with *A. chevalieri* (Mangin). This has not been adequately described in the earlier paper, and is given only a brief description by Thom and Church. The following is an amended diagnosis—

A. chevalieri (Mangin). Colonies on wort-agar at 25° C. predominantly perithecial at first, bright yellow, velvety, gradually showing patches of dirty bluish-green conidiophores, with more abundant conidial growth at lower temperatures; reverse slowly becoming orange-red to deep red; stalks arising from substratum, smooth, thin-walled, septate, up to 10·5μ in diameter; heads radiate or more or less globose; vesicles flask shaped, fertile all over or on upper half or two-thirds only, up to 25μ or even 35μ in diameter; sterigmata in one series, mostly 7–9μ, occasionally 11μ by 3–5μ: conidia ovate, verrucose, about 5μ long at 25° C., becoming 6–7·5μ at 18–20° C.; perithecia 140μ, occasionally 150μ in diameter; asci 10·5μ in diameter; ascospores with deep furrow and well-marked crests, 4·7–5·2μ by 3·3–3·7μ. Mangin's description of the spores, "shaped like pulleys with bulging sides," is very apt.

Form G. 1 differed from the remainder in producing smooth conidia, nearly globose, 3·5–4μ in diameter. It is doubtful whether this difference alone is sufficient to separate it from the other forms, which it resembles closely in other respects.

THE *ASPERGILLUS PENICILLOIDES* GROUP

Group Characteristics—Colonies growing very poorly and non-characteristically on Czapek agar, growing moderately well or, in a few cases, quite freely on wort-agar, green, dark green, greyish-green, brownish-green, or bluish-grey; surface velvety but frequently heaped and buckled; heads typically columnar; stalks slender, smooth, sinuous, often septate; vesicles inverted cone shaped, fertile only on upper surface; sterigmata in one series, closely packed as in *A. fumigatus;* conidia barrel shaped to ovate, dark coloured, spinulose, resembling the conidia of the *A. glaucus* series rather than those of *A. fumigatus.*

Thom and Church recognise three species belonging to this group—*A. gracilis* Bainier, *A. conicus* Blochwitz, and *A. penicilloides* Spegazzini. *A. conicus,* distinguished by the production of masses of slime enveloping the conidial fructifications, has not been encountered in the present investigation. The available descriptions of the other two species are decidedly fragmentary and, therefore, the diagnoses given below, whilst believed to be based on correct identifications, may possibly differ from the original authors' conceptions.

A. gracilis Bainier. Apparently satisfied by a culture received from the B.C.I.R.A. as representative of Galloway's *A. fumigatus/nidulans* series. Colonies growing only moderately well on wort-agar, pale bluish-green, then dark green, becoming browner and greyer, and partially overgrown with dirty white sterile hyphæ; reverse tardily brown; surface velvety, folded and buckled; heads forming compact slender columns, up to 300μ by 20μ; stalks smooth, sometimes septate, about 3μ in diameter at base, widening upwards to 4–5μ in diameter just below vesicles; vesicles conical, flask shaped or sub-globose, 9–12μ in diameter; sterigmata in one series, closely packed, with outer ones curved towards axis, 5·5–8μ by 1·5–2·5μ; conidia green, barrel shaped, delicately roughened, 4–5μ by 3μ. In general appearance resembling closely certain monoverticillate *Penicillia.*

A. penicilloides Spegazzini (Figs. 3 and 7). The description here given covers a number of strains isolated from mildewed dhooties. Although some of the dimensions are larger than those cited by Thom and Church for a culture accepted by Spegazzini, it is considered that the true affinity of this series of strains is with Spegazzini's species.

Colonies growing fairly slowly on wort-agar, rich dark green with paler edge, turning darker and duller, and finally becoming dirty greenish-grey overgrown with sterile hyphæ; reverse brown, greenish-brown, and dark green in patches; surface much wrinkled and folded; heads globose when young, 40–70μ in diameter, becoming columnar, somewhat ragged, and up to 200μ long; stalks arising either from substratum or from aerial hyphæ, smooth, thin walled, 75–150μ long by 6–10μ in diameter; vesicles rather sharply marked off from stalks, pear shaped to sub-globose, 15–23μ in diameter, fertile over the upper half or two-thirds; sterigmata in one series, crowded, 8–10μ by 2·5–3·5μ; conidia ovate, barrel shaped or nearly spherical, usually showing connective, rough, 3·5–5μ by 3·2–4μ, with very dark coloured walls. Distinguished from the succeeding species by the greener colour of the colonies, by the shape of the heads, particularly when immature, and by the somewhat smaller conidia.

A. restrictus n. sp. (Fig. 5). The following diagnosis covers a large number of strains obtained from mildewed cloths, including one received from the B.C.I.R.A.

Colonies growing very poorly on Czapek agar; growing moderately well on wort-agar, dark dull green, gradually turning grey or brownish-grey; reverse in some cultures uncoloured, in others green to dark green; surface velvety at first, becoming wrinkled and often acquiring a warted appearance; heads forming long, compact, slender columns, up to 350μ by 20–30μ in diameter; stalks arising mostly from substratum but also as branches of aerial hyphæ, commonly 50–100μ, occasionally 150–200μ long by 3–3·5μ in diameter, often with one or two septa, smooth, sinuous, uncoloured; vesicles flask shaped, 7·5–14μ in diameter; sterigmata in one series, borne on upper surface of vesicles only, 6–9μ by 2·5–3μ; conidia rough spinulose, elliptical or somewhat pyriform, often showing a distinct connective, dark greenish-brown, 4–6·5μ by 3–4μ, mostly 4·5–6μ by 3–3·5μ. The young conidia are hyaline and cylindrical and almost appear to be segments of enormously elongated septate sterigmata. They gradually swell without increasing in length, at the same time becoming pigmented, but even in old heads they adhere strongly together in columns of parallel chains and mounts made in lacto-phenol usually show compact, twisted, columnar masses of ripe conidia, both attached to and separated from the heads.

In an extended series of cultures, on a variety of media, no tendency to perithecium formation has been observed.

A. restrictus n. sp. *variety B* (Figs. 4, 6, and 8). One strain, obviously allied to the foregoing, has differed from all others in showing somewhat larger dimensions throughout and, more particularly, in the production of conidia up to 10μ or more in length.

Colonies growing well on wort-agar; columnar heads up to 600μ by 40μ; stalks 3–7μ in diameter; vesicles up to 18μ in diameter; sterigmata mostly 7·5μ by 3–3·5μ, but occasionally attaining 13·5μ by 4·5μ; conidia very dark brownish-green, spinulose, varying much in shape and size, nearly globose 4–7μ in diameter, or ovate to pyriform 5–14μ by 3·6–6·5μ.

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REFERENCES

[1] Smith. J. Text. Inst., 1928, **19**, T92-T100.
[2] Galloway. J. Text. Inst., 1930, **21**, T277-T286.
[3] Mangin. "Qu'est ce que l'Aspergillus glaucus?" Ann. Sci. Nat. Bot., 9 Ser., 10, pp. 303-371, 1909.
[4] Thom and Church. "The Aspergilli." (London, 1926).

EXPLANATION OF PLATES

Fig. I. Mangin's illustrations of ascospores of *A. herbariorum*.
As. ζ, As. *o*, and As. ψ=*A. herbariorum series minor*.
As. μ, and as. η=*A. herbariorum series major*.

Fig. II. Mangin's drawings of ascospores of three species in the section of the *A. glaucus* group with spores less than 6μ in long axis. As. β=*A. repens*. As. χ=*A. chevalieri*. As. θ=*A. amstelodami*. Note the similarity between As. θ and As. μ.

Fig. III. *A. penicilloides*, photographed from specimen mounted in lacto-phenol. ×250.

Fig. IV. Conidia of *A. restrictus var. B.*, some of them fairly young and definitely cylindrical. ×1,000.

Fig. V. *A. restrictus*, from specimen mounted in lacto-phenol. ×500.

Fig. VI. *A. restrictus var. B.*, mounted. ×250.

Fig. VII. *A. penicilloides*, photographed from living culture in Petri dish, showing heads of various shapes, from nearly globose to definitely columnar. ×50.

Fig. VIII. *A. restrictus var. B.*, from living culture, showing columnar heads up to 600μ long. ×50.

8—THE CHEMICAL ANALYSIS OF RAYONS

i—THE CHEMICAL PROPERTIES OF SOME COMMERCIAL RAYON YARNS

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(British Cotton Industry Research Association)

CONTENTS

INTRODUCTION AND SUMMARY

The present work was undertaken in order to ascertain the composition and amount of the non-cellulosic constituents of commercial rayons, and the extent to which the cellulose itself is chemically modified by the processes involved in the manufacture of the yarns, in the hope that the results would illuminate some effects of the technical operations concerned in the bleaching, dyeing, printing, and finishing of cotton-rayon and all-rayon fabrics.

While within recent years considerable progress has been made in improving the mechanical and physical properties of these yarns, it would appear from a study of the literature that their chemical characteristics have received little attention. Such papers as have been published have recorded the results of very few tests, and their value has often been diminished by the omission of adequate descriptions of the materials used. Possibly this lack of data may be due to a feeling that the rapid improvements in manufacturing technique might render any detailed records of results out of date almost before they were published, but it is considered that the majority of rayon products are now sufficiently stabilised for the accumulation and publication of such data to be worth while. Moreover, an examination of the chemical properties of rayon, showing the kind of variation to be expected in normal commercial samples is a necessary preliminary to the work on the chemical effects of bleaching and finishing now being carried out in the Association's laboratories.

Literature

Kami[15] has determined the percentages of ash and material extractable by solvents in a large number of samples of viscose, several of cuprammonium, and one of acetate rayon, and the water-solubility and sulphur content of a few—chiefly Japanese—varieties, and since his results may not be generally available, they are reproduced in Table V, p. T131. Wahl and Rolland[23] have recorded the copper number (Schwalbe-Braidy), ash, and sulphur content of a few kinds of viscose, cuprammonium, and nitrocellulose rayons (Table VIII, p. T134). These results are substantially confirmed by the present work, but the sulphur values obtained by Wahl and Rolland correspond with those found for undesulphurised rather than desulphurised viscose, and their values for cuprammonium yarns are about ten times as high as the highest now given. The reason for this is not clear. Ristenpart[21] has determined the loss of weight suffered by rayons on treatment with boiling 4% sodium hydroxide solution for 30 minutes—conditions somewhat different from those employed in this investigation—but the order in which his method places the different types is the same as that now found. Ash content has also been studied by Reinthaler,[19] and his range for viscoses (0·2–0·35%) is confirmed, but Courtaulds' Dulenza and the Fibro staple-fibre material now examined do not show the abnormally high values previously reported by him, whilst the lowest content is found for Bemberg cuprammonium yarn made from cotton linters (with acetate rayons next in order) instead of for acetate rayons. His statement that nitrocellulose rayon yarns generally have values exceeding 1% does not hold for the one sample of Obourg material now tested, and the present results show that it is possible to differentiate between cuprammonium rayon yarns made from wood pulp and cotton linters respectively. Several of the materials tested by him were of pre-war manufacture, and, probably, discrepancies between his results and those now recorded are to be attributed to improvements in manufacturing technique that have tended to reduce the non-cellulosic residues to a minimum. Thus, to quote from the figures given by Reinthaler, the 1914 Obourg nitrocellulose rayon yarns had values of 2–2·2%, whilst a 1927 sample had an ash content of only 0·36%—a value in agreement with the 0·43% now found.

Scheme of Work and Results

The materials used in the present investigation have been obtained from comparatively few firms, but the samples themselves may be regarded as fully representative of good quality yarns belonging to the different types of rayon, and in order to obtain as much information as possible about their chemical characteristics and the non-cellulosic impurities they contain, the following properties have been measured for standard (first quality) varieties of viscose, Lilienfeld, cuprammonium, acetate, and nitrocellulose rayons of recent manufacture, mostly of British origin—copper number, loss of weight on boiling with alkali, methylene blue absorption, fluidity in cuprammonium hydroxide solution, ash content and ash alkalinity, material extractable by solvents, sulphur, copper, and iron content, and for acetate rayons, the acetic acid content. Mean values of the experimental results are collected in Table I, and the methods of measurement employed (except for copper and iron) are described, where necessary, in the experimental section.

Inferior grades of rayon are stated to differ from first grade material chiefly in the physical condition of the yarns when sorted in the finished state; in other words, both first and lower grade yarns are spun from the

Table I
Collected Results

Variety	Origin	Date of Delivery *	Copper Number	% Loss of Weight on Alkali Boiling	Methylene Blue Absorption	Fluidity 2% Solution	% Ash	Ash Alkalinity	Ash Alkalinity per gram of Ash	% Extract-able Matter (Ether)	% Sulphur	Mg. of Copper per 100 g. Catalytic	Colori-metric	Gravi-metric	Mg. of Iron/100g.
VISCOSES—															
Unbleached Snia ...	Italian ...	1927	0·98	—	1·51	9·9	—	—	—	—	—	—	—	—	—
Bleached Snia	,, ...	1927	0·82	—	1·33	11·5	—	—	—	—	—	—	—	—	—
Unbleached Feld ...	German ...	1927	0·95	—	—	9·5	—	—	—	—	—	—	—	—	—
Bleached Feld	,, ...	1927	0·87	—	—	13·9	—	—	—	—	—	—	—	—	—
Courtaulds' "A" Quality	British ...	1928	1·17	7·0	2·01	9·8	0·21	2·73	13·0	0·57	0·013	0·12	0·12	0·13	1·48
,, Escorto ...	,, ...	1928	1·01	5·8	1·56	9·0	0·18	2·08	11·5	0·21	0·005	0·19	0·19	0·17	1·08
,, Dulesco ...	,, ...	1928	1·16	7·4	1·61	10·7	0·17	1·84	10·8	0·80	0·029	0·14	—	0·32	0·70
,, Dulenza ...	,, ...	1928	1·09	6·5	1·52	11·1	0·10	1·0	10·0	0·56	0·033	0·11	0·09	0·33	1·63
,, Tudenza (not desulphurised)	,, ...	1928	0·92	7·3	1·72	8·0	0·41	5·75	14·0	1·36	0·350	0·69	—	1·10	2·2
Celta Hollow (1) ...	,, ...	1928	1·63	8·7	2·10	13·2	0·24	5·0	21·0	0·31	0·023	—	—	—	—
,, ,, (2) ...	,, ...	1930	0·96	—	1·71	9·6	0·20	4·7	23·6	—	—	0·29	—	1·13	0·72
Harbens' Standard ...	,, ...	1930	0·90	6·1	1·73	9·7	0·06	1·9	32·0	0·12	0·010	0·07	—	0·13	2·0
,, Lower Grade	,, ...	1930	—	—	—	11·3	—	—	—	—	—	0·07	—	—	—
Bleached Moresia ...	,, ...	1929	1·12	—	2·34	11·2	—	—	—	—	—	—	—	—	—
,, ,, ...	,, ...	1929	1·65	—	2·30	14·2	—	—	—	—	—	—	—	—	—
Obourg	Belgian ...	1928	1·45	6·2	1·97	6·7	0·21	4·64	22·1	0·09	0·021	—	—	—	—
Snia	Italian ...	1929	1·13	6·54	1·63	9·9	0·14	3·55	25·4	0·15	0·023	0·23	0·17	—	—
STAPLE FIBRE—															
Courtaulds' Fibro ...	British ...	1929	0·96	8·45	4·56 (on 1gm.)	9·7	0·24	5·4	22·6	—	0·046	Trace	—	0·19	0·85
Vistra	German	1928	0·83	8·64	2·36	4·2	0·43	6·1	14·2	—	0·074	0·54	—	1·09	3·64
LILIENFELD—															
Courtaulds' Durafil ...	British ...	1929	0·78	7·18	2·14	3·9	0·16	1·8	11·3	0·49	0·02	0·11	0·16	0·15	1·14
Nuera Tenasco (Unbleached)	,, ...	1929	1·21	—	2·07	2·9	0·28	3·35	12·0	0·18	0·058	6·1	6·7	8·9	2·34
Nuera Tenasco (Bleached)	,, ...	1929	1·45	11·6	2·50	6·3	—	—	—	0·24	—	—	—	—	—
CUPRAMMONIUM—															
Bemberg	German	1929	0·55	—	1·75	2·7	0·04	1·15	28·7	2·04	Trace	0·75	0·72	0·54	3·3
,, ...	,,	1929	0·51	6·76	1·38	2·86	—	—	—	—	—	—	—	—	—
I.G. Bemberg	,,	1929	0·58	6·9	1·39	3·16	0·08	2·0	25·0	2·53	—	—	—	—	3·3
Brysilka (Old) Unbleached	British ...	1928	1·53	11·8	2·16	6·0	0·35	—	—	0·24	0·024	8·0	7·4	9·1	4·15
,, ,, Bleached	,, ...	1928	1·50	9·7	2·20	7·2	0·34	—	—	—	—	—	—	—	—
,, "W" quality	,, ...	1930	0·98	6·85	1·30	4·14	0·24	4·56	19·3	—	—	1·00	—	—	—
,, ,, ,, (2)	,, ...	1930	0·93	7·4	1·45	4·54	0·24	4·45	18·6	—	—	0·40	—	0·84	1·2
,, "C" quality	,, ...	1930	1·21	8·8	1·57	5·84	0·25	5·3	21·0	—	0·006	0·70	—	—	0·9
ACETATE—						% Acetic Acid									
Courtaulds' Seraceta ...	,, ...	1928	3·0	48·3	1·11	53·4	0·16	2·65	16·5	1·97	0·035	6·9	5·9	6·7	3·7
Celanese (190 den.) ...	,, ...	1925	2·9	46·5	1·12	54·2	0·11	2·33	21·0	—	—	—	—	—	—
,, (250 den.) ...	,, ...	1925	3·0	45·7	1·22	—	0·09	—	—	—	—	3·0	3·15	1·65	3·8
,, (150 den.) ...	,, ...	1930	2·92	46·1	0·80	53·8	0·12	2·37	19·2	2·0	0·052	1·6	—	1·75	2·3
Esterified Cotton 1 ...	,, ...	1930	0·45	23·8	0·96	27·6	—	—	—	—	—	—	—	—	—
,, ,, 2 ...	,, ...	1930	0·65	23·6	1·08	25·6	—	—	—	—	—	—	—	—	—
NITROCELLULOSE—						Fluidity 2% Solution									
Obourg	Belgian	1928	2·75	19·4	2·02	16·7	0·43	—	—	0·06	0·10	0·18	—	—	1·2
WOOD PULP—						0·5% Solution									
Bleached	—	1928	3·84	18·7	2·18	15·6	—	—	—	—	0·05	—	—	—	—
Numerous different samples	—	1929	—	—	—	14 to 34 Mean 19·3	—	—	—	—	—	—	—	—	—
COTTON LINTERS—															
Bleached	—	1929	< 0·5	about 1·5	0·8 to 1·1	1–4	—	—	—	0·01	—	—	—	—	—

*The "date of delivery" is the date of presentation to the Shirley Institute or of purchase by the Institute in the open market.
All values determined by the authors refer to material dried at 105–110° C.

same solution, but those hanks of the finished yarn that do not comply with the requirements for first quality as regards weight, number of broken filaments, yarn breaks, etc., are classified as lower grade. Whilst this may be true in general, it is possible that the lower grades occasionally include yarns obtained from, say, over-ripe or otherwise inferior spinning solutions, and whereas in the former case the chemical properties of first and lower grade yarns would be the same, in the latter they would differ. Thus the fluidities of the fifteen samples of lower grade viscose rayon, recorded in Table IV, p. T128, mostly lie about the normal figure of 10 for unbleached material, but three values are higher even than the normal figure for bleached viscose. Variations of this kind would be expected when the chemical nature of the spinning solutions was adversely affected. With this exception, no attempt has been made to study the properties of lower grade materials, although such an investigation might be of some value in view of the increasing demand for such yarns for weaving on account of their lower price.

Of the chemical properties mentioned above, the first four are dependent mainly on the extent of chemical modification of the cellulose itself, while the remainder are indicative of the nature and amount of the non-cellulosic impurities, which may be derived from the wood pulp or cotton raw material, free sulphur and sulphur compounds, metallic salts, etc., used during the manufacturing processes, or from the soaps or oils used as yarn dressing agents.

The chemical processes involved in the manufacture of rayons, either from purified cotton or wood pulp, are such that some attack of the cellulose itself is to be expected, since in all such treatments either oxidation or acid attack or both may occur. It is to be anticipated, therefore, that the chemical properties of these materials will resemble those of modified cotton cellulose rather than those of the purified but otherwise unchanged material. Table I shows this to be so. Thus, whereas the copper number, loss of weight on boiling with alkali, methylene blue absorption, and fluidity of purified but chemically unchanged cotton are respectively near to zero, 1–1·5%, 0·8–1·0%, and 1–3, the corresponding values for normal viscose are about 1, 6–8%, 1·5–2, and 35–40 (or, in 2% solution, 10–12, see "Fluidity," Experimental Section). For other varieties of rayon the individual values are different; for example, the fluidity range of Lilienfeld and cuprammonium rayon yarns is considerably lower (3–6 in 2% solution) than that of viscose rayon. Enhanced attack of the cellulose, however, is always indicated by increased values of one or more of these properties, and it should therefore be borne in mind in textile processing that rayon yarns behave chemically like over-bleached or acid-attacked cotton. This is illustrated by the loss of weight on boiling with alkali. It has been shown previously[4] that oxycelluloses of copper number about 1, prepared from scoured cotton by the action of different oxidising agents, all lose 6–8% in weight as a result of treatment with boiling 1% sodium hydroxide solution for four hours, and it is now shown that normal viscose rayons, which have about the same copper number, experience the same loss under identical conditions. The amount of this loss is virtually the same as that found when grey, unbleached cottons are scoured under technical conditions, so that a grey cloth woven from cotton and a normal viscose yarn would lose roughly the same percentage of weight from both components in, say, an open or pressure boil, though a viscose rayon of higher copper number would lose more weight in this process. Coupled with the fact that it is difficult to obtain a good white in cotton without giving the material an efficient pressure boil, this suggests that in dealing with certain classes of mixed cotton-rayon fabrics, such as, for example, handkerchief cloths, in which loss of weight of the rayon would be accompanied by loss of strength, cover, and possibly lustre, it would be well to consider whether greater economy would not be effected in the long run by the use of scoured or bleached, instead of grey cotton warps, when a mild washing treatment, followed if necessary by a very light chemick, would give a good white in both component yarns without detracting from the strength or handle of the fabric.

Apart from its chemical composition, the physical condition of the cellulose, i.e. its degree of swelling or dispersion, plays an important part in determining the behaviour of the rayon material in such operations as dyeing and bleaching. For example, the series plain cotton, mercerised cotton, and viscose rayon represents three stages of increasing degree of dispersion of the cellulose, and if samples of all three are dyed together in the same dyebath, their order of increasing depth of shade is that given. It is, however, unlikely that increasing the degree of dispersion has any effect whatever in giving rise to the higher initial values for rayons of the four properties mentioned above, since the increased dispersion caused by the mercerisation of cotton produces no significant increase in the values of those properties (see Table IX, and Clibbens and Geake,[7,8] and Farrow and Neale[12]). Hence it may be considered that the enhanced degree of modification exhibited by rayons is due to chemical alteration of the cellulose, as distinct from swelling, during the processes concerned in the production of the yarns, and perhaps also of the starting materials themselves.

None of the chemical properties measured can be used to characterise all the varieties examined; thus copper number and loss of weight on boiling with alkali fail to distinguish between viscose, Lilienfeld, and cuprammonium yarns made from wood pulp; methylene blue absorption is lowest for acetate rayons, but is otherwise very variable, and fluidity values are low and approximately the same for Lilienfeld and cuprammonium rayons made from cotton linters (Bemberg type), and are high for acetate varieties, though here they are of little significance because these are not composed wholly of cellulose. The difference between cuprammonium yarns made from wood pulp and from cotton linters is shown by all these properties except methylene blue absorption, and the lower values obtained for the cotton products are presumably connected with the lower initial state of chemical attack of the cellulose in the linters than in the pulp. An illustration of this is afforded by a comparison of the properties of typical samples of these two materials as recorded at the end of Table I, and it is a significant fact that in the manufacture of acetate and nitrocellulose rayons, in which the chemical attack of the cellulose is much greater than obtains with viscose, it is at present impossible to use wood pulp as starting material on an industrial scale.

In general, loss of weight on boiling with alkali runs parallel to copper number, and the order of increasing loss is—cuprammonium, viscose, and Lilienfeld varieties (bleached and unbleached) about 6–11%, nitrocellulose about 19%, and acetate 46–48%. Athough the bulk of the loss of the acetate is due to the removal of acetic acid residues, some of the cellulose material is also lost. It is sometimes stated that acetate rayons are much more resistant to attack by oxidising (bleaching) solutions than are other varieties of rayon; while the truth of this statement is not at present in question, it is certain that tendering of these materials occurs most readily when they are treated with hot alkaline liquids, owing to loss of acetic acid through the hydrolysis of the cellulose acetate compound. In this case, fluidity measurements yield results the interpretation of which is entirely different from that placed on the results of similar measurements made on cotton and regenerated cellulose rayons. Furthermore, copper number determinations alone are of little value, so that the most obvious method of assessing the extent of tendering of acetate rayons would appear to be by determination of their acetic acid content. The percentages of acetic acid (53–54%) corresponding to the original chemically unchanged materials are given in Table Ia, for different samples of acetate rayon, and values below these are indicative of tendering to a greater or less degree.

Table Ia
Acetic Acid Content of Acetate Rayons

Material	% Acetic Acid	
	Ost Method	Barnett Method
Seraceta (not extracted)	53·4	53·3
„ (extracted)	54·7	—
„ „	55·3	54·7
Celanese (not extracted) (190 den.)	54·2	—
„ „ (150 den.)	53·9	53·7
„ (extracted) (150 den.)	54·7	54·1
Esterified Cotton No. 1	27·6	—
„ „ 2	25·6	—

It is found, however, that the fluidity of partly hydrolysed acetate rayon in cuprammonium hydroxide becomes greater as the degree of hydrolysis increases and that there is a linear relationship between the fluidity and the loss of strength or the loss of acetic acid. This relationship must be attributed to the increase in the proportion of cellulose present in the material as the acetic acid is progressively removed and the use of the fluidity measurement for the assessment of tendering of acetate rayons by saponification is being further elaborated.

All the chemical tests applied agree in showing the chemical inferiority of nitrocellulose rayon compared with other members of the regenerated cellulose type, and its high loss of weight on boiling with alkali is almost sufficient in itself to condemn the use of this yarn as a high grade textile material.

As already indicated, the amount of non-cellulosic residues in rayons is very small, if added dressing agents, such as oil, are neglected; for example, the ash content of the cuprammonium varieties prepared from cotton is less than 0·1%, whilst for the acetate varieties it is about 0·13%, and for normal viscose rayons about 0·2%. Abnormal viscose rayons, i.e., those not desulphurised (Tudenza), or hollow kinds (Celta), and cuprammonium rayons made from wood pulp (Brysilka) have higher values, which, however, are still less than 0·5 per cent. The percentage of matter extracted by organic solvents depends largely, of course, on whether oil or soaps have been used in the manufacture or finishing of the yarns, and on whether the rayon has been desulphurised. It is generally less than 0·5%, but may be as high as

2–2·5% for oiled yarns, while for undesulphurised viscose rayon fairly high values are found owing to the mechanical removal of sulphur during the solvent extraction. The ease with which this substance may be removed mechanically is shown by the fact that when such yarn is used as weft in the loom, a fine yellow deposit of sulphur is often found round the eye of the shuttle.

Owing to the presence of sulphur in the free state, or in unstable compounds, the total amount of this element present is not necessarily included in the values for ash content, and an estimate of the total impurities can only be made by taking into consideration ash and sulphur contents and extractable matter. An average value of the sulphur content is about 0·02%, but higher values, not exceeding about 0·06%, are found for the acetate and Nuera Lilienfeld varieties, and that for undesulphurised viscose rayon (Tudenza) is about ten times as high as for the desulphurised product. Bemberg cuprammonium rayon, made from cotton linters, contains only a trace of sulphur, whereas the Brysilka, from wood pulp, may have the average amount of 0·02%; hence the differentiation between viscose and cuprammonium rayons by means of a sulphur determination is trustworthy only in so far as it is certain that the cuprammonium material under examination was made from cotton. It has frequently been laid down in the technical literature that viscose and cuprammonium rayons may be distinguished from one another by the presence of sulphur and absence of copper in the former, and the reverse in the latter, but it is now shown that both elements are generally to be found in both types of material. Whilst such statements may have had some foundation in the earlier days of manufacture, when the amounts of impurity left in the yarns were much larger than they are to-day, and when less rigorous methods of analysis were employed, the present investigation shows that modern practice has tended towards the elimination of all but the smallest amounts of non-cellulosic residues, and that, therefore, all such qualitative tests as the above must be reconsidered in the light of this knowledge.

The results of further examination show that the Tenasco Lilienfeld rayon contains combined sulphuric acid. This has not been found in any of the other regenerated cellulose yarns examined, although acetate rayons[5] are known to contain such acid.

Additional information regarding the composition of the ash is given by the ash alkalinity, copper, and iron values. Abnormally high ash alkalinities are shown in Table I for Obourg, Tudenza, and Celta viscoses, the staple-fibre products Fibro and Vistra, and for the Brysilka cuprammonium rayons, but while these are normally accompanied by high alkalinity per gram of ash, the reverse holds for Vistra and Tudenza, which therefore contain a large percentage of inorganic matter incapable of neutralising acid, e.g. silica, stable neutral salts, and so forth.

Considerable importance has been attached to the determination of the heavy metal content of rayons, since the yarns themselves are very susceptible to attack by chemical agents in virtue of the high degree of dispersion of the cellulose of which they are composed, and traces of such metals are well known to exert catalytic action in accelerating the attack of cellulose by hypochlorite and other oxidising liquids, such as are used in the bleaching of textile fabrics. It is not impossible, therefore, that rayons with a high heavy metal content might be more easily tendered than those of lower content on this account, and that certain observed cases of local tendering in rayon yarns and fabrics might be attributable to this cause.

Qualitative analysis of the ash obtained both by the ordinary and by acid ashing methods showed the presence of copper, iron, aluminium, calcium, sodium, and in some yarns traces of zinc, whilst lead, chromium, nickel, and manganese were absent, and since the only metals present of catalytic importance are copper and iron, quantitative determinations were confined to these. The largest amounts of copper found were of the order 8–10 mgm. per 100 g. of dry rayon, and this quantity is so small that unless almost the whole were localised at one place in the yarn—an extremely unlikely state of affairs—the possibility of damage in bleaching due to catalytic effects such as those suggested may be considered small. It was surprising to find that the highest copper contents were shown not by the cuprammonium yarns, but by the acetate and Tenasco (Lilienfeld) rayons, which gave values of 1·6–9 mgm. per 100 gm. Cuprammonium varieties—with the exception of the 1928 quality Brysilka, which was a standard product at the time of its purchase, but has now been replaced by a superior yarn—have a mean value of about 0·6 mgm. whilst that for normal desulphurised viscose rayons is about 0·22 mgm.

The copper values given in Table I were obtained by analysis of a hydrochloric acid solution of the ash remaining after complete combustion of the rayon in a platinum dish; the factors affecting loss of platinum from the dish and the quantitative recovery of copper under the conditions of ashing and of dissolution of the residue employed will be discussed in a separate paper. It will be shown that the loss of copper probably does not exceed 10% of the amount found, and may be much less than this. Such an error does not significantly affect the conclusions drawn from the values given.

Iron content does not necessarily run parallel to copper content, although viscose rayons have the lowest values of both. For these yarns the range is 0·7–2 mgm. and for all other varieties about 2·3–4·2 mgm. per 100 gm. of dry rayon. Reference to Table I shows that for many of the viscose samples the total iron and copper content represents only about 1%, and for acetate rayons 6–7% of the ash; hence the heavy metal content of good quality yarns of any variety may for all ordinary purposes be considered negligible.

DISCUSSION OF RESULTS

I—The Extent of Chemical Modification of the Cellulose

It has already been stated that in all varieties of rayon the cellulose has suffered chemical attack, but the extent of this modification varies according to the type of yarn, the starting material used in its manufacture, and the conditions of any bleaching treatment to which the material has been submitted. Further, an estimation of the degree of chemical attack is dependent to some extent on the particular test or tests used as a means of measurement. For example, a high copper number may result from tendering of the cellulose, or it may be due to non-cellulosic impurities associated with substantially undamaged cellulose in the yarn. Similarly, the loss of weight on boiling with alkali, the methylene blue absorption, and the fluidity may also be affected by the presence of impurities. Previous work[3] on the chemical attack of cotton cellulose has also shown that under some conditions of bleaching a high copper number and a low methylene blue absorption may be obtained for the same material, while under others exactly the reverse is found; hence the danger of relying solely upon one chemical test as a measure of the modification of cellulose cannot be too strongly emphasised. When chemical damage of the material has been considerable, as, for example, in the Obourg nitrocellulose rayon (see Table I), enhanced values for all these properties are obtained, but for comparatively mild attack some may be high while others are low, as for the Obourg viscose rayon, where relatively high copper number and methylene blue absorption are accompanied by low loss of weight and fluidity. The effect of non-cellulosic impurities in significantly modifying such values must, however, be considered very small, except for the methylene blue absorption, in which case ash alkalinity is known to be of some importance. As with cotton, there can be no doubt that the fluidity measurement affords the most reliable means of estimating the extent of chemical attack.

Copper Number

The values for viscose rayon, including staple-fibre materials, lie within the range 0·8–1·2, except for Obourg and Celta (hollow) varieties, where they are abnormally high. A high value is also recorded for one of the bleached Moresia yarns, but there it is accompanied by a high fluidity and may no doubt be ascribed to the yarn bleaching treatment. Lilienfeld rayons in the unbleached state behave like ordinary viscoses, whilst the cuprammonium yarns show two ranges of values—1–1·5 and 0·5–0·6; the former covers the normal viscose range, while the latter is considerably below it, and it is significant that viscose rayons and the cuprammonium rayon of the type with higher copper number (Brysilka) are manufactured from wood pulp, whereas those corresponding with the lower range are made from cotton linters; the former material is, of course, more degraded chemically than the latter (see Table I, wood pulp and cotton linters).

Both the acetate and nitrocellulose rayons have high copper numbers ranging from about 2·8–3·2, but whilst there can be no doubt that this is due to chemical degradation of the cellulose units in the latter, it does not necessarily follow that the copper number of a cellulose ester can be interpreted in exactly the same way as that of an all-cellulose substance, such as viscose- or cotton-cellulose. The following results, however, indicate that the high value obtained for acetate rayon must still be ascribed to chemical attack of the cellulose units themselves in the same way as for ordinary cellulose. Thus, the cellulosic residue remaining after the complete hydrolysis of acetate rayon (Seraceta yarn) with dilute sodium hydroxide solution—conditions that have a negligible effect in increasing the extent of chemical modification of the cellulose—has a fluidity of 12–13 in 2% solution and a copper number of 2·5, both of which are high even for a regenerated cellulose. On the other hand, the copper number of a mixture of viscose rayon and sodium acetate in the proportions that would be present if, e.g. Seraceta yarn were completely hydrolysed with alkali (as must happen during the boiling treatment with the alkaline solutions used in the determination of copper number) to give sodium acetate and a residue similar to viscose cellulose, is 0·84, i.e. no higher than that of normal viscose rayon itself.

As is well known, the copper number of a modified cellulose is diminished by treatment of the material with alkaline solutions, more especially if they are hot, owing to dissolution of some of the reducing substances in the liquid. Increasing hydrolysis of acetate rayon with an alkaline solution also causes a progressive fall of copper number, and it must be remembered when assessing the value of this property that a high copper number may correspond with no tendering, whereas a lower value may coincide with considerable loss of strength owing to hydrolysis.

Loss of Weight on Boiling with Alkali

It has been shown previously[3,11] that for the initial stages of chemical attack of cotton cellulose the loss of weight on boiling with alkali under the conditions standardised is approximately proportional to the copper number of the modified material, and it would be anticipated, therefore, that the losses suffered by rayon yarns would be greater the higher their copper numbers. Reference to Table I shows that, in general, this is so. Thus for viscose, cuprammonium, and Lilienfeld rayons of copper number up to about 1·2 the loss is about 6–8%, for those of higher copper number up to 1·5 it is about 11%, whilst nitrocellulose rayon of copper number 2·75 loses 19%; these are the losses that would be expected according to the relation established by Clibbens, Geake, and Ridge[11], on the assumption that rayons of the regenerated cellulose type behave chemically like oxycelluloses of the same copper number prepared by the oxidation of cotton. Naturally the highest loss is found for acetate rayons, since under these conditions of treatment complete hydrolysis of the cellulose acetate occurs. For Courtaulds' Seraceta yarn, which contains about 2% of material extractable by solvents, complete hydrolysis corresponds with the loss of weight, due to the removal of acetic acid residues, of 38%, and since the dressing material is also removed by the boiling, a total loss of 40% would be expected. Under the standard conditions, however, a loss of about 48% is found, from which it must be concluded that roughly 8% of cellulosic material is simultaneously removed.

The effect of prolonging the time of boiling with alkali beyond 1 hour is small, since, for example, Tudenza yarn, which showed a loss of 6·8% after one hour, lost only 7·3% as a result of four hours treatment, so that the bulk of the soluble matter is removed during the early stages of the boil.

Methylene Blue Absorption

The methylene blue absorption of viscose rayons ranges from about 1·3–2, and, as with their copper numbers, the values of the Obourg and Celta varieties are high; the highest values, however, are found for the staple-fibre products Vistra and Fibro, although their corresponding copper numbers are low. With the exception of the 1928 Brysilka—which was known to be of inferior quality from its chemical properties—cuprammonium varieties have values within the viscose range, while the acetate rayons have the lowest absorptions measured, 0·8–1·2. In this respect their behaviour towards the dyestuff is similar to that towards water; for example, the moisture content of these yarns is generally less than 6%, whereas that of viscose rayons, and other types of regenerated cellulose, is near to 11% under the ordinary conditions of temperature and humidity. High values of over 2 are obtained for the Lilienfeld yarns, and these might be expected if the materials retain combined sulphuric acid owing to the conditions of their preparation. Thus, it has been shown by Clibbens and Geake[8] that whilst attack of cotton cellulose at the ordinary temperature by hydrochloric or sulphuric acids of relatively low concentration is accompanied by a decrease of methylene blue absorption, when sulphuric acid is used in concentrations of 50% or over, an increased absorption results which is definitely associated with an enhanced retention of acid. Lilienfeld yarns are manufactured by spinning the viscose solution into coagulating baths of 50–85% sulphuric acid, with or without the addition of salts, and in these circumstances retention of acid is not improbable. In the experiments made by Clibbens and Geake,[8] combined sulphuric acid was found as a result of steeping the cotton in the relatively concentrated solutions for some hours, whereas in the manufacture of the Lilienfeld rayons the time of contact with the acid must be comparatively short, but it should be remembered that prior to and during coagulation the cellulose present in the viscose is in a state of maximum liability to chemical attack, and therefore an effect that takes some hours to produce with normal cotton may occur in a few minutes with freshly precipitated cellulose. It is very unlikely that the high absorptions shown for the staple-fibre products Fibro and Vistra are due to retention of acid, because these materials are made under substantially the same conditions as the ordinary viscose rayons, i.e. the viscose solutions are coagulated by means of dilute acid, and/or salt baths, and it is more probable that here they are to be attributed to the abnormally high ash contents and ash alkalinities of these materials. In order to examine further the reasons suggested for the high absorptions of the Lilienfeld and staple-fibre products, the following experiments were undertaken. It has been shown previously[3] that cotton materials that have a high ash content and ash alkalinity also have a high methylene blue absorption, but if the amount of alkaline ash constituent is reduced by acid washing a corresponding fall of absorption occurs. On the other hand,[10] if the high absorption is due to combined sulphuric acid, even a prolonged boil with alkali fails to remove more than about 50% of this acid, and the absorption cannot be reduced to a normal low value. Samples of the Vistra and Fibro staple fibre, and of the Durafil and Tenasco Lilienfeld rayons, were accordingly steeped in dilute (0·1*N*) hydrochloric acid for half an hour, washed to neutrality with distilled water, dried in the air, and their absorptions again found. The results are given in Table II, and it is seen that whereas the values for the Vistra, Fibro, and Durafil are considerably reduced by this treatment, that of the Tenasco is unchanged. Hence, soluble material to which their high absorptions are partly due, has been removed from the former but not from the latter. These values also show that there is a difference between the Durafil and Tenasco Lilienfeld yarns in that the high absorption of the former is due to the presence of soluble impurities, but that of the latter is not, as will be seen later, and a further difference between these materials is shown by their respective values for ash, ash alkalinity, and sulphur content (Table I). It has also been shown[8] that a comparison of the methylene blue absorptions obtained by steeping the material in dye solutions of *p*H 7 and *p*H 2·7 gives definite information whether the chemical attack of cotton, which gives rise to a high absorption in neutral solution, has been caused by oxidising action (over bleaching) or by acid attack under such conditions that combined acid is retained by the cellulose. Thus, oxycelluloses show a pronounced decrease of absorption from the acid dye solution compared with the neutral liquid, but hydrocelluloses show only a small decrease or even increased values in the *p*H 2·7 solution. Measurements of the absorptions of the above materials, and also of Courtaulds' "A Quality" Viscose, were accordingly made in these dye solutions on separate samples of the well cut-up and mixed material; the results are given in Table III. (It was not found practicable to measure the absorptions on the *same* sample in the two liquids in the manner recommended by Clibbens and Geake, because, even after four treatments with boiling acetic acid, a considerable amount of methylene blue was left on the fibres after the first absorption measurement, and this interfered with the second determination.) The values recorded show that with all the materials except Tenasco a considerable fall of absorption occurs for the *p*H 2·7 solution,

Table II

Methylene Blue Absorptions of Lilienfeld and Staple Fibre Rayons

Variety	Absorption Millimoles per 100 gm. of Dry Material	
	Before	After Acid Washing
Lilienfeld—		
Courtaulds' Durafil	2·14, 2·20, 2·07, 2·12	1·50
Nuera Tenasco	2·07, 1·67, 2·23, 2·18	2·23
Staple Fibre—		
Vistra	2·36	1·72
Fibro	4·56 (1 gm. Sample)*	2·3

*When 2·5 g. of this material was used the dye solution was almost completely exhausted, so that the smaller weight was taken.

Table III

Methylene Blue Absorptions from Solutions of *p*H 7 and *p*H 2·7

Material (Acid Washed)	Absorption Millimoles per 100 gm. of Dry Material	
	*p*H 7	*p*H 2·7
Lilienfeld—Durafil	1·50	0·92
Tenasco	1·79	1·75
Staple Fibre—Vistra	1·72	1·3
Fibro	2·3	1·18
Viscose—"A" Quality	1·75	0·94

Table IIIa

Sulphur Content of Lilienfeld and Viscose Staple Fibre Rayons after Washing with Acid

Material	% Sulphur	
	Before Acid Wash	After
Lilienfeld—Tenasco	0·058	0·058
Durafil	0·02	0·012
Staple Fibre—Vistra	0·074	0·020
Fibro	0·046	0·026

whilst with Tenasco no significant change is produced; the presence of combined acid is therefore indicated for this, but not for the other materials. Further support is given by the fact that the Tenasco yarn is the only one the sulphur content of which is not reduced by washing with acid and water, as shown by the figures recorded in Table IIIa. No reduction would be expected if the sulphur were present as combined acid, but otherwise (except perhaps if it were present as elementary sulphur) a considerable fall should result. The presence of free sulphur, however, is of no importance in this connection, because this substance has no effect in raising the methylene blue absorption; for example, the absorption value for Tudenza viscose rayon (Table I) is no higher than that of the Harbens sample, although its sulphur content—largely free sulphur—is 35 times greater.

Reference to Table II shows that the absorption values of the Tenasco yarn are both high and variable, whilst those of Courtaulds' Durafil are also high but perhaps less variable. For cotton fabrics it has been found previously that a high and variable absorption coincides with unlevel dyeing properties, and it may be that the reported difficulty of obtaining level dyeing on some Lilienfeld yarns is also associated with high and variable methylene blue absorptions.

Table IV

Fluidities of Commercial Rayons

Sample	Origin	Fluidity
Viscoses—		
Celta	From yarn manufacturer ...	14·1, 12·4.
Tudenza	,, ,, ...	8·0.
"A" Quality	,, ,, ...	9·8, 9·7.
Dulesco	,, ,, ...	11·1, 10·5, 10·5, 10·2, 11·0.
Escorto	,, ,, ...	9·0.
,, ...	From winder (pirns) ...	10·0, 10·2, 10·7, 10·0.
Dulenza	From yarn manufacturer ...	11·1.
Harbens' Grade I ...	,, ,, ...	9·7.
,, Lower Grade ...	... ...	9·5, 10·4.
,, ,, ...	Weft from 15 samples of grey cotton-rayon cloth	15·4, 10·3, 10·6, 11·3, 14·5, 14·7, 12·2, 11·4, 11·4, 10·2, 9·8, 10·4, 10·2, 10·7, 10·5.
Moresia (Scottish) 150 den. (bleached)	From yarn manufacturer...	11·5.
,, ,, 300 den.	,, ,, ...	14·2.
Obourg	From yarn manufacturer ...	6·7.
Snia	,, ,, ...	9·9.
Lilienfelds—		
Durafil	From yarn manufacturer ...	4·26, 4·29, 4·01, 3·58, 3·54.
,, ...	Pirns from winder	3·78, 3·80.
Tenasco (unbleached) ...	From yarn manufacturer ...	2·90.
,, (bleached) ...	,, ,, ...	6·3.
Cuprammonium—		
Bemberg	From yarn manufacturer ...	2·86.
I.G. Bemberg	,, ,, ...	3·15.
Bemberg	From yarn winder (pirns) ...	2·64, 2·65, 2·69.
Brysilka	From yarn manufacturer ...	6·1, 5·8, 5·4, 5·2.
,, (bleached) ...	,, ,, ...	7·4.
,, ...	,, ,, ...	6·9.
,, ...	Pirns from yarn winder ...	6·6, 6·7, 6·4.
,, ("W" Quality) ...	From yarn manufacturer ...	4·1.
,, ("C" Quality) ...	,, ,, ...	5·84.
Staple Fibre—		
Fibro (Courtaulds') ...	From yarn manufacturer ...	9·71, 9·64.
Vistra	,, ,, ...	4·23, 4·15.

Fluidity

Mean fluidity results are given in Table I, and individual measurements are recorded separately in Table IV, which indicates to some extent the variability met with in technical yarns and in different samples from the same delivery.

The range for normal viscose rayons is about 9–11·5, although in some cases this is exceeded. For example, Celta, some of the Harbens varieties, Moresia, etc., have high values, which may be due either to the bleaching treatment given by the yarn manufacturer or to variations from the normal conditions of preparation of the viscose solution—over-ripening of the alkali cellulose, etc. The remaining varieties have, generally, lower ranges, 3–4 for Lilienfelds, 2·5–3·5 for cuprammonium rayon made from cotton linters, and about 4–6 for that made from wood pulp, but the Obourg nitro-cellulose sample has the high value of 16·7, which accords with the high values for the other properties of this material.

Of the staple-fibre products, Courtaulds' Fibro has a fluidity corresponding with that of a normal, good quality viscose rayon, whilst Vistra (I.G. Farben-industrie A.-G.) compares with Lilienfeld or cuprammonium yarns. According to Reinthaler,[19] Vistra is spun from unripened viscose, and the alkali cellulose used in its preparation is also allowed to ripen only a little; these factors, which both make for decreased chemical modification of the cellulose units, are sufficient to account for this low value. The differences between the values for viscose rayons and those of the Lilienfeld and cuprammonium varieties must be ascribed to differences in the properties of the starting materials, to differences in the extent of chemical attack of the cellulose in the manufacturing processes, or to both.

From the values of the chemical properties of samples of wood pulp and cotton linters, recorded at the end of Table I, it is evident that, if the same process were used for both, rayon prepared from the former would be chemically inferior to that from the latter. Also, yarn manufactured from wood pulp which has a higher α-cellulose content (i.e. from material which is superior from the point of view of its chemical properties) is known to be chemically superior to that made by the same process from pulp with a lower α-cellulose content.

The effect of bleaching in raising the fluidity value is shown by a few of the examples in Tables I and IV, but results of a detailed investigation of the effects of acid and oxidising attack on this property of rayons will be communicated later.

The Acetic Acid Content of Acetate Rayons

The amount of acetic acid obtained by the complete hydrolysis of acetate rayons that have not been submitted to ether extraction in order to remove surface oil or soap is about 53–54%, calculated on the dry weight of the original acetate yarn. Since the glucose residues from which cellulose is built up each contain three hydroxyl groups capable of acetylation, the percentages of acetic acid that would be obtained from the theoretical mono-, di-, and tri-acetates are respectively 29·4, 48·7, and 62·5%, from which it follows that the purified (i.e. solvent-extracted) acetate rayon yarns contain approximately 2·4 acetyl groups per $C_6H_{10}O_5$ unit.

A few values for the acetic acid content of some commercial esterified cottons are also given in Table Ia, and here the amount of acetic acid in combination with the cellulose is less than corresponds with one acetyl group per $C_6H_{10}O_5$ unit.

The determination of the acetic acid content of acetate rayons by the Ost[18] method is to some extent unsatisfactory, because the procedure involves steam distillation of the hydrolysed product, and the titration of a large volume (roughly 2 litres) of distillate which contains a relatively small amount of acetic acid. Further, in an experiment in which distillation was continued for six hours, traces of acid were still being carried over in the condensate. Although the error involved in judging the exact end-point is of minor importance in determining the approximate acetic acid content of an unhydrolysed acetate rayon, it is of considerable moment when a comparison is being made between the relative degrees of hydrolysis of two partially hydrolysed materials which have been treated in very nearly the same manner, because here the difference found may depend on very small titration differences, and a variation of a fraction of a cubic-centimetre in estimating the end-point of each distillation may then make a considerable difference in the degrees of hydrolysis found.

Barnett's method,[2] on the other hand, does not depend on steam distillation (see p. T138), and gives good results for yarns that are completely soluble in acetone, but since partially hydrolysed material is incompletely soluble, this method cannot be used for determination of the degree of hydrolysis.

An investigation of other methods for the accurate determination of relatively small differences of acetic acid content is being made in order to overcome these difficulties.

II—The Non-cellulosic Impurities

Ash Content and Ash Alkalinity

The comprehensive table of ash contents given by Kami (Table V) shows that the values for all types of rayon vary from 0·05 to 2·07%, with an average of about 0·25 per cent. Kami states that higher values are given by dyed material, and that the actual magnitude of the ash content varies according to the country of origin of the rayon; for German yarns it is about 0·15%, and for French about 0·40%, and he ascribes this variation to differences in the cellulose used and in the methods of coagulation, washing, and after-treatment.

Reference to Table I shows that values of the same order are obtained by the present workers. The mean for all the samples examined is 0·21, but since only a few foreign rayons have been used it is not possible to differentiate varieties according to country of origin. In general, it may be said that the ash content of modern rayons is so low as to make its determination of little value. The Bemberg yarns (cuprammonium, prepared from cotton linters) have the lowest content, less than 0·1%, acetate yarns are next in order, 0·09–0·16%, and the remainder have values up to about 0·35%. Abnormally high figures, about 0·4%, are given for the undesulphurised Tudenza, Vistra staple-fibre, and the Obourg nitrocellulose rayon. These values vary in much the same way as those for bleached cottons, which are entirely dependent on the conditions of bleaching and washing of the material. Thus, well-scoured fabric or yarn washed with acid in the laboratory has a negligible ash content of 0·05% or less—comparable with that of the German Bemberg yarns—whereas technically bleached and washed material may have values of over 0·3% according to the extent of scouring, the efficiency of the acid wash, and the alkalinity of the final wash water. No values for rayons approaching those for raw cottons (1·2–1·3%),[13] or the high values for Givet and Lyonnaise viscose rayon given by Kami (Table V), have been found by the present authors.

As previously found for bleached cottons, ash alkalinity runs parallel to ash content, but if these quantities are plotted against one another it is found

Table V

Properties of Rayons

(Y. Kami, *J. Cellulose Inst.*, Tokyo, 1929, **5**, 234–236).

Type of Rayon	Ash %	Fat %	Water Solubility %	Sulphur Content %
Japanese I Viscose	0·12	0·42	1·80	0·02
Japanese II ,, ...	0·18	0·50	2·22	0·03
Japanese III ,, ...	0·24	0·58	2·36	0·03
Japanese IV ,, ...	0·15	0·23	1·21	0·03
Courtaulds' Viscose	0·24	0·59	1·89	—
Western Viscose	0·16	0·67	—	—
Glanzstoff Viscose	0·28	0·47	—	—
,, ,, ...	0·57	0·28	—	—
Borvisk Viscose	0·21	0·62	—	—
Glanzfaden Viscose	0·15	0·33	—	—
Viscosa Viscose	0·15	0·84	—	—
Spinfaser Viscose	0·05	0·36	—	—
Spinnstoff-Glauchau	0·10	0·17	—	—
Spinnstoff-Zehlendorf	0·08	0·76	—	—
Fr. Küttner	0·11	0·31	—	—
Glanzstoff	0·20	0·20	—	—
,, ...	0·33	0·51	—	—
Enka Viscose	0·25	0·70	—	—
Breda Viscose	0·25	0·18	—	—
Chatillon Viscose	0·27	0·61	—	—
,, ,, ...	0·20	0·61	—	—
Snia Viscose	0·33	0·30	—	—
,, ...	0·39	0·29	—	—
Vareda Viscose	0·59	0·12	—	—
La Soie Artificielle Borvisk Viscose	0·59	0·72	—	—
,, ,, ,,	0·48	0·77	—	—
Italiana della Viscosa	0·25	0·15	—	—
National de la Viscose	0·21	0·57	—	—
Besançon Viscose	0·35	0·62	—	—
,, ,, ...	0·80	0·49	—	—
Givet Viscose	0·32	0·59	—	—
,, ...	1·84	0·65	—	—
Izieux Viscose	0·33	0·84	—	—
Française de la Viscose ...	0·40	0·44	—	—
St. Etienne Viscose	0·31	0·18	—	—
Lyonnaise Viscose	0·37	0·88	—	—
,, ,, ...	2·07	0·25	—	—
Mulhouse Viscose	0·57	0·22	—	—
Valenciennes Viscose	0·19	0·24	—	—
Strasbourg Viscose	0·23	0·15	—	—
Viscose Suisse Emmenbrücke ...	0·23	0·73	1·50	—
Rorschach Viscose	0·20	0·59	—	—
Anversoise Viscose	0·50	0·17	—	—
Obourg Viscose	0·23	0·43	—	—
,, ,, ...	0·31	0·48	—	—
Tubize Viscose	0·27	0·48	—	—
,, ,, ...	0·19	0·46	—	—
Japanese IV Cuprammonium ...	0·79	0·25	1·54	—
Bemberg Cuprammonium ...	0·21	0·18	—	—
,, ,, ...	0·21	0·48	—	—
,, ,, ...	0·13	0·64	—	—
Fr. Küttner Cuprammonium ...	0·25	0·32	—	—
,, ,, ...	0·20	0·45	—	—
,, ,, ...	0·17	0·17	—	—
Japanese IV Acetate	0·07	0·30	1·96	—
Corona Wood Pulp	0·03	0·41	0·97	—
V. S. Wood Pulp	0·31	0·38	1·52	—
Kippawa Wood Pulp	0·30	0·35	—	—

that points for all the samples examined lie on one or other of two curves (Fig. 1), so that the materials are divided into two broad classes. This behaviour is reflected by the values of ash alkalinity per gram of ash, which show that the Courtaulds' viscose rayons, Durafil, and Nuera Lilienfelds, and Vistra have low values of 10–14, while the remainder have values near to 20 or over. This may be explained by the fact that the ash of the materials of high ash alkalinity per gram of ash contains a larger proportion of substances, such as oxides, carbonates, etc., which are capable of neutralising dilute mineral acid, whereas the remainder are richer in such materials as silica or neutral salts like sodium sulphate.

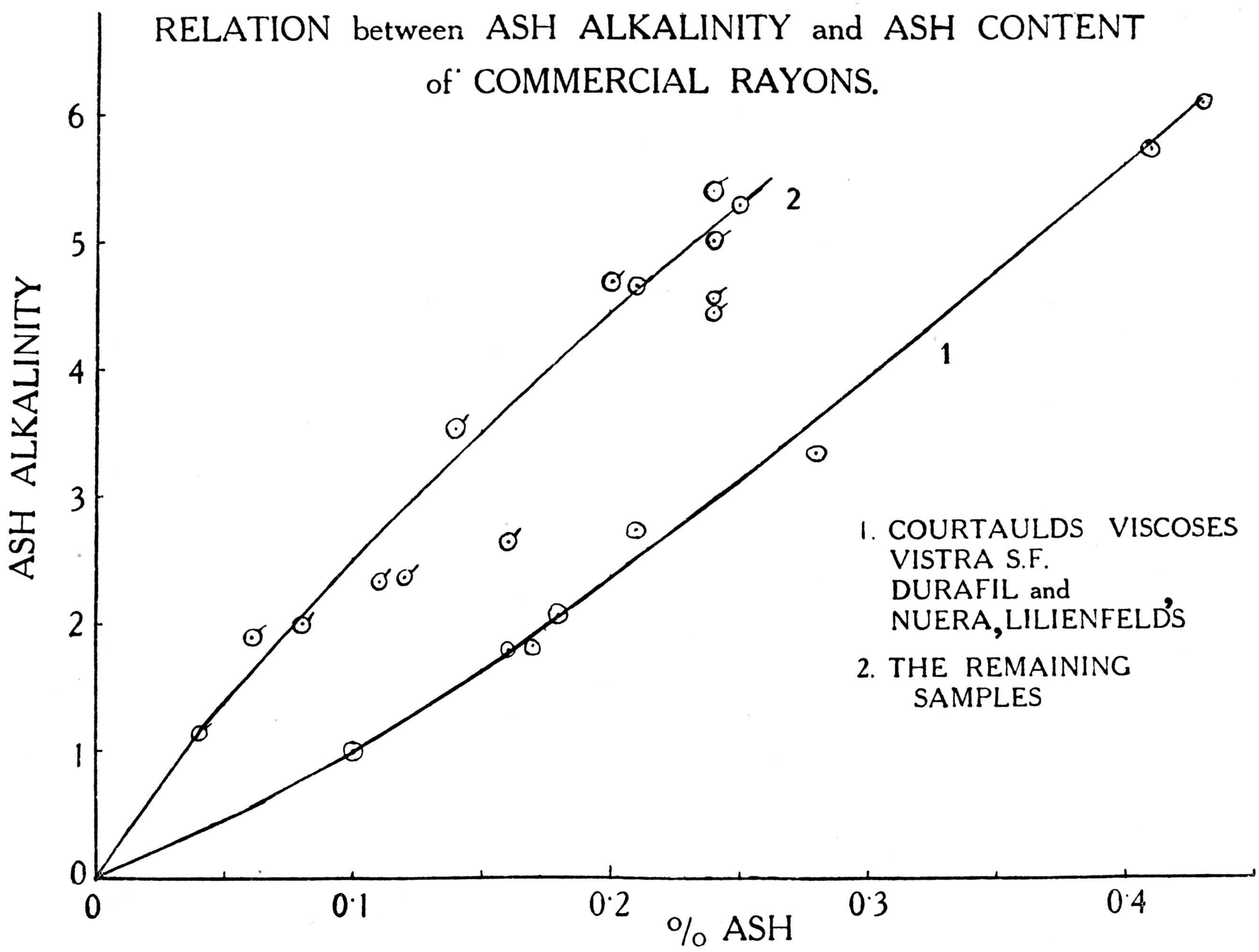

FIG. 1

Material Extractable by Solvents

Under this heading is included all material removed from the rayons under the conditions employed, irrespective of its composition, and no attempt has been made to analyse it into its components. Such material may be derived from the external dressings applied to the yarns after their manufacture, from oil incorporated in the filaments for delustring purposes (e.g. Dulesco and Dulenza yarns), from fat and wax residues from the wood pulp or cotton originally used, or from any other soluble or mechanically removable impurities. When mineral or other oil has been mixed with the viscose solution before spinning, it is impossible to remove it to any great extent by one extraction process such as that given in the present instance, but since the yarns were always treated with dilute mineral acid before extraction, all soap (part of which would otherwise have remained on the material) was removed. The solvents used were ether and chloroform, except for the acetate rayons, when only ether was employed, and the results obtained are collected in Table VI, while mean results for the ether extractions only are also given in Table I, facing p. T118. In general, the values obtained by extraction with chloroform are lower than those with ether, exceptions to this being those for the Bemberg and Brysilka cuprammonium yarns. Table V, p. T131, shows the values obtained by Kami, but since no definite particulars of his treatment of the yarns is available, no strict comparison can be made between the sets of results here given. According to Kami, the "fat content" range is about 0·2–0·9% for all varieties, and the values vary according to the country of origin of the rayon; German and Italian yarns have low, and French and Swiss high values. The range now recorded for normal material that has not been dressed after manufacture is about 0·1–0·8%, and therefore agrees with that given by Kami, but the values for the Bemberg cuprammonium and the acetate yarns are considerably higher on account of oil, soap, etc., applied externally. As already mentioned above, the undesulphurised Tudenza viscose rayon also has a high value owing to the ease with which sulphur is removed from it mechanically during the extraction with solvent.

The lowest values obtained correspond with the fat and wax content of well-scoured cotton yarns, namely, 0·1–0·2%, and, indeed, figures lower than this are hardly to be expected.

Table VI
Extractable Material in Commercial Rayons, %

Variety	Ether	Chloroform
Viscose—		
"A" Quality	0·57, 0·57; mean 0·57	0·49
Escorto	0·21, 0·20; ,, 0·21	0·17
Dulesco	0·67, 0·94; ,, 0·80	0·63
Dulenza	0·54, 0·57; ,, 0·56	0·57
Tudenza	1·37, 1·35; ,, 1·36	1·28
Celta	0·31	—
Harbens	0·11, 0·12; ,, 0·12	—
Obourg	0·09	—
Snia	0·15	0·12
Lilienfeld—		
Durafil	0·50, 0·48; ,, 0·49	0·39
Tenasco (bleached)	0·24, 0·24; ,, 0·24	0·18(unbleached)
Cuprammonium—		
Brysilka	0·25, 0·22; ,, 0·24	0·32
Bemberg	2·01, 2·06; ,, 2·04	2·93
I.G. Bemberg	2·64, 2·42; ,, 2·53	—
Acetate—		
Seraceta (75 den., 1928)	2·00, 1·90, 2·02; mean 1·97	—
Celanese (150 den., 1930)	2·00, 2·00, 2·00; ,, 2·00	—

Sulphur Content

The range found for desulphurised viscose and all other types of rayon is about 0·005 to 0·1%, with a mean value of 0·032%, while for the undesulphurised Tudenza viscose rayon the content is 0·35% (see Tables I and VII). Desulphurisation therefore appears to reduce the sulphur content to, quite roughly, a tenth of its original value for the undesulphurised unbleached material. Kami[16] has shown that the value for viscose rayons can never be reduced to zero by the use either of sodium sulphide or of ammonia solutions. If the latter are used in air-tight vessels, the content may be reduced to about 0·1%, which is lower than the minimum value for treatment with sodium sulphide, but no viscose rayons have been found

Table VII

Sulphur Content of Commercial Rayons

Variety	% Sulphur	Mean
Viscoses—		
Courtaulds' "A"	0·013, 0·012	0·013
,, Dulesco	0·030, 0·032	0·031
,, Dulenza	0·031, 0·036	0·033
,, Escorto	0·005	0·005
,, Tudenza	0·375, 0·381	0·378
Harbens'	0·010, 0·009	0·010
Snia	0·023	0·023
Obourg	0·021	0·021
Celta (hollow)	0·024, 0·021	0·023
Staple Fibre—		
I.G. Vistra	0·074	0·074
Courtaulds' Fibro	0·046, 0·045	0·046
Lilienfeld—		
Courtaulds' Durafil	0·023, 0·019	0·021
Nuera Tenasco	0·055, 0·061	0·058
Cuprammonium—		
Brysilka (old sample)	0·027, 0·021	0·024
,, "C" quality	0·006	0·006
Bemberg	Trace	Trace
Acetate—		
Courtaulds' Seraceta	0·034, 0·035	0·035
Celanese	0·052	0·052
Nitrocellulose—		
Obourg	0·097	0·097
Wood Pulp—		
Bleached	0·049, 0·050	0·050

Table VIII

Composition of Commercial Rayons

(Wahl and Rolland, *Rev. Gen. Mat. Col.*, 1929, **33**, 1–4).

Variety	Copper Number	% Sulphur	% Ash
Tubize (Nitro)	3·0	0·24	0·1–0·56% according to nature of rayon. Celta (hollow filament), 0·30%
,, Marron Clair	2·93	0·33	
,, Gris Clair	3·11	0·41	
Valenciennes Viscose unbleached	0·85	0·26	
Viscose	0·96	0·39	
,, bleached	0·73	0·21	
Celta, unbleached	1·19	0·32	
,, dyed	0·85	0·28	
Chardonnet (old sample) ...	3·02	1·08	
Cuprammonium 60 den. ...	0·68	0·42	
,, 100 den. ...	0·51	0·20	
Wood Pulp—			
Swedish, bleached ...	2·5	—	
,, half bleached ...	2·0	—	
,, unbleached ...	1·2	—	
Sulphite, bleached ...	1·9	—	
,, unbleached ...	0·8	—	

from which sulphur is entirely absent. Kami's values (Table V) of about 0·03% are confirmed by the above, but the range given by Wahl and Rolland (Table VIII) of 0·2–0·4% is comparable only with that now found for undesulphurised viscose rayon. Obourg nitrocellulose rayon has the fairly high value of 0·1%, whilst those for Tenasco (Lilienfeld) and Celanese (acetate) yarns are somewhat higher than the normal figure for viscose rayons. Bemberg cuprammonium yarn made from cotton linters has a negligible sulphur content, whereas the 1928 quality Brysilka has the normal value for viscose rayons (0·02) and the 1930, C, quality contains only 0·006%, which is very low for a rayon prepared from wood pulp.

Copper Content

The values recorded in Table I are expressed as mgm. of metal per 100 gm. of dry material, and when it is seen that for the majority of samples they are less than 1 (i.e. the copper content is less than 0·001%, or 1 part in 100,000), it is realised how very small this content is. In these circumstances the mean results obtained by the three different methods used show as good agreement as can be expected, especially in view of the fact that absolute uniformity of metal content is hardly realisable in practice. Some of the values obtained in individual experiments varied between wide limits, especially with the 1928 quality of Brysilka, when, by the gravimetric method, results from about 1·5 to 26 mgm. per 100 gm. were obtained in ten experiments, with a mean of 9·1, although the mean of six, excluding the extreme values, was 7·4, which agrees well with the mean found by the colorimetric method. In others, and especially with the acetate samples, the variation between individual results was comparatively small.

It might be expected that the greatest values would be shown for cuprammonium rayons, but this is not so. It is true that the highest values recorded in Table I are for the 1928 Brysilka, but considerable improvements have recently been made in the manufacture of this material, as shown by the properties of the "W" and "C" qualities; the latter is the standard material now supplied, so that this and not the 1928 quality must be regarded as representative of this product.

The highest values, then, are given by the acetate and the Tenasco Lilienfeld rayons, for which the range is about 1·6 to 9 mgm. per 100 gm., while the mean value for normal desulphurised viscose rayons is 0·22, and that for the cuprammonium varieties (excluding the 1928 Brysilka) is 0·56. Courtaulds' Fibro staple fibre and Durafil Lilienfeld have values within the viscose range, and Vistra staple fibre has the slightly higher mean value of 0·82.

The catalytic effect of copper in accelerating chemical reactions increases with increasing amounts of the metal present, but since the amounts found in the varieties of rayon examined are so small (except for the 1928 Brysilka, and the Seraceta acetate and Tenasco Lilienfeld yarns) the danger of catalytic action during bleaching due to the presence of this metal may be considered negligible. Nevertheless there can be no doubt that efficient removal of copper from such yarns is highly desirable in order that the possibility of this action may be entirely excluded.

Iron Content

The iron content of the rayons examined varies within narrower limits than the copper content. The range is about 1 to 4·2 mgm. per 100 gm. of dry material, and this value is so small that effects due to the presence of this metal must also be considered of no importance. Viscose yarns have the smallest content, about 0·7–2, while all the other varieties have values between 2·3 and 4·2, and the highest content is again shown by the 1928 Brysilka.

EXPERIMENTAL SECTION

Materials—The yarns employed are adequately described in the Introduction and Tables.

Sampling—A quantity in excess of that required for the experiments was taken from one or more hanks of the rayon, cut into 1-inch lengths, thoroughly mixed by hand, and sampled by the quartering method; sufficient material for both moisture determination and analysis was taken from it.

Moisture Content—Unless otherwise stated, in order to obtain the dry weight of material to be used in calculating the results, 0·5 gm. samples were weighed out at the same time as the amounts taken for analysis, and dried for three hours at 105–110° C. in an electric oven.

Methods of Measurement

Several of the analytical methods used have been described in previous publications from the Shirley Institute, to which brief references are given. In other determinations more or less well-known methods of analysis have been modified to suit requirements, and the experimental procedure is given in detail.

(1) *Copper Number*—The Schwalbe-Braidy method as examined by Clibbens and Geake[7] was used.

(2) *Methylene Blue Absorption*—This was determined on 2·5 gm. samples of air-dry rayon by the titrimetric method previously described,[3] except that a solution buffered to *p*H 7, as recommended by Clibbens and Geake,[8] was used.

(3) *Loss of Weight on Boiling with Alkali.*[4]

(4) *Fluidity in Cuprammonium Hydroxide Solution*—The method and apparatus described by Clibbens and Geake[9] were used, except that the concentration of cellulose in the solutions was 2% instead of 0·5%.

(5) *Acetic Acid Content of Acetate Rayons*—Both the Ost[18] and the Barnett[2] methods were employed.

(6) *Ash Content and Ash Alkalinity.*[3]

(7) *Material Extractable by Solvents*—The material was washed with acid and then with water, dried, and extracted, with ether in one series of experiments, and with chloroform in another, and the dry residues from the extracts were weighed.

(8) *Sulphur Content*—Samples of the rayon were ashed with concentrated hydrochloric and nitric acids, and the sulphate in the residue was precipitated and weighed as barium sulphate.

(9) *Copper Content*—Three methods of analysis were used for this measurement—(*a*) Direct precipitation of the metal as thiocyanate from a solution of the ash, and weighing as such[22]; (*b*) an indirect method, using as a measure of the copper content the catalytic effect of copper in accelerating the reduction of ferric salts by sodium thiosulphate solution[1,14]; and (*c*) the colorimetric method with diethyldithiocarbamate described by Callan and Henderson.[6]

(10) *Iron Content*—A modification of the method of Knop[17] was used, in which the metal, present in the ferrous state, was titrated with potassium dichromate solution, diphenylamine being used as indicator.

Experimental Procedures

Measurement of Fluidity.

The importance of the fluidity measurement as applied to cotton and chemically modified cotton is now quite generally recognised, so that the extension of this test to rayons of the regenerated cellulose type follows as a natural consequence. In this extension it is very desirable that the apparatus and experimental conditions employed for cotton materials as described by Clibbens and Geake[9] should be retained as far as possible, but whereas the fluidity of a 0·5% solution in cuprammonium of a well-scoured cotton under these conditions is about 1–3, and the time of outflow from the viscometer is about 15–20 minutes, that of a similar solution of a normal viscose rayon is 35–40, and the corresponding time of outflow is about one minute. The latter is much too short to be satisfactory when it is remembered that any slight overbleaching or acid attack of the rayon decreases the time of outflow still further, hence an alteration in the experimental conditions for rayon is necessary. As the alternative to modification of the standard viscometer, a change in the cellulose concentration of the solution is to be preferred, and the adoption of 2% for rayons instead of 0·5%, all other conditions remaining the same, has been found to give reasonably low values for the normal unmodified materials, and to allow of a convenient range of higher values for those that have suffered chemical attack. Thus, Table I shows that under these conditions the fluidity of normal viscose rayons is about 9–11·5—values that may be compared quite arbitrarily with the value 10 for cotton in 0·5% solution, which is tentatively accepted as the upper limit for technically bleached material—and figures in excess of this are indicative of overbleaching or attack by acids.

For the remaining varieties, other than nitrocellulose or acetate rayons, lower initial values are obtained; those for the nitrocellulose material are high but of minor importance, since this is seldom met with in British textile fabrics, and no values for acetate rayon are recorded because comparison between such values and those for all-cellulose materials is impossible owing to the difference in chemical composition of these types.

Results of a detailed investigation of the relation between fluidity and the tensile strength of rayon yarns will be published later.

Transfer of the rayon to the standard viscometer is facilitated by weighing the finely cut up material in a short piece of glass tubing open at both ends, instead of on a watch glass, inserting small corks in the ends to prevent loss while the remaining samples are being weighed, and then withdrawing the corks, placing the tube a short distance inside the upright viscometer, which is partly filled with cuprammonium solution, and pushing out the contents with a plunger formed from a piece of glass rod round the end of which a piece of rubber tubing is fixed so as to give a tight fit between it and the walls of the tube (see Fig. 2).

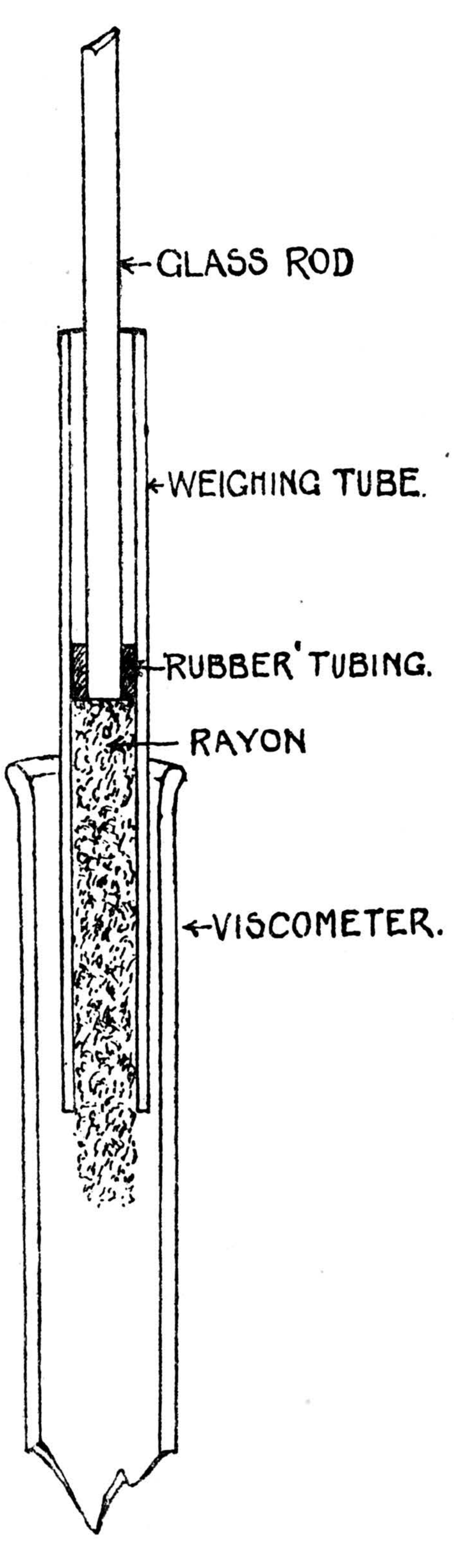

FIG. 2

In this way loss is avoided and the transfer is quickly and neatly accomplished. Further, if the same tube is always used with the same viscometer, its weight and that of the cellulose necessary to give a 2% solution in the particular viscometer can be recorded, and time is saved when a series of routine measurements is to be made.

Acetic Acid Content.

Ost's Method[18]—Samples of air-dry material weighing 0·5 gm., of known moisture content, cut up and separated as far as possible into individual filaments by brushing between two pieces of card-clothing, were treated in small tubes or stoppered flasks with 5 c.c. of 50% (volume) sulphuric acid for 20–24 hours at room temperature. The resulting liquid was diluted to 100 c.c. with water, transferred to the flask of a steam distillation apparatus, and subjected to distillation until, after 2–2½ hours, the last 50 c.c. of distillate required only one drop of 0·2*N* sodium hydroxide solution to develop the colour of the phenolphthalein indicator. The acetic acid content of the sample was calculated from the alkali titre, and expressed as grams of acid per 100 gm. of dry acetate rayon.

Barnett's Method[2]—One-gram samples of the finely divided, air-dry, material were dissolved in pure, redistilled acetone, 10 c.c. of 1*N* sodium hydroxide solution were added, the mixture was shaken continuously for some minutes to prevent gel formation, phenolphthalein indicator was added, and the whole allowed to stand at room temperature for 24 hours. After this time 10·5 c.c. of 1*N* sulphuric acid were added, the mixture was shaken during half an hour, and the excess of sulphuric acid was titrated with 0·1*N* sodium hydroxide solution. Blank experiments on the reagents in the absence of acetate rayon gave a mean value of 0·12 c.c. of the sodium hydroxide solution to be deducted from the above titre, and the percentage of acetic acid present was then found in the usual way.

Sulphur Content.

A micro-method for the determination of combined sulphuric acid in cotton has been elaborated by Clibbens and Geake,[10] but the method of ashing adopted by them—ignition of the cellulose material, previously wetted with a dilute solution of sodium carbonate, in a porcelain or silica crucible, is unsuitable for use with rayons when greater amounts of material are taken, first, because sulphur is sometimes present largely in the elementary condition or as compounds other than sulphate, and, secondly, because the use of sodium carbonate solution in amount sufficient to wet the material results in attack of the silica vessel during ashing, and in the formation during the subsequent operations of a silica gel which apparently retains sulphur somewhat tenaciously since lower values were always obtained when silica or porcelain vessels were used than when the ashing was performed similarly in a platinum dish.

The following procedure was therefore adopted and found to give reproducible results (see Table VII).

About 10 gms. of sampled material, in pellet form, were introduced into a 250 c.c. Kjeldahl flask, and 20 c.c. of pure concentrated hydrochloric acid were added from a measuring cylinder. When all the pellets were wetted, 60 c.c. of concentrated nitric acid were poured in, the flask was gently shaken and cautiously heated over the flame of a micro-burner until a homogeneous liquid was obtained. Shaking was continued at intervals during this time (about half an hour), and the liquid was then evaporated to small bulk, care being taken to avoid charring. At this stage it was generally observed that a certain amount of mucilage and scum was present in the flask; this resisted further attack by the acids under the somewhat mild conditions of heating employed. The scum was specially noticeable with Dulesco and other yarns in which mineral or other oil was present either as a partial delustring agent or as a dressing, and it appeared to be connected with the presence of this oil. Substances such as vaseline and some oils give a somewhat similar scum on treatment with acids under these conditions. The mucilage, on the other hand, resulted from the degradation of the cellulose itself. In order to remove this material before precipitation of the sulphate, the contents of the flask, diluted with 20 c.c. of water, were washed into a centrifuge tube and centrifuged at a high speed for 10–15 minutes. The clear supernatant liquid was transferred to a beaker, the residue washed with boiling water and again centrifuged two or three times, and the washings were added to the contents of the beaker, whilst the residue was rejected. Sulphur was never detected in an elementary analysis of this residue.

The contents of the beaker, amounting to not more than 80 c.c. were heated to boiling, 5 c.c. of 0·2*N* hydrochloric acid and 10 c.c. of a filtered and boiling 0·1*N* solution of barium chloride were added, and the mixture was left to digest for two hours on the top of a steam oven. Finally, the precipitated sulphate was collected on a fine filter paper, washed, dried, and ignited in the usual way. Since ignition of the filter paper in contact with the precipitate causes reduction of some of the sulphate to sulphide, the residue was treated with 2–3 drops of concentrated sulphuric acid and re-heated before cooling and weighing. The results obtained, expressed as grams of sulphur per 100 gm. of dry material, are given in Tables I and VII.

The Effect of Mercerisation on the Chemical Properties of Cotton

The processes concerned in the manufacture of rayons generally involve swelling of the cellulose to a greater or less degree, and it might be thought that this swelling, as distinct from chemical action, would be partly responsible for the higher values of such properties as fluidity, copper number, methylene blue absorption, and loss of weight on boiling with alkali of these materials as compared with those of normal, purified cotton. This, however, is very unlikely since, as already stated on p. T120, increasing the degree of dispersion of the cellulose by mercerising cotton with sodium hydroxide solutions, produces no significant increase in these properties, and there is no reason why the greater dispersion which obtains, for example, with viscose rayon should have such an effect. Evidence, in support of that already published, of the fact that mercerisation causes no increase in the above properties of cotton is given by the results of the following investigation.

Hanks of the cotton yarns specified in Table IX were given the same scour with 1% sodium hydroxide solution at 40 lb. excess pressure for six hours, washed with water, and centrifuged. Each hank was then cut in two, one set of halves was mercerised with 9*N*-sodium hydroxide solution. without tension, and washed with hot water, and all portions were soured with hydrochloric acid and washed with distilled water until neutral. The moisture content of these air-dried samples was determined separately for each experiment, and measurement of the particular property was made on the cut-up and well mixed material. Fluidity measurements for the corresponding mercerised and unmercerised cottons were made in the same viscometer in order to avoid slight variations due to the use of different instruments.

Results are given in Table IX, and it is shown that there is no significant increase in the respective values as a result of mercerisation. Slightly higher values for loss of weight on boiling with alkali are shown for some of the samples, but strict accuracy is hardly to be expected here owing to difficulties in manipulation, and to the fact that the loss is determined by finding a small difference between two relatively large weights.

Table IX

Effect of Mercerisation on the Chemical Properties of Scoured Cottons

Variety	Unmercerised				Mercerised			
	Fluidity	Copper Number	Methylene Blue Absorption	Loss of Wt. in Alkali Boil %	Fluidity	Copper Number	Methylene Blue Absorption	Loss of Wt. in Alkali Boil %
Egyptian Sakel	3·68	0·01	1·17	1·32	3·70	0·01	0·96	1·23
,, Uppers	3·38	0·01	1·10	1·20	3·34	0·01	0·95	1·31
Tanguis ...	3·47	0·015	1·24	0·84	3·42	0·01	1·09	1·28
Arizona ...	3·87	0·01	1·35	1·37	3·67	0·01	0·98	1·30
Peru Mitafifi	3·52	0·01	1·03	0·88	3·21	0·01	0·88	1·0

Many of the measurements recorded above were made by Mr. H. Bowden and Mr. H. S. Cliff.

REFERENCES

[1] Baines. J. Soc. Chem. Ind., 1929, **48**, T303.
[2] Barnett. J. Soc. Chem. Ind., 1921, **40**, T9.
[3] Birtwell, Clibbens, and Ridge. Shirley Inst. Mem., 1923, **2**, 227; or J. Text. Inst., 1923, **14**, T297.
[4] Birtwell, Clibbens, and Ridge. Shirley Inst. Mem., 1924, **3**, 321; or J. Text. Inst., 1925, **16**, T13.
[5] Caille. Chim. et Ind., 1928, **19**, 402.
[6] Callan and Henderson. Analyst, 1929, **54**, 650.
[7] Clibbens and Geake. Shirley Inst. Mem., 1923, **2**, 383; or J. Text. Inst., 1924, **15**, T27.
[8] ,, ,, Shirley Inst. Mem., 1926, **5**, 19; or J. Text. Inst., 1926, **17**, T127.
[9] ,, ,, Shirley Inst. Mem., 1927, **6**, 117; or J. Text. Inst., 1928, **19**, T77.
[10] ,, ,, Shirley Inst. Mem., 1927, **6**, 34; or J. Text. Inst., 1927, **18**, T168.
[11] Clibbens, Geake, and Ridge. Shirley Inst. Mem., 1927, **6**, 65; or J. Text. Inst., 1927, **18**, T277.
[12] Farrow and Neale. Shirley Inst. Mem., 1924, **3**, 67; or J. Text. Inst., 1924, **15**, T157.
[13] Fargher and Probert. Shirley Inst. Mem., 1925, **4**, 175; or J. Text. Inst., 1926, **17**, T46.
[14] Hahn and Leinbach. Ber. deut. chem. Ges., 1922, **55**, 3070.
[15] Kami. J. Cellulose Inst., Tokyo, 1929, **5**, 234.
[16] Kami. Brit. Chem. Abstr., *B*, 1930, p. 607.
[17] Knop. J. Amer. Chem. Soc., 1924, **46**, 263.
[18] Ost. Z. angew. Chem., 1919, **32**, 82.
[19] Reinthaler, trs. Rowe. "Artificial Silk," p. 129 (London, 1928).
[20] ,, ,, "Artificial Silk," p. 179 (London, 1928).
[21] Ristenpart. Seide, 1928, **33**, 195.
[22] Treadwell and Hall. "Analytical Chemistry," Vol. II, p. 186 (New York, 1919).
[23] Wahl and Rolland. Rev. Gen. Mat. Col., 1929, **33**, 1.

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THE JOURNAL OF THE TEXTILE INSTITUTE

ABSTRACTS

LIST OF ABSTRACTORS

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

British Cotton Industry Research Association	C.
British Launderers' Research Association	La.
Wool Industries Research Association	W.
British Silk Research Association	S.
Linen Industry Research Association	L.
Water Pollution Research Board	D.
F. Grove-Palmer	P.
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T. Hollis	Ho.
Textile Institute	T.

NOTES—In the references to publications abstracted the name of the publication is followed by the year, Vol., Issue No., or date if necessary, and Page No. (or Nos.).

Literature relating to the composition and manufacture of dyestuffs is not dealt with in the abstracts of this *Journal.*

1—FIBRES AND THEIR PRODUCTION

(B)—ANIMAL

The Dependence of Thyroid Development on Breed, Age, Sex, and Season in the Different Breeds of Sheep. W. Spöttel. *Zeit. f. Anat. u. Entwicklungsgeschichte,* 1930, 89, 5-6.

It was found during the course of this study that there is a correlation between the breed type and the weight of the thyroid. The author believes that there is a connection between variation in this characteristic and early and late maturity. He refers to the possibility of the influence of the seasonal cycle of the thyroid on the development of the coat, and states that removal of the thyroid increases the fineness of the wool. W.

The Term "Character" as Applied to Merino Wool. P. D. Rose. *Farming in S. Africa,* 1930, 5, 134-135.

Quotations are given from various writers in order to show that the term "character" is applied rather loosely to mean rather different things. The author's conclusion is that if the term is to be used at all it should be used in the following sense and with the following restrictions—" 'Character' in wool means a combination of expressions, qualities, or peculiarities which, when considered in combination, serve to distinguish the wools of different breeds. The term 'character' can be used to advantage when describing the wool from a poorly bred sheep, which, while indicating the existence of certain blood, lacks definite expression of the peculiarities that characterise that breed. Such wools may be said to lack breed character. Whenever the term 'character' is used, it must always be accompanied by the name of the breed concerned, e.g. Merino character, Lincoln character, etc. Its complete elimination is definitely recommended when a comparison of wools from the same breed is made. Criticisms or comparisons of wools from the same breed should be expresed in terms of its other attributes, such as quality, length, fineness, etc." W.

Structure and Pigment of Horsehairs, also Racial Differences. G. Lodemann. *Biol. Abs.,* 1930, 4, 228 (from *Zeit. Tierz.,* 1927, 9, 349-454).

This is a report of investigations upon large samples from ten animals of each of the following breeds of horses—Belgian, Pinzgauer, Oldenburger, and English and Arabian thoroughbred. The histology of horsehair is described in detail. The unpigmented hairs usually are longer and thicker than the pigmented ones in the same animal; the cross-section of the unpigmented hair is always somewhat more elliptical than that of the pigmented hair. Red and black hair contain differently stained pigment granules, of approximately the same size; the same is true for Isabella and cream-coloured hair. From chemical and optical investigations, it is concluded that there is, in the different types of hair, a pigment of the same chemical nature but of different degrees of oxidation. The length of the hair just above the hoof of the forelegs can be used to characterise the breeds; it is shorter in the thoroughbred animals than in the others. In stallions the hair in this place is somewhat longer than in mares. The diameter of the hair in this region also is typical for the different breeds, although to a less striking degree. The cross-section of the centre of the hair shows sexual differences; it is rounder and usually of greater diameter in stallions than in mares. Only in the English thoroughbred horse the cross-section forms a breed character; here it is an almost perfect circle. The relation between the average diameter of the hair and the average diameter of the medulla of the hair shows typical breed differences in the hair of the withers; the medulla is relatively large in the English and Arabian thoroughbred horse, much smaller in the Belgian and Pinzgauer, and intermediate in the Oldenburger. W.

Sheep Breeding Investigations at the New Hampshire Station. E. G. Ritzman. *Exper. Sta. Rec.*, 1930, 63, 219 (from *New Hants. Sta. Bull.*, 250 (1930), pp. 20-21).

Studies of inbreeding in sheep, by E. G. Ritzman, over a period of 15 years, during which no outside blood was introduced for seven generations, resulted in a decrease in size, even with constant elimination of the small-sized individuals. There was, however, no reduction in fertility, and the percentage of twins increased. Further studies indicated that higher milk-yielding capacity was associated with the multi-nipple characteristic, but few individuals have been produced with more than two functional nipples. Other studies on the effect of crossing coarse and fine wool breeds indicated that the crossbreeds are intermediate. W.

Studies of Wool Growth. H. Hackedorn and J. Sotola. *Exper. Sta. Rec*,. 1930, 63, 263 (from *Wash. Col. Sta. Bull.*, 237 (1929), pp. 19-20).

In co-operation with the Bureau of Animal Industry, United States Department of Agriculture, the authors have made a study of the rate of growth of the wool of Rambouillet sheep. The results of four years' work have shown no marked variation in the average length growth of staple of wethers shorn in the usual manner and those carrying a four-years' fleece. The fleece of a wether unshorn for four years weighed 62 lb. and averaged 10 inches in length. The gains in body weight were quite uniform in the two groups, considering the fleece that the unshorn wethers carried. There was little difference in the length of staple grown in winter and summer, nor was there any significant difference in the length of staple grown the first and fourth years. Little difference was found in the length growth of wool of two lots of ewes, one of which was bred and one allowed to go dry. W.

Gonad Grafts in the Sheep Herds of Algeria. Moussu. *Biol. Abs.*, 1930, 4, 238 (from *C. R. Acad. Agric. France*, 1928, 14, 74-81).

Voronoff proved that aseptic transplantation of particles of testes removed from animals ten months to one year old to male animals will reinforce sexual qualities and be of economic use in increasing hair and meat production. Caution is enjoined by Moussu, who believes that proofs would be convincing only if twins were used in experiments, one serving as a control. The test animals should be studied before treatment. He does not believe that the stimulus would outlast resorption of the explantate, but thinks the experiment well worth further studies. W.

Wool from "Vegetable Sheep." W. B. Dall. *Text. World*, 1930, 77, 1378-1379.

Within the last year or two a variety of treated vegetable fibres has been promoted as wool substitutes. Low-priced spinnable fibres are numerous, starting with the widely used jute, sisal, and hemp, and running through the lesser exploited plants, such as ramie and pineapple fibre, to the fibre-bearing plants which grow over thousands of square miles in the tropics, but which so far have found little or no commercial use. Most of these fibres hold their place in commerce because workable into coarse, cheap materials, but so far they have found limited use and that principally in mixtures which possess the advantage of permitting two-colour effects through cross-dyeing. Jute and ramie are the two principal sources from which the new vegetable wools are derived. Information concerning ramie is quoted. Mention is made of some fibres which have been noteworthy in recent years. It is the opinion of impartial observers that the whole art of wool and vegetable blends will be more rapidly advanced when the various substitutes are offered quite plainly under their own names. In carpets and felts some conditions which limit the clothing industry do not appear, and this, consequently, offers a field for the development of wool substitutes. W.

Wool versus Artificial Fibre. *Text. Expt.*, 1930, 4, No. 42, p. 29.

The uses of rayon and its position in the textile trade and its uses when blended with wool are briefly referred to. W.

South African Wool. *Text. Expt.*, 1930, 5, No. 43, p. 21.

Features of current interest are discussed, with particular reference to the South African burr, alleged false packing, and bi-annual shearing. W.

Reducing Properties of Wool. *See* Section 9.

(C)—VEGETABLE

Cotton Lint and Seed: Effect of Soil Conditions on Quality and Yield. F. C. Vilbrandt and J. R. Murphy, jun. *Cellulose*, 1930, 1, 142-144.

Plots of cotton land were selected offering extreme soil conditions and both the seeds and fibres from the cotton grown on the various soils were examined. Since all the plots were purposely selected from the same farm, the weather conditions were constant and likewise the breed of seed planted on all the plots was the same. The lint was classified into good, medium, green, and dead fibres and the nitrogen and oil contents of the seeds were determined. The results are tabulated. These results show that the lint per cent. as a criterion for determining the merit or demerit of cotton fibre is misleading. A high lint per cent. ordinarily indicative of a superior cotton fibre may be due to the stunted or immature growth of the seed rather than to the full development of the fibre. The cotton seed is affected to a greater extent by extremes of soil condition than is the cotton fibre. The nitrogen content of the seed is fairly constant, ranging from 5% to 6% on the kernels, while the oil content is more variable. Where the condition of the soil is fairly constant the oil content of the cotton seed is a function of the percentage of normal fibres (good or medium) in the sample. The oil content of the seed is affected by soil conditions and by the maturity of the seed on the stalk. C.

Cotton Seed Sampling Machine. G. S. Meloy. *Oil and Fat Ind.*, 1930, 7, 337, 347.

The seed is fed by hand into a hopper through the bottom of which pass two narrow travelling belts. These draw out the sample of seed into a continuous ribbon which is later split by a divider so that the two halves fall into separate receiving boxes. Divisions of 1,000 g. of seed have been made in this way, the two halves of which did not exceed 1·5 g. in error. C.

Cotton Plant: Variety Tests. H. B. Tisdale and J. T. Williamson. *Exper. Sta. Rec.*, 1930, 62, 732 (from *Alabama Sta. Circ.* 55, 1930, pp. 8).

Varietal trials during the period 1926-1929 showed D. & P.L. 4-8, Cook 1010 (Williamson), Delfos, Trice, and Cook 1627 to lead in order in yields in North Alabama, and D. & P.L. 4-8, Dixie Triumph, Cook 1627, Cook 588, and Cleveland (Piedmont) in Central Alabama. In comparisons of wilt resistant varieties in Central and South Alabama, Cook 307 (Rhyne), Dixie Triumph, Toole (Council), Lewis 63, and Cook 307 (Bridges) led during these years. C.

Cotton Plant: Variety Trials in Antigua. *Rept. Agric. Dept. Antigua*, 1928-29, pp. 4-6.

Data relating to field characteristics, lint length, weight of 100 seeds, lint index, and ginning output are given for selections from Antigua, Montserrat, and Barbados types. Montserrat yielded seed cotton at the rate of about 7,400 lb. per acre. C.

Long Staple Cotton: Cultivation in the United States. O. F. Cook. *Trans. Natl. Assoc. Cotton Mfrs.*, 1929, **126**, 40-51.

A lecture and discussion on the prospects for the rehabilitation of the Sea Island, Allen Seed, and Peeler types of long-staple cotton in the U.S.A. The disadvantageous marketing conditions and the importance of one-variety communities are stressed. C.

Cotton Plant Diseases in Tanganyika. G. B. Wallace. *Rev. Appld. Mycol.*, 1930, **9**, 506 (from *Ann. Rept. Dept. Agric. Tanganyika Territory*, 1928/1929, Part ii, pp. 35-36, 1930).

During the period under review four new diseases were reported, viz. violet root disease (*Rhizoctonia crocorum*) [*Helicobasidium purpurem*] a leaf spot due to *Ascochyta*, a *Diplodina*, and *Gibberella monoliformis* which was found once in the conidial stage in open bolls. The only important diseases are those caused by *Bacterium malvacearum*, *Nematospora gossypii*, and *Mycosphærella gossypina*, which are present in the Tabora and Mwanza areas. C.

Boll Weevil: Control. *Exper. Sta. Rec.*, 1930, **62**, 757 (from *Georgia Coastal Plain Sta. Bul.* 11, 1929, pp. 20, 21.

The results of poisoning work extending over a period of six years are said to show conclusively the value of early poisoning and that the early applications should begin a week to ten days before squaring. Two, or preferably three, applications should be made at weekly intervals. Later applications can be made most efficiently with calcium arsenate dust. C.

Mechanical Cotton Pickers and Harvesters. *Int. Cotton Bull.*, 1930, **8**, 292-294.

The Durant Cotton Picker is a small light machine 2 ft. wide and 5½ ft. long, weighing about 300 lb. It carries a bag to hold 100 lb. of seed cotton and is pushed between the cotton rows by two men operating the two nozzles. The nozzle is held against the boll and each picker-head contains a pair of revolving aluminium rollers which pick the cotton and pass it to a flexible tube through which a current of air draws the boll to the sack. Before being deposited in the sack the boll is thrown against a metal screen which separates dirt and sand from the cotton. The makers claim that the current of air removes moisture from the lint so that the cotton may be picked when dew is still on the plants, and also that the grade and colour are improved. One drawback is that the machine fluffs out the bolls and in many cases separates the different locks, thus causing the lint to be gin-cut. The Smith Conrad "Combine" cotton harvester is a cotton stripper, cleaner, and huller combined. The single-row machine will harvest 5 to 7 acres a day. The machine is a sled, but the open cotton is picked separately and deposited in one receptacle, while the "bollies" pass on to the hull extractor which separates the lint from the hulls. C.

Methods for the Control of Flax Sickness of the Soil. A. N. Kletschetoff. *Rev. App. Mycology*, 1930, **9**, No. 12, p. 783 (from *Flax and Hemp Indus. News, Moscow*, 1930, **vii**, No. 6, pp. 488-500).

After giving a brief survey of the present state of knowledge in Russia and abroad of the condition of the soil known as "flax sickness," which his recent investigations have shown to be mainly due to the accumulation in the soil of fungi parasitic flax, e.g. *Colletotrichum lini*, *Fusarium lini*, *Thielavia basicola*, and others, the author discusses the lines on which the problem of its control may be saved. Observations in widely separated flax-growing regions of Russia, as well as in Eastern Europe and North America, have shown that in soils continuously sown to flax, "flax sickness" occurs in from two to five years, and that it appears soonest in loose, moist, and warm soils rich in humus. In the usual field practice the moment of the appearance of the conditions is difficult to determine, owing to its being frequently masked by a more vigorous state of the surviving plants, thus rendering crop yields in fibre and in seed an unreliable criterion. As established by the author, the organisms responsible for the disease can persist in the soil for at least six years, a fact which, unless immune or resistant varieties of flax are evolved and effective means are found for the disinfection of the soil, makes crop rotation systems of a shorter duration unsafe. So far no soil disinfectant is known that is both cheap and does not injure the flax plants, but promising results were obtained by preliminary experiments with copper sulphate, formalin, and particularly toluol, which, in pots with heavily infected soil, reduced the rate of mortality of the flax seedlings from 74·7 to 7·8%. In some localities of

Russia a fair measure of control was occasionally observed in fields where the vegetation was burnt before sowing the flax. Of 134 seed disinfectants tested, which included germisan, segetan, upsulun, and various German proprietary dusts, none gave satisfactory results; the only chemical which effectively controlled seed infection and did not impair the germination of the seed was concentrated sulphuric acid, in which the seed was dipped for three to five minutes and then washed in water. Of interest also is the statement that in 1918 the author isolated a micro-organism (the nature of which is not indicated) which, when added to actively growing liquid cultures of *Colletotrichum lini*, immediately arrested the development of this fungus and killed it in 20 days. No further description is given of this organism, which is termed "anti-Colletotrichum." L.

(D)—Artificial

Viscose Rayon: Shrinking. A. Wehrung. *Cellulosechem.*, 1930, **11**, 170-173.

When freshly-spun rayon is dried it shows a tendency to shrink. This shrinkage is accompanied by a development of energy and differs from that following swelling of the rayon in water. It may be regarded as the end of the coagulation process and may be compared with the phenomenon observed in the drying of freshly-precipitated metal hydroxides. These processes involve a change from the amorphous to the crystalline state and a surface condensation process. The effects of the conditions of precipitation of the viscose and the influence of the resulting surface development on the swelling and adsorbing powers, strength, and other properties of the rayon are discussed. C.

Cellulose Acetate: Development and Manufacture. P. Chaumeton and V. E. Yarsley. *British Plastics*, 1929, **1**, 275-277.

A review of the historical development and the methods of manufacture of cellulose acetate. C.

Cellulose Acetate: Manufacture and Application. C. J. Staud. *Cellulose*, 1930, **1**, 166-169, 191-194.

An indication is given of the progress which has been made in the technology of cellulose acetate and the general procedure for the preparation of cellulose acetate is outlined. The available plasticisers and solvents for cellulose acetate are discussed. C.

Rayon Bobbin Spinning Machine. C. Hamel A.-G. *Rayon Rec.*, 1930, **4**, 991.

One of the distinctive features of the new bobbin spinner is an automatic winder spindle reversing motion. With this mechanism, all the working spindles are arrested simultaneously and a second series of spindles is set to work, the threads being severed automatically from the full bobbins and transferred automatically to the empty spools. In this manner, a uniform thread is maintained from beginning to end of the spinning period of the bobbin, deviations in the denier-counts being completely eliminated. This motion reduces the number of operatives required. The new machine is also equipped with a mechanism which permits the length of the traverse, i.e. the width of rayon wound upon the bobbin, to be adjusted in an accurate manner during the spinning process; this is of special advantage when using perforated bobbins, as the holes must be well covered to ensure the best results in vacuum washing. The cams are completely enclosed in a box and immersed in oil, with the result that the action of the traverse motion is exceedingly light. Each driving shaft is connected with a cone pulley drive which automatically reduces the speed of the shaft in proportion as the diameter of the bobbin increases, thus enabling the threads always to be drawn off at a constant speed. The new machine is suitable for high filament speeds ranging from 50 to 100 metres per minute, according to quality and denier-counts, as against 30 to 60 metres in the old-type machines. C.

Mixed Cellulose Acetate and Cyanoacetates: Preparation. G. R. Levi. *Chem. Abs.*, 1930, **24**, 4387 (from *Bol. assoc. ital. chim. tese. col.*, 1930, **6**, 80-81).

Mixed acetic and cyanoacetic cellulose esters rich in nitrogen can be prepared, that spin like the triacetate and can be mixed in all proportions with its acetic solution. The -CN groups are transformed into -CONH by treating at 40-50° with alkali and hydrogen peroxide under conditions in which the triacetate is not altered. The preparations with -CN groups have a larger affinity for colours and principally for those with -CONH groups. By hydrolysis, further preparations are obtained with free carboxylic groups without saponifying the cellulose esters, which retain all the physical properties of the cellulose triacetate. C.

2—CONVERSION OF FIBRES INTO FINISHED YARNS

(A)—Preparatory Processes

Bale Opener. Howard & Bullough Ltd. *Text. Weekly*, 1930, 6, 105.

The new type of bale opener is designed to deal with very hard and matted bales. The machine is based on the ordinary hopper principle with an evener or regulating mechanism and a stripper or beater. The elevating medium consists of two spiked cylinders instead of a spiked lattice. The cotton from the bales is thrown on to the feed lattice in the usual way and carried into the hopper to be brought into contact with the first spiked cylinder, approximately 12 inches in diameter, rotating at 35 r.p.m., and having a surface speed of approximately 110 feet per minute. Co-operating with this small spiked cylinder and placed almost vertically above it is the second or larger cylinder, also spiked, approximately 27 inches in diameter, rotating at 12 revolutions per minute, and about 81 feet per minute. The function of the smaller roller is to convey the cotton to the larger opening cylinder from the feed lattice and, at the same time, due to its higher surface rate, allow a full charge of cotton to be presented to the spikes of the larger cylinder. To permit of variations in conditions as demanded by different cottons, the smaller spiked roller is adjustable vertically. A machine of this type operating on very hard pressed cotton is attaining a production of 2,400 lb. per hour. C.

Carding Engine: Effects of Change of Draft. S. H. Sherman (Arkwright's Inc.). *Text. World*, 1930, 78, 1337.

Bales of $1\frac{1}{16}$ in. strict middling Louisiana Peeler were used for the tests. The cotton was sprayed with 0·3% Breton E oil and run through parallel lines of machinery using drafts of 100, 120, and 140. The results of tests show that the 100-draft gave yarn with the highest breaking load and evenness and the lowest number of ends down in spinning. The 140-draft gave a cloudy and neppy web and neppy yarn with considerable amounts of fly and dirt on the roller beams and guides. C.

Rayon Staple Fibre and Rayon Waste: Application in Woollen and Worsted Industries. H. R. Woodward. *Text. World*, 1930, 78, 1512-1514.

A discussion of the use of rayon staple fibre and rayon waste in the woollen and worsted industries, and the methods of blending and processing on woollen and worsted machinery. C.

Rayon Waste: Mixing with Cotton. C. A. Weston. *Text. World*, 1930, 78, 1515.

Generally when rayon waste has been put through several beaters of a waste machine, it is carded on a waste card, put into sliver, and cut; or, if it is broken up well by the beaters, it is merely mixed with cotton, made into laps, and put through the usual cotton processes. Where only small amounts of rayon and cotton are to be mixed, the best method is to lay down a layer of rayon, a layer of cotton, a layer of rayon, etc. Where large quantities are to be mixed, hoppers can be used and the percentage regulated by altering the speed of the apron and rolls in the hoppers. When cotton processes are used for rayon and cotton mixtures, it is essential for the sake of evenness that the rayon stock to be mixed with the cotton be of the same length, or of slightly less length, than the cotton staple. Stock varying in diameter cannot be drafted out smoothly. The resulting yarn may not contain the same proportion of rayon as the original mixture since different machines tend to throw out more rayon than cotton. C.

Card Clothing Foundation. "Harmon." *Text. Amer.*, 1930, 54, No. 3, pp. 21-22.

The foundation of card wires is of much greater importance than is generally supposed, and to a certain extent the properties of the carding points and of the foundation are intimately linked together. This is discussed in detail with particular reference to the elasticity of the wire in relation to that of the foundation. The function of the card clothing is described. As a fundamental rule it may be laid down that carding without damage to the fibre is an utter impossibility, but there is a very early limit to beneficial damage in the way of breaking droughty wool fibres. In this connection some interesting experiments have been made. The wire and the clothing should be as fine as possible compatible with the quality of the carded sliver required. W.

Bates Type Wool Card. Whitin Machine Works. *Melliand*, 1930, **2**, No. 6, pp. 852-853.

The principle of this Bates type card, known as Model "L," is opposed to the older method of large diameter cylinder. Its working is fully described. This set of cards can be arranged for either belt drive or individual motor drive. W.

Automatic Feeding of Scribbling Machines. "Tex." *Wool Rec.*, 1930, **38**, 551-553.

Automatic hopper feeds give exceedingly good results in practice. Their main parts and working are described, their efficiency depending upon at least three factors—sensitiveness of the weighing mechanism, reliability of mechanism for giving accurate results, and convenience in making alterations. Improvements incorporated in the latest machine made by Messrs. John Haigh & Sons Ltd., of Huddersfield, are enumerated in detail. W.

Short Wools and Noils: A New Comb. E. Midgley. *Wool Rec.*, 1930, **38**, 783.

Investigations clearly indicate that the yarns produced from short wools rejected by the worsted industry, together with certain types of noils, possess properties which are not contained in yarns manufactured from the more expensive long shafty wool materials. Crossbred noils, and even remanufactured wool fibres, are capable of being made into most suitable yarn for hosiery and for use in the manufacture of lightweight, soft-handling dress fabrics. The fibres are more uniform in length and their diameter is finer than that of fibres constituting the staple top, thus providing better conditions for producing a uniform level yarn. The whole problem of the successful manipulation of this class of raw material is bound up with the use of the intersector gill box, and a combing machine with a new type of comb designed and built for processing short fibres. This comb has four heads, and it is claimed that each will process 10 lb. of wool per hour, thus giving an output of 40 lb. per hour, compared with 7 lb. per hour on the so-called French comb. There is no reason, however, why the number of heads should not be increased. W.

The Adjustment of the Lister Comb. "Spyndle." *Text. Rec.*, 1930, **47**, No. 563, pp. 51 and 53.

The Lister comb is used for dealing with long wools and hairs. During the preparing operation the material is converted from a staple formation and produced in a sliver form; long wools require backwashing. Unlike the Noble comb, there is no special method of feeding the Lister comb. The fallers used on this type of comb are compared with gill box fallers. The initial combing is done by means of the combination of the gill part of the comb and the nipper jaws. Setting the carrier comb, the circular comb alignment and the adjustment of drawing-off rollers are described. The noils are removed by means of lifting knives set between the rows of pins in the circle. W.

Use of Intersecting Gill-boxes. Hall & Stells Ltd. *Text. Mfr.*, 1930, **56**, 56-57.

The intersecting gill-box is in extensive use on the Continent, where it has been developed for the working of fine, short wools. Machines are now supplied on the Bradford type of frame. Their construction and working are described. W.

Twisting and Winding-on in Open Drawing. *Wool Rec.*, 1930, **37**, 687-689 and 692.

The function of twist in wool is explained, the amount required at any given stage depending on various factors. The winding-on and distribution of the slubbing is described, with particular reference to irregular winding, the method of regulating the drag, the use of washers and the working of loose materials. W.

Drafting Roller Covers. *Text. Expt.*, 1930, **3**, No. 36, pp. 25 and 27.

Methods of detecting faulty rollers are given. Better apparatus for roller covering in general has lengthened the life of iron rollers so much that they do not require covering more often than wood; and as they remain true even under much more adverse circumstances, they are now in general use for fine crossbred and botany drawing and spinning. Although leather covers on rollers are far from being permanent, as yet nothing has been found to supersede them. Invariably drawing rollers are now made of iron, either "hard" or "soft," covered with leather, and although they vary in size in the different processes of drawing, resemble one another very closely. The question of the selection of hides for the covers is discussed and the process of the covering of the rollers described. W.

Latest Developments in Drawing Machinery. Prince Smith & Son Ltd. *Text. Merc.*, 1930, 82, 383 and 407.

In introducing new types of drawing machinery, the makers claim that increased production would be obtained and that greater efficiency would be procured with more safety for the operative and easier working. The design of the "Primus" drawing box and its method of driving are described. It is adaptable for an individual motor drive. In the new design of "Primus" finishers, reducers, and rovers, the object has been to distribute the metal in such a manner as to obtain extreme rigidity without excessive weight. A description of the machine, its working and its guarding, is given. W.

Balancing Slivers in Worsted Drawing. "Tex." *Wool Rec.*, 1930, 37, 619.

The balancing of slivers by spinners should be carried out as early as possible in the drawing to ensure that slivers which are slightly under the required weight are run with those over standard weight. Although not generally the practice, the material should be balanced twice during the drawing operations—once at the first gill box and again in the middle of the drawing at the weigh box. The balancing operation implies—(1) Cans at the gill box and bobbins at the weigh box being respectively balanced to a given and uniform weight. (2) Knocking-off motions on balancing boxes set to give the same length of material in each can or on each bobbin. (3) Weighing each can or bobbin and noting differences in weight. (4) Placing the lighter slivers with the heavier so that the sum of the weights per set conforms to a predetermined standard. W.

Notes on the Gill Box. A. Schmitt. *Rev. Text.*, 1930, 28, 725 and 727, 887-895, and 1049-1057.

It is claimed that a Frenchman, Philippe de Girard, was responsible for the original invention of the fundamental principle of the gill-box. A description is given of two machines which have been developed from this principle, one the design of M. Alcan, the other patented in April, 1926 (F.P.603,209) by Richard Hartmann A.-G. W.

Spindleage in Worsted Drawing. S. Kershaw. *Wool Rec.*, 1930, 37, 895-900.

This question presents many difficulties. The following list gives the primary factors governing the number of spindles required in any drawing process. (1) The weight of slubbing or roving required per week. (2) The rate of delivery from the front rollers. (3) The twist required to make slubbing strong enough to wind on, yet with suitable drafting play. (4) The speed of the spindles. (5) The factor of efficiency. Secondary factors are—draft, number of ends feeding, size of bobbins (this governs the possible spindle speed), and character of material and its ultimate use. The earlier processes in worsted drawing are described. In a table taken from a working set of porcupine drawing, correlated items of interest are shown, such as the constant front roller speed, constant drafts, and the constant expectancy with regard to production. The factors influencing production in each process in porcupine drawing are listed. Graphs show the relation between twist and spindle speeds and output. W.

Twist in Worsted Preparing. N. Heaton. *Text. Mfr.*, 1930, 56, 278.

Twists or turns imposed upon a number of fibres make them, collectively and by overlapping, into one slubbing, roving, or thread of continuous length and predetermined thickness. In the English system of roving preparation—open or cone drawing—twist is the primary factor governing the method of manipulation. The difference between the methods of cone and open drawing is in the methods of tensioning and winding the material on to the bobbins. The most important factor governing twist is the quality of the material and difference in structure of the various types of fibres. Length is also important. Quality, etc., being equal, the longer the length of fibre, the less twist will the material require. The amount of twist required is decided by the strength of the slubbing. When the material is subject to drafting, the tendency is for it to take out the twist, and a remedy for this has to be employed. The question of ascertaining the required rates for materials is considered. W.

Paragon Roving Frame Spindle. "Tex." *Wool Rec.*, 1930, 37, 1031-1033.

The requirements in flyer spinning are, a high speed spindle, low power consumption, durability of parts and an insignificant amount of lubrication necessary to keep the whole machine in good working order. The results of extensive research are seen in the "Paragon" spindle for reducer and roving frames developed by Messrs. Hall & Stells, of Keighley. The spindle is controlled at the top, steadied in the middle, supported and suitably lubricated at the bottom. The steadying collar, top control, ball bearings and footsteps are described in detail. W.

Recent Developments in Worsted Machinery. Hall & Stells Ltd. *Text. Merc.*, 1930, 83, 335.

This firm have, during the last few years, remodelled all their drawing, spinning, and twisting machinery, which they now term "Paragon" pattern, applying their patent worm and wheel drive to the carrier rollers, and bringing the draft and twist gearing to one end of the machine. Mention is made of some of the many specialities brought out. A new system of working wool has been evolved, which embodies the Continental and English system in one type of machine, known as "Stells' Patent Porcupine Drawing." The basis is the Continental system of drawing adapted to work either oil or dry combed wools, which enable Bradford spinners to use their present combing and spinning plants, and yet produce either oil combed or dry combed yarns from a much wide selection in qualities and lengths of wool, and to give a softer and fuller handle to the final product, either in the yarn or cloth. W.

(B)—Spinning and Doubling

The Standardisation of Spinning Plant. J. Paillet-Jourdain. *Rev. Text.*, 1930, 28, 1163-1169.

Technical skill has been successfully applied to the construction and working of textile machinery. Under present conditions, there are various problems to be faced. Two of these, the question of improving manufacture by attaining, as far as possible, mechanical perfection, and that of the possibility of lowering the cost of output, are discussed with particular reference to spinning plant. W.

Inter-Roving Frame; High Drafting on——. J. Hemsley. *J. M/cr. Coll. Techn. Text. Soc.*, 1928, 18, 32-36.

Improvements in the Inter-Rover over the ordinary roving frame may be broadly stated under three groups—(*a*) The Inter-Rover is not a high draft machine, although in practice it may be considered as such. (*b*) It eliminates all the intermediate frames, some of the slubbing frames, and a percentage of the roving frames required in any mill. (*c*) The speed of the spindles may be anything up to 1,400 revolutions per minute, according to the class of the material being worked (if long collars are used). The roller system consists of two sets of three lines of drawing rollers by means of which two drafts of the usual length are obtained. The drafts used on this machine and the gearing and operation of the machine are discussed. C.

Roller Delivery Motion on Self-acting Mules. Asa Lees & Co. *Text. Merc.*, 1930, 82, 257.

A special arrangement is being introduced for roller delivery motion during twisting at the head, the advantages of which are described. They may be applied to any pattern of the firm's mules made during the last 38 years. W.

Production of Worsted Yarns in U.S.A. *Text. Rec.*, 1930, 47, No. 563, p. 55.

An analysis of production of worsted sales yarns has been completed by the Industrial Research Department of the Wharton School of Finance and Commerce, University of Pennsylvania. The analysis covers two periods, the first from 1911 to 1913, and the second from 1919 to 1929 inclusive. W.

Comparison of Spinning Methods. J. A. B. Mitchell. *Scotch Tweed*, 1930, 7, 217-219 and 236-237.

The mule is the main machine for spinning woollen yarn in the Scottish tweed trade. Despite development from a crude machine to a "self actor," the spinning process has not essentially changed. The actions are delivery, drafting, twist insertion, and winding-on. A comparison is drawn as to working and output between "intermittent" or mule spinning, and "continuous" or frame spinning. A short account is given of the history and development of the ring frame. A spinning frame for woollen yarn has recently been patented. The main changes from previous types are—(1) Delivery and draft rollers are covered with carborundum. (2) A new and smaller ($3\frac{1}{4}$ inch) form of twister tube is introduced. (3) A tension regulator or levelling device is fitted over the tube and between two lines of rollers. (4) A high drafting system is adopted admitting of drafts of $2\frac{1}{2}$-4 in place of a maximum of 2 in the existing machines. W.

Spinning Frame Speeds and Production. S. Kershaw. *Wool Rec.*, 1930, 38, 423-427.

It is necessary to know when to change the speeds of frames, and it is considered that, although frames are now available permitting quick changes, some attention needs to be directed to speeds for counts and qualities of wool, and to the mechanical limitations of the machines. For ordinary and self-doffing flyer spindles the maximum speed is 3,400 r.p.m., but instances are given when lower speeds than this are compulsory. Two methods of calculating the production of worsted yarn are illustrated. Three tables are given showing an estimate of production per spindle per week in flyer spinning, cap spinning, and ring spinning respectively. W.

Angora Wool on the Woollen System. *Text. World*, 1930, 78, 432.

Angora wool is very hard to work successfully on the woollen system of carding and spinning. Owing to the slippery nature of the fibres it is difficult to keep the stock uniform in weight on the card. Also the problem of getting sufficient rub in the roping so that it will come off the spools freely in spinning is important. The successful accomplishment of these two points in carding will determine the quality of the spinning, and instructions are given as to the best methods of working. W.

Sizing of Worsted and Woollen Yarns. B. R. D. Sharp. *Text. Mfr.*, 1930, 56, 197-198 and 240-241.

The object of sizing animal fibres is to increase the strength of the yarn by laying the projecting fibres to the body of the yarn. To secure the best results the choice of ingredients of the size mixing is important. In making a sizing solution for animal fibres the ingredients can be generally classified as adhesives, softeners, and antiseptics. In the application of size to warp the systems in general use are ball-warp sizing, section sizing, and full-width sizing. The mechanism is simple in construction and easy to operate. The drying of the yarn is important. The construction of a new sizing machine is described. The makers have further enhanced the drying properties, simultaneously reducing the amount of steam consumption. The question of cold sizing is discussed. W.

(D)—Yarns and Cords

Some Novelty Yarns and their Use in Worsted Mills. L. M. Harless. *Text. World*, 1930, 77, 1754-1755.

The novelty yarn manufacturer may be said to owe some of his success to the faults which have been produced in yarns. Many defects which produce a novel or attractive effect in the yarn, may be made regularly by the assistance of specially constructed machinery. The precautions necessary in weaving loop yarns, and particulars with regard to hub and gimp yarns are given and the use of union and grandrelle yarns is considered. W.

Woollen Yarns for Knitting. "Harmon." *Text. Amer.*, 1930, 54, No. 3, p. 63.

The making of yarns for knitting calls for every care and for all available skill in carding and blending. In oiling woollens neutral oils are not essential, those having a high acid value generally being used. The higher percentage of acid the oil contains in free state, the less the amount of soap required in the subsequent scouring process. Cotton is often introduced into woollen knitted yarns, a typical blend being described. The names of the yarns are various, depending largely upon their quality, the chief indications of this being price and appearance. Speed and settings for four different blends are shown in tabular form. W.

Heald Yarns: Selection. *See* Section 3C.

3—CONVERSION OF YARNS INTO FABRICS

(A)—Preparatory Processes

Rayon Crêpe Twist: Setting. *Text. World*, 1930, 78, 1000-1001.

It is not considered absolutely necessary to have a preparation on rayon crêpe-twisted yarn to set the twist. Twist setting may be accomplished through the action of steam at 150 to 160° F. or by cold water immersion. The preparation of the yarn for twisting and subsequent setting is usually accompanied by some type of sizing or pre-treatment. Some concerns use oils or other softening preparations in pre-treating the yarn for high twisting. A method of making rayon crêpe in which the twist is automatically set as part of the operation is described. A rayon throwing cream is employed which is made of emulsified coconut oil, soap, stearic acid, and gum. To this is added rayon size, in amount depending on the denier of the rayon. Silk-soaking equipment is used and the skeins are prepared in the same way as silk. The tint, previously dissolved, is added to the bath. The rayon is entered and worked until thoroughly wet out. It is then soaked for one hour, taken out, and extracted. After drying, the rayon is thrown as usual. It is found that no setting of the twist is necessary because the size holds the twist and keeps the yarn dead so that it will not kink, curl, or corkscrew. The method gives a very even tint. A slight increase in weight is obtained which makes it possible to clear the lots satisfactorily. C.

Striped Warps: Beaming. J. Chittick. *Text. Rec.*, 1930, 48, No. 569, pp. 39-40.

For the weaving of striped fabrics in which there are different weaves each having a different take-up, the different warps should be wound on separate warp beams so that the varying shortenings can be adjusted in the fabric. Many cotton looms, however, are not equipped for the handling of goods requiring more than one beam and the warp containing stripings is all beamed on the same beam It is beamed very tightly and held under extremely heavy tension in the loom. The result of this is that an actual stretch is put upon the threads, and, therefore, those stripes in the warp which ordinarily would soon be running too slack for proper weaving, owing to their looser take-up, are held sufficiently tight to permit of the weaving going on, the yarn in the more closely woven stripes being stretched sufficiently to permit this. Some incipient tendency to puckering is observed in the grey goods. In bleaching, substantial puckering develops, but in finishing the goods are held out under heavy tension and thus smoothed out again, the maintenance of this smooth appearance being assisted by dressings. On washing, however, the dressings are largely removed and the goods display objectionable puckering. A typical example is described. C.

"Triomf" Rayon Swift. Etablissements G. Parrier. *Rayon Rec.*, 1930, 4, 889.

The new "Triomf" rayon swift weighs only about 250 g., including the spindle, but hanks from 0·88 to 1·55 metres in perimeter may be reeled on it. It is composed of a wheel, a ring, a spindle and six arms, which, distributed on both sides of the ring may be freely extended to practically double the diameter. A simple pressure screw fixes the ring at the desired position. This arrangement of the arms on both sides of the wheel, and their alternate insertion in the slots of the ring in which they slide, gives a robust and durable apparatus with a minimum of inertia. When the swift is adjusted once for any particular hank, it does not require to be reset in any way for hanks of the same diameter. The great flexibility of the arms, which are composed of piano wire, enables the hanks to be very easily fixed, and they are maintained perfectly stretched. A brake gear, carried by the spindle, is capable of adjustment during the process of reeling. Diagrams are given. C.

Winding Device. W. Schlafhorst. *RUSSA*, 1930, 5, 1373-1375.

A new method of mounting horizontal spindles is described in which the spindle is fixed to a pivot support. This arrangement makes it possible to separate the spindle and bobbin from neighbouring bobbins and remove the bobbin easily. Various systems are shown in diagrams. C.

Hank Reeling Machine Measuring Motion. Dobson & Barlow Ltd. *Rayon Rec.*, 1930, 4, 987-989.

A detailed description is given of a new hank length measuring motion for rayon reeling machines which eliminates the necessity of changing any wheels or parts in order to wind hanks of different lengths. When a change of hank length is desired only one simple adjustment of a slotted disc is necessary. The principle may be regarded as similar to that of an ordinary combination lock, in that its operation depends upon the action of a spring-loaded plunger relative to a certain combination of slots, which may be varied, in a rotating disc. C.

High-speed Weft Winding Machine. W. Schlafhorst & Co. *Leipziger Monats. Text. Ind.*, 1930, 45, Fachheft 2, 55-56.

The Model SK machine especially designed for winding rayon is described. The mechanism is such that the spindles start gently and work up gradually to the full number of revolutions, at which point a positive drive by means of worm wheels automatically becomes operative. Four or five spindles share an oil box, but any one may be removed without throwing the others out of action. The spindles on the two sides of the machine may be driven at different speeds since the sides are independently driven. C.

Warping and Beaming Machine Electric Drive. Gebrüder Sucker. *Leipziger Monats. Text. Ind.*, 1930, 45, Fachheft 2, 61.

Two forms of an electric drive for warping and beaming machines are described in which the machines are respectively belt driven and gear driven from individual motors. For the belt drive, motors with 900-1,000 r.p.m., and for the gear drive motors with 1,400-1,500 r.p.m., are required. The power consumption is about 1·5 h.p. and older machines can be modernised by fitting the complete driving head to them. C.

Hand Warping Tools. *Spinn. u. Web.*, 1930, 48, No. 38, pp. 1-4.

Methods of improving the preparation of warps by hand are briefly discussed and diagrams are given of devices for simplifying the leasing of the threads. C.

Rayon: Winding, Warping, and Weaving. P. Allen. *Text. World*, 1930, 78, 1496-1499.

Precautions to be taken in the winding, warping, sizing, and weaving of rayons are discussed. Illustrations are given of different types of rayon fabrics, together with notes on their production. C.

Rayon Pirn Winding Tension Compensator. *Rayon Rec.*, 1930, 4, 1039-1043.

Causes of bright picks in rayon fabrics are enumerated. These are often the results of excessive tension in pirn winding. The usual types of tensioning devices are critically discussed and a new type of compensator which gives an even yarn tension from pirn to pirn is described. In this type a rigid rod takes the place of the fixed spring arm, and on the opposite side of the compensator bar is a threaded rod set at a definite angle upon which are two threaded adjustable weights. These weights act in combination with a spring, which is interposed between the brake strap and the compensator arm, and can be set to apply tension to the thread from a quarter of an ounce upwards. When correctly set and the balance obtained, the compensator represents the same weight in its lowest position as in its highest position, a value which is constant throughout the whole range of its movement. Any tendency towards an increase in tension is counterbalanced by the arm lowering to release the unrolling bobbin brake and the tension on the thread remains constant. As the unrolling bobbin reduces in yarn diameter and the speed increases, the compensator assumes a lower working position to release the equivalent amount of unrolling bobbin brake. The fluctuations in starting-up of this type of compensator are very slight and settle down very quickly as compared with the numerous fluctuations of the spring arm type. An application to pirning spindles which are frictionally driven is described. C.

Winding Frame: Production. L. Moulin. *Revue Text.*, 1930, 28, 1273-1277 and 1437-1439.

Formulæ are given for the determination of the theoretical and practical productions of winding frames. C.

Winding Mechanism. *Revue Text.*, 1930, 28, 1387-1391.

When the pressure of the balance weight of the thread guide is transmitted to the bobbin through direct contact of the bush with the bobbin in cross winding, owing to the small surface of contact, the yarn is wound tightly and the resulting full bobbin has an irregular shape. As a result of this method of winding the elasticity of the yarn is diminished and difficulties arise in the dyeing process. Better results are obtained if the pressure is transmitted to the bobbin by means of a bar carried by the thread-guide frame and placed in front of the thread guide. The bar is parallel to and a little longer than the axis of the bobbin and distributes the pressure uniformly over the whole length. In this way uniform loose winding may be achieved. Diagrams are given and the functioning and control of the system are described. C.

(B)—SIZING

Linseed-oil Sizes: Application to Rayon. *Text. Mfr.*, 1930, 56, 295.

Linseed oil may be applied either dissolved in an organic liquid or emulsified in water. One of the essentials for a good sizing effect is a thorough oxidation, whereby a film of hardened oil is formed on the surface of the threads. This oxidation is brought about either by atmospheric oxygen in the presence of suitable catalysts, or without a catalyst, by the action of ozonised air. Formerly, manganese compounds were most commonly employed, but at the present time lead finds more favour. The first stage of the oxidation is characterised by the formation of a film of varnish and is completed in about 24 hours. The second stage of the oxidation involves the breaking down of the linseed-oil molecule. The chief products of the decomposition are unstable bodies of the peroxide type, which are capable of leading to the formation of oxycellulose. Formic acid, formaldehyde and other acid products are also produced. When applied by means of a solvent, the sizing material impregnates the whole body of the fibres evenly, but very little penetration can be demonstrated when the oil has been applied as an emulsion. The possibility of damage to the fibres resulting from the use of linseed-oil sizes is briefly discussed and the need for further investigation of this subject is emphasised. C.

Warp Sizing Machine. C. B. Johnson. *Text. World*, 1930, 78, 903.

Important improvements made in the new sizing machine are fully automatic temperature control and a new type high pressure squeeze roller. Independent temperature control is provided for each cylinder and the size box. The three-roller high pressure squeeze roller is designed to give an even squeeze over the entire width of the warp, and at the same time to allow the adjustment of pressure necessary to produce complete penetration with various types of rayon. It is claimed that the innovations insure even sizing and drying of warps and complete penetration of size. Automatic temperature control is said to result not only in more even sizing, but also in increased pliability of warps and reduced breakage in the looms. Baking of ends is prevented, boiling-off of sizing is facilitated, and even dyeing is promoted. C.

Linseed Oil Size: Application and Disadvantages. *Spinn. u. Web.*, 1930, 48, No. 36, pp. 16-19.

A general discussion of the application of linseed oil size to rayon, the difficulty of removing the size, its possible injurious effects on the fibre, and other disadvantages from the point of view of the finisher. C.

Cotton Warp: Sizing. E. F. Titcombe. *J. M/cr. Coll. Techn. Text. Soc.*, 1928, 18, 37-40.

A general discussion of the materials and machines used in the sizing of yarn, giving standard recipes. C.

Cotton Warp: Sizing. *Houghton's Black and White*, 1930, *Text. Edn. B*, 3, No. 5, pp. 12-13.

Good penetration of the size compound produces greater strength of the warp yarns, less shedding of the size in the loom, and better protection against mechanical damage to the warp yarn during weaving. The penetration depends on the condition of the size solution in the size box, the speed of the yarn, the amount of immersion of the yarn in the size bath, the temperature of the size solution, the degree and method of squeezing out, and the rate and method of drying. The effects of these factors are briefly discussed. C.

Rayon: Sizing. A. K. Johnson. *Text. World*, 1930, 78, 1500-1502.

The following methods are in common use for the sizing of rayon—(1) Skein sizing; sizing during packaging, as in winding or coning; and on the perforated package. (2) Spool-to-spool sizing during the transference from one package to another. (3) Creel-to-beam sizing during the making of the warp. (4) Warp sizing on the completed warp while winding from one beam to another. (5) Spray or wax-roll sizing on the completed warp while weaving in the loom. The sizing materials used include partially saponified oils, fats and waxes, soaps, carbohydrate materials, vegetable gums and proteins, animal proteins, glycerin and glycerin substitutes. The composition of the mixture is varied according to the degree of lubrication, softness, moisture-resistance, cohesion, and penetration required. Precautions necessary in the different processes are discussed. C.

(C)—Weaving

Vertical Shaft Jacquard Drive. —. Richter. *Textilber.*, 1930, 11, 594.

An improved vertical shaft drive for Jacquards is described in which considerable economy of oil and easier running are obtained by means of a device for oiling the shaft in the footstep bearing in such a way that the oil circulates continuously in the bearing and is not centrifuged, whilst the danger of displacement of the bevel wheels and of the keyways in the shaft or the keys is eliminated by providing a claw coupling between the upper bevel wheel and the shaft. C.

Warp Stop Motion. R. Tauscher (for E. T. Wagner, Chemnitz). *Spinn. u. Web.*, 1930, 38, No. 35, pp. 1-5.

A detailed description is given of a warp stop motion without drop wires. The steel wire healds are provided with large eyes at each end giving a play of 8-12 mm. about the staves passing through them. When the shaft is in the lower shed the healds are drawn upwards by the warp threads. If a thread breaks the corresponding heald falls so that the upper eye is in contact with the upper part of the upper stave and thus makes electrical contact between two conductors forming part of this stave. The conductors project through the shaft frame and by means of a wire or spring and bolt make contact with a conducting angle on the loom side when the shaft is in this position. The electrical connections are shown in diagrams and discussed. The advantages of this type of stop motion over the type with drop wires are pointed out. C.

Weaving. *Text. Mfr.*, 1930, 56, 166, 319-320.

The causes and methods of avoiding various faults in cotton weaving, such as oil stains, weft breaking and ballooning, cloth bagging and faulty selvedges, are discussed and hints are given on the selection and care of shuttles. C.

Grosse-Greiz Automatic Jacquard. *Leipziger Monats. Text. Ind.*, 1930, 45, Fachheft 2, 65-66.

In connection with attempts to lower the costs of production of bordered jacquard fabrics, attention is drawn to the Grosse-Greiz two-cylinder centre shed jacquard with automatic change from one cylinder to the other during running of the loom. C.

Heald Yarns: Selection. *Text. Weekly*, 1930, 6, 55.

Cotton healds should be made from the best Egyptian yarns and the varnish used should be free from grit. A table is given showing the counts and qualities of yarns generally used for making healds to be used in weaving various twists. C.

Ruthardt Double-lift Open-shed Dobby: Advantages. *Spinn. u. Web.*, 1930, 48, No. 37, pp. 3-6.

Various disadvantages of the Hattersley type of dobby are pointed out and it is claimed that these disadvantages are overcome in the patent Ruthardt double stroke dobby. The functioning of this mechanism is described. C.

Two Shuttle Box Loom. H. Nisbet (for H. Livesey Ltd.). *Text. Merc.*, 1930, 83, 301.

The mechanism of the new improved shuttle box motion consists essentially of a large toothed segment or sector mounted slidably on one end of the second-motion shaft, and when employed for ordinary "two-and-two" weft-mixing, gears intermittently (i.e. once in every two picks) with the teeth of a smaller toothed segment compounded with an eccentric disc. The latter, through the medium of a connecting-rod, bell-crank lever, and vertical poker-rod, controls the vertical movement of the two shuttle-boxes which carry two vertical spindles that slide freely in bushed bearings, and thus ensures a true and steady movement of the boxes as they rise and fall. A very simple patented device prevents the movement of the shuttle-boxes if from any cause either of the two shuttles fail to enter their respective boxes, in which event, injury to the shuttles is prevented by the operation of a safety clip connecting joint constructed on the vertical poker-rod supporting the shuttle-boxes. The checking of an incoming shuttle is effected by the operation of a patented device which dispenses entirely with the use of check straps and functions in such a manner that, after checking the shuttle, the pressure on the box swell is released automatically, while the shuttle is held quite steady in its box by the slight pressure of a light blade spring. An ingenious micrometer screw adjustment on the vertical poker-rod ensures the alignment of the shuttle-boxes with the surface of the shuttle race-board with absolute precision. This new shuttle-box motion may easily be fixed to existing single box looms of any of the usual standard models at a comparatively small cost. C.

Warp Stop Motion. Textima A.-G. *Leipziger Monats. Text. Ind.*, 1930, 45, Fachheft 2, p. 69.

A warp stop motion actuated by two parallel cords which pass across the loom in the plane of the warp and in the vicinity of the lease rods is described. The stop motion acts when, for any reason, the more delicate warp threads, such as silk, rayon, and fine cotton and wool become entangled behind the lease rods. C.

Automatic Loom Let-off Motion. *Revue Text.*, 1930, 28, 1443-1447.

A new let-off motion is described in which the angular velocity of the warp beam is increased automatically as the diameter decreases so that the warp is delivered at a constant rate. The change is produced by the sliding of a pirn in a groove in a fork forming part of the driving mechanism. C.

"Brüta" Weaving Shed Output Charts: Application. P. Branscheid. *Spinn. u. Web.*, 1930, 48, No. 18, pp. 1-4.

An explanation is given of the Brüta (Branscheid Übersichts-Tafeln) system of charts for the control of weaving operations. By the use of these charts it is possible to obtain a survey of the progress of the work on hand and hence to organise the work so that orders are executed without loss of time. C.

Picking Bands: Manufacture. B. M. Das and U. N. Dutt. *Indian Text. J.*, 1930, 40, 515-517.

The annual imports of picking bands into India are discussed and it is claimed that these could be manufactured from Indian buffalo hides by the native tanneries. Suitable methods of tanning are described. C.

Shaped Neckties: Weaving. W. Bertram. *Textilber.*, 1930, 11, 677-679.

An account is given of the weaving of shaped ties on ribbon looms with conical reeds, and the method of making gearing calculations and determining the shape of the cam which controls the raising and lowering of the conical reed. C.

Warp Beam: Braking. U. Schirdewan. *Spinn. u. Web.*, 1930, 48, No. 18, pp. 4-5.

The braking force of a rope on a warp beam increases with the first few turns and then tends to a constant value, but the number of turns required to reach this constant value decreases with increase in the coefficient of friction. The numbers of turns above which no further increase is produced are given as follows—iron on iron, $3\frac{1}{2}$; iron on wood, $1\frac{1}{2}$; hemp rope on iron, $2\frac{1}{2}$; hemp rope on wood, $1\frac{1}{2}$. C.

Warp Beam Brake Weights, Buffers, and Buffer Straps: Standardisation. *Textilber.*, 1930, 11, 735-736.

Proposed standards and specifications for warp beam brake weights for silk looms and for buffers and buffer straps are put forward for comment. C.

Improved Automatic Warp Stop Mechanism for Looms. H. Nisbet. *Text. Merc.*, 1930, 83, 505.

Describes a warp stop mechanism constructed by Messrs. Henry Livesey Ltd., Blackburn, which is applicable to all kinds of looms. It consists of thin drop wire detectors operating in conjunction with two or more notched cross bars, extending across the loom immediately above the warps. Each cross-bar consists of two notched bars, one fixed and slotted to receive the second notched thin steel strip, to which is imparted a reciprocal side movement of about $\frac{5}{8}$ in., once in each direction every two picks. On breakage of a warp yarn threaded through a central hole in the drop detector, the latter falls and engages in a notch in the steel strip, thereby arresting its movement and stopping the loom. This object is effected by a simple mechanism which, through the medium of a flexible wire cable, raises a small trigger finger swivelled on the starting handle. The finger is struck on the next advance of the sley and so removes the starting handle from its retaining catch. A distinctive feature consists of special and simple attachment to the weft fork lever which prevents the risk of thin places which are liable to occur on restarting. The movement of the starting handle from its retaining slot is caused to act through the weft fork lever to raise the retaining catch from the teeth of the ratchet wheel on the taking-up motion and thus arrests its movement for one or two picks. A "pinning" device can also be supplied which is stated to facilitate the tedious operation of "gaiting-up" a new warp. L.

The Timing of the Loom. "Tuner." *Text. Argus*, 1930, 7, 117, 148, 181, and 211.

The weaving of distinct kinds of cloth requires the alteration to their limits of the various timings. The timing of the sheds, cylinders, and picks is discussed, and with regard to the beating-up of the weft, the size of the crank, weight of going part, swing back rail and eccentric driving wheels. Double timing, shield and catches, contrasts in taking-up, and timing of boxes are also considered. W.

The Selvedge. Fh. *Melliand*, 1930, 2, No. 6, p. 875 (from *Z. ges. Text.-Ind.*, 1929, 429).

The most handsome feature of a finished fabric is a clean made, perfectly straight selvedge. The author replies in detail to the question, what is the cause of the faults met with in selvedges (jagged, curved, folded, slack, too loosely or too tightly woven, curling) and how they can be avoided. The following are the chief points to attend to. Beam the warp in the width required by the sett of the warp in the heddles. Pay due regard to the weave of the fabric when weaving the selvedge; the Panama weave is the best for the selvedge. The selvedge threads must be given a special tension and guided separately from the others. The filling in the selvedge must have the proper tension. If a Jacquard is being used, the lingos must be adjusted so as to reduce their pendulating movement and vibration when the lay beats up to the fell. W.

The New Automatic "Let-off" for Looms. *Text. Merc.*, 1930, 83, 33.

It has been proved that at least half the work of a weaver is the result of warp breakages. Upon the correct tensioning of the warp threads practically everything in plain cloth weaving is dependent. Tests of warp tensioning were made on a loom supplied with a chain weighted lever and a vibration motion, the conditions thus being ideal as far as they applied to the average Lancashire loom for plain cloth weaving. Attention has just been drawn to an appliance which seems to meet the suggested requirements of the foregoing tests. It is described as an automatic let-off motion, with constant tension for all makes of looms. The makers claim that they can provide absolutely constant and regular tension upon the warp, perfect beating-up, the total elimination of bars, or thick and thin places, supple unwinding of the warp, and 50% decrease in thread breakages. The construction and working of the motion, with particular reference to a new system of braking, are described. W.

The Making and Functions of the Sley. Parts I and II. Tuner. *Text. Argus*, 1930, 7, 755 and 789.

In the process of sley making, gauge wires vary considerably in thickness according to the type of fabric for which they are used. There are also certain thicknesses of cotton to suit the set of the sley, but in any case the cotton band has to be passed through a bath of boiling pitch to be fairly well saturated, and is then wound on to suitable bobbins for the reed-making machine. The setting of the machine is described with particular reference to the delivery of wire, the wrapping arms, coil pushers and intermittent and creeper motion. The two ends of the sley are fitted with a specially marked flat piece of metal which indicates its set. Four different makes of sleys are described as regards the types of reeds used. Many districts have sets of their own, but the only system to be recommended is that known as the Stockport system, based on the number of reeds per inch. The four-fold function of the sley is described. When assistance is needed to produce a better fabric, a false reed is used. The sley has to be held firm when beating up the weft, this being achieved in three ways—by a grooved fast reed, a movable sley rack or a loose reed. The question of the weaving position is discussed. Without uniform straightness there can be no straight running for the shuttle. The sley is subject to certain dangers, some of which can be averted by carefulness. W.

Compound Cloth Structure in Relation to Woollens and Worsteds. VII. A. Yewdall. *Text. Mfr.*, 1930, 56, 282-283.

Wadding wefts are applied to warp-backed structures for the purpose of obtaining an increase of weight without affecting the surface appearance. Wadding picks permit the use of materials different from those forming either the face or back of the texture. The three most common arrangements in inserting wadding wefts are described and particulars given for the construction of different wadded warp-backed designs. W.

Negative Dobbies. J. Place. *Text. Rec.*, 1930, 47, No. 565, pp. 37-38.

The modern negative dobby has been developed rapidly during the past few years and is now being used for the production of cloths of all types. The merits of the Keighley dobby are enumerated, and the mounting, starting and care of dobbies generally are discussed. Types of dobbies may be divided into two classes—(1) Closed shed or single lift; and (2) open shed or double lift. The former, except for special light fabrics of the leno type, is now almost obsolete. In the latter there are two distinct types, positive and negative. The negative dobby has been developed to a very high standard. It is made with single or double jacks and may be fitted with one or more pattern barrels, according to the requirements of the design. The disadvantages of the single jack dobby are discussed. W.

The Weaving of Silk Stripings. J. W. Hutchinson. *Wool Rec.*, 1930, 37, 759.

It is usually the warp that is selected for stripe formation, especially that made from wool-dyed yarns. The silk is much more distinct in worsted textures than in woollens, as the fibrous nature of the latter conceals its lustrous quality. The method of weaving is fully described. W.

Blanket Manufacture. I, II, III, IV, and V. T. Roberts. *Wool Rec.*, 1930, 38, 739-743, 803-807, 863-867, 927, 929, 987, and 989.

A very varied and extensive range of blanket fabrics is manufactured, typical examples being cotton, union, and wool rugs and blankets. A wide range of colour and shade can be readily obtained. A summary is given of the average sizes and weights usually adopted, also specimen blends and making particulars. Details are given as to the sett or number of threads per inch in the warp, the picks per inch of the weft, the counts of the warp and weft yarns, and the greasy and clean weights of the piece. The question of shrinkage is discussed. Making particulars are supplied for three different weights and sizes in a range of low union blankets or "rugs." In the manufacture of fine union blankets, the importance of putting down blends as free as possible from vegetable impurities is stressed. For a fine union weft blend—average 40-44's quality—the following is recommended—65% of N.Z. slipe medium staple, 20% of short head or pelt wool, and 15% of pulled flannel or waste. The manufacture of various types of blanket is described with reference to raw materials, making particulars, and finish. Mention is made of the Ayrshire or Scotch blanket, the Kersey, and the type of fabric somewhat vaguely known as blanketing. W.

Eliminating Kinks from Hard Twisted Yarns. *Text. Argus*, 1930, 7, 86.

There are many types of cloth made from yarns with a relatively large number of turns per inch. These yarns, if used straight from the spinning or twisting frame, are somewhat difficult to control in the processes preparatory to weaving, and also during weaving. This difficulty depends largely upon the amount of twist in the yarn; the harder the twist the greater the tendency for the yarn to kink when not held under tension. If hard twisted yarns are used for weft, the tendency to form kinks is probably greater than when they are used for warp. The tensioning of the weft yarn is achieved by the insertion of a brush of worsted yarn inside the shuttle over which the yarn passes on its journey from the spool to the shuttle eye. The tension may be varied by using a smaller or larger brush. Various practices have been introduced with the object of overcoming the tendency to form kinks; these forms of control are considered from the following points of view—(1) The actual levelness of the yarn. (2) The efficiency of the methods adopted to control the yarn during the various necessary operations. (3) The finishing treatment to which the yarns are subjected in the woven fabric to produce the effect desired. The setting process is described, the degree of conditioning depending upon the amount of twist in the yarn. W.

The Picking Motion. P. Hanne. *Textilber.*, 1930, 11, No. 4E, p. 235 (from *Leipzig. Monats. Text. Ind.*, 1929, 194).

The over-pick motion is used for light to medium heavy looms and consists of the following parts—picking tappet coupling, picking tappet, picking nose, vertical shaft, picking bowl, picking spring, picking stick bearing, picking stick. The author deals in detail with the construction and adjustment of the picking stick, the types of picking straps and their attachment, how to prevent wobbling of the picking stick, and how to strengthen the picking, how to repair picking noses, and the expansion of the tip of the picking nose. In under-picking a distinction is made between picking by tappet, the crank picking motion, and the spring picking motion. The drive of the tappet with crank-pin roller is in the ratio of 1:2. The crank picking motion is mostly used for buckskin looms, but the spring picking motion is employed for various looms. The picking sticks of under-pick looms must be capable of easy movement in all directions. The article concludes with a few remarks upon the wear and tear of cords, pickers, picking straps, shuttles, and so on. W.

Rayon: Winding, Warping, and Weaving. *See* Section 3A.

(D)—Knitting

"Jacarograph" Flat Knitting Machine. Mellor, Bromley & Co. Ltd. *Text. Merc.*, 1930, 83, 339.

On the "Jacarograph" flat knitting machine the pattern is produced directly from the graph or pattern drawn on squared paper. The squares on this paper are spaced to conform to the gauge of the machine. The graph is mounted on rollers behind the back bed of the machine, each square coinciding with the point of a specially designed jack. When working the machine, the jacks corresponding with the pattern are depressed to the operating position by hand. These jacks are made in two parts, one part sliding backwards and forwards within the other. On the sliding portion there is a projection that is acted upon by a cam in the back cam box; the selected jacks then raise to the knitting position the needles required, and the course is knitted in the usual manner. After the course has been knitted the graph moves automatically to the next course. The machine is equipped with two yarn carriers, one for the ground and the other for the patterning colour. By changing the bobbins, however, it is an easy matter to introduce any number of colours into a pattern. When the jacks have been placed in the operating position they will remain in that position until they are changed by hand. The "Jacarograph" is particularly suited for producing large irregular designs, and intricate patterns can be made easily and cheaply on it. The machine is also suitable for preparing samples or experimenting with designs prior to mass production on the ordinary Jacquard machines. C.

Wildt's Model "J" Jacquard Knitting Machines. W. E. Boswell. *Text. Merc.*, 1930, 83, 283 and xii.

Model "J" circular knitting machines are built in three diameters, 9 in., 18 in., and 21 in., and are suitable for the manufacture of scarves in two-ply fabric, jumpers, coats, and other garments. A table is given showing gauges, numbers of needles, and numbers of automats. The needle selection is dual on gauges over ten needles per inch, and single on gauges up to that number. A series of automats are arranged round the machine cylinder, each automat consisting of a jacquard card which controls a set of levers; one end of each lever carries a pin which rests on the jacquard card, the other end enters a trick of the needle cylinder. A jack is arranged under each needle, the lower end of the jack being above and just clear of the lever. The cams revolve, the needle cylinder being stationary and the jacquard cards, which are punched according to pattern, make a selection of the levers immediately before the approach of each feeder, the selected levers being carried forward as the jacquard drum turns. A variety of stitches may be made on these machines, the cams being capable of automatic manipulation to give a change from one to another. Two of the most popular types of stitch are plain and jacquard accordion. The knitting action of the needles in the production of these types is described. C.

Delustred Silk Hosiery: Manufacture. *Houghton's Black and White*, 1930, *Text. Edn. B*, 3, No. 5, pp. 8-11.

Dull-lustre hosiery may be produced by delustring ordinary hosiery tram. This may be accomplished by a two-bath process in which an insoluble salt is precipitated in the fibre or by the use of suspensions of finely divided material. A second and more expensive method of producing dull-lustre hosiery is to manufacture it from grenadine and crêpe yarns. The true grenadine hosiery yarn is a three-thread yarn in which the three individual threads are twisted 36 turns to the left and then doubled and twisted 32 turns to the right. Details of suitable crêpe yarns are given. In the soaking of these highly twisted yarns it is necessary to add a special soluble oil which penetrates rapidly and increases the softness of the yarn to the tram soaking oil. Stronger concentrations of back-winding solution are necessary and the yarns must be mellowed in a humidifying cabinet for a longer time than is required for hosiery tram. The addition of complex fluoride derivatives to the back-winding solution is recommended for the prevention of mildew. C.

Full-fashioned Hosiery Machine Drive. F. K. Fogleman. *Melliand*, 1930, **2**, 233-237.

The development and characteristics of the new GE type BTA motor, which provides a brush shifting, alternating current motor drive for full-fashioned knitting machines, are outlined. C.

Hosiery: Knitting. J. S. Bach. *Melliand*, 1930, **2**, 204-208.

An account is given of the development of methods for knitting women's hosiery in one process on Cotton's machines. C.

Latch Needle. *Revue Text.*, 1930, **28**, 1471.

With the ordinary type of latch needle, if the needle fails to catch the thread at any point, the latch closes and remains closed, producing a fault in the piece which may not be observed immediately. A new type of needle is illustrated in which the latch is controlled by a spring. The back of the spring rests against a grooved support arranged so that the threads do not catch and break on the spring. C.

Lined Hosiery: Knitting Frames. *Revue Text.*, 1930, **28**, 1473-1475.

Descriptions and diagrams are given of mechanisms for the production of stockings and socks with secondary systems of loops forming a lining to give additional warmth not only in the sole but also in the toe and heel sections. C.

Rayon: Knitting. M. C. Miller. *Text. World*, 1930, **78**, 1506-1508.

The characteristics of rayon and natural silk are compared and the use of rayon in the knitting industry is discussed. Knitting machines may be classed as (1) circular, independently-operating-needle machines; (2) circular, fixed-needle machines; (3) flat machines; (4) Lamb machines; and (5) warp machines. All types of rayon can easily be knitted on machines of the first class but machines of the second class are not so suitable for rayon. Full-fashioned hosiery is being produced from rayon, but the yarn does not lend itself ideally to this form of knitting, in which sinkers must kink the yarn between the needles prior to the needles re-kinking the yarn to form loops. The use of rayon on Lamb machines is quite practical and if care is taken in the winding of rayon on to warp beams the warp knitting machine may be used successfully. C.

The Modern Automatic Rib-knitting. IV. J. B. Lancashire. *Text. Mfr.*, 1930, **56**, 47.

The older types of automatic rib-knitting machines, those that have stationary needle cylinders, are driven from two separate shafts; on modern machines both circular and oscillating motions are obtained from the same driving shaft. The form of drive employed is virtually the same irrespective of the build of machine. The working of the "Komet" machine, built by the Bentley Engineering Co., of Leicester, is described with particular reference to thread guides and the introduction of splicing. W.

Glossary of Terms used in Full-fashioned Knitting. *Melliand*, 1929, **1**, No. 8, pp. 1206-1212; No. 9, 1356-1362; No. 10, 1489-1494.

This glossary has been compiled as an addition to the Parts Catalogue of the Textile Machine Works, Reading, Pa. The German expressions for the more common words and terms are given, these being printed in italics. The glossary is divided into the three following parts, according to the different numbers of the periodical—Adjusting Arm to French Heel, French Narrowing to Press-off, Press-off Designs to Yarn Carrier. W.

Fashioning Details for Knitted Outerwear. W. E. Boswell. *Text. Merc.*, 1930, 82, 227.

Fashioned garments are made on a straight-bar frame and the parts shaped to fit the body as they are being made. Machines of Cotton's patent type or flat knitting machines are used. The details of the narrowings or widenings required to shape the part must be carefully worked out before the garment is made, allowance being made for shrinkage after the work has left the machine. The courses and stitches per inch are then ascertained and calculations made to find the number of needles, rows of knitting, narrowings or widenings required. Examples of such calculations are given for men's pullovers, ladies' cardigans, and girls' pullovers. These garments are made on a seven-gauge flat knitting machine with 2/16's worsted yarn, the fabric having 9 stitches and 14 courses per inch. W.

Still-bath Method of Boiling-off Hosiery. H. C. Roberts. *Text. World*, 1930, 78, 1679.

The still-bath method of boiling-off or degumming eliminates the mechanical motion of the hosiery through the bath or the bath through the goods, except the circulation of the liquor due to a gentle boil. It has been found that this method, which is described here, not only reduces the danger of mechanical damage to the hosiery, but also lessens the tendency of the degumming process to show up sleazy knitting. W.

New Machinery and Processes. *See* Section 8D.

Woollen Yarns and Knitting. *See* Section 2D.

(E)—Lacemaking and Embroidering

Barmen Torchon Lace Machine and Yarns. R. P. Marenzana. *Melliand*, 1930, 2, 290-293.

An account is given of the manufacture of torchon lace on the Barmen machine and of the yarn requirements for this branch of the industry. Carded yarns are useless and must give way to combed yarns. Since more spindle movements are executed to the left than to the right a right-hand twisted, twofold yarn is adopted for general use and, to prevent opening-up, more twist is inserted than is usual for ordinary work; 6's, 8's, 10's, and 16's, all twofold, are the usual counts and they are given 8, 10, and 12 turns of right-hand twist in doubling. Rayon is now widely used for making torchon laces. A doubled yarn having 2¼ turns of right-hand twist was found by experiment to be satisfactory. C.

Vistra Lace: Manufacture. *Spinn. u. Web.*, 1930, 48, No. 39, pp. 5-6.

The history of lace manufacture is outlined and the use of Vistra yarns in the lace industry is discussed. Machines for the production of different types of lace are briefly described. C.

(G)—Fabrics

Jacquard-design Knitted Fabrics. W. Davis. *Melliand*, 1930, 1, 1789-1792.

An illustrated account is given of some modern tendencies in Jacquard designs for knitted fabrics, including an imitation hand knit fabric and imitation woven designs. C.

Narrow Twill Fabrics: Designing. E. J. Gibbons. *Text. World*, 1930, 78, 988-993.

A discussion of the use of varied twill effects in narrow fabrics and the structure of broken twills, figured broken twills, skip twills, broken and fancy skip twills, angle twills, reclining twills, curved twills, and broken curved twills. C.

Reinforced Fabrics: Manufacture. U. Schirdewan. *Leipzig. Monats. Text.-Ind.*, 1930, 45, 272-273.

A simple method of determining draft and card cutting plan, that does not require the preparation of a point paper design, is described with reference to certain dobby-woven, reinforced cloths with a single warp and two or more weft systems in which the individual wefts appear alternatively on the face and back of the fabric. C.

Fancy Yarn Dress Materials. *Text. Merc.*, 1930, 83, 275, and 279.

The use of fancy yarns in dress materials is increasing in popularity. Five principal varieties of these special yarns are being used—namely, loop, snarl, slub, spiral, and spot. Illustrations are given of dress materials manufactured from these fancy yarns and the structures are outlined. C.

Dress Fabrics: Structure. A. Hamann. *Spinn. u. Web.*, 1930, 48, No. 27, pp. 1-6.

A discussion of the structure of various new dress fabrics in which characteristic effects are obtained by the use of right- and left-hand twisted yarns. C.

Fancy Backed Fabrics. *Text. Merc.*, 1930, 83, 389.

Particulars are given of a few fabrics in which coarse yarns are used as extra backing threads for warp or weft. They include cheap dress goods, imitation wool crêpes, hangings, and covers. C.

Lenos: Weaving. W. E. Shinn and A. E. McKenna. *Melliand*, 1930, 2, 31-36, 195-201.

A general article on the design and weaving of lenos. This class of fabrics includes a wide variety of materials similar in structure in that certain warp threads or groups of threads cross one another in intersecting with the weft. The crossing of the warp threads gives the fabric a very firm structure and a fabric woven on the leno principle is considerably stronger than other fabrics containing a similar number of ends and picks per inch of the same yarns. C.

Lettered Labels: Designing. E. J. Gibbons. *Melliand*, 1930, 2, 215-223.

A general article on the design and construction of narrow woven fabrics bearing lettering.

Narrow Rayon Fabrics: Weaving. E. J. Gibbons. *Text. World*, 1930, 78, 1509-1511.

Simple rules for the use of rayon in narrow fabrics in order to obtain the greatest ornamentation effect are discussed and illustrations are given of suitable weaves. It is advisable to use as loose an interlacing as possible compatible with the texture or effect desired. The rayon should not be floated on the back of the fabric in cases when it may just as well be made to interlace with the face of the goods. Though the appearance of the back of the material is often inconsequential, the value of the product may often be enhanced by simple ornamentation. C.

Rayon Marquisette Fabrics: Weaving. R. Tauscher. *Spinn. u. Web.*, 1930, 48, No. 18, pp. 22-24.

The use of rayon in curtains and furnishing materials is discussed, and the structure of different marquisette fabrics is explained. A top shedding Jacquard machine for the weaving of such gauze fabrics is briefly described and diagrams are given. C.

Ultra-violet Rays and Dyed Fabrics. *Melliand*, 1930, 2, No. 6, p. 878 (from *Art. Silk Wld.* (*Rayon Rev.*), 1929, 5, 223, and 235).

The presence of dyestuff on a fabric greatly reduces its penetration by ultra-violet rays, because they are absorbed in direct ratio to the depth of the dyeing. Comparative illumination of undyed fabrics of various materials has proved that the nature of the fibre does not affect the penetration of the rays, but that it does depend upon the intersection of the threads and the structure of the fabric. All fabrics, however, possess the property of being very impermeable by ultra-violet rays. The question of the effects of absorption that are produced by dulling agents is discussed. W.

Compound Cloth Structure in Relation to Woollens and Worsteds. VII. *See* Section 3C.

4—CHEMICAL AND FINISHING PROCESSES

(A)—Preparatory Processes

Cloth Singeing Machine. T. F. Hughes. *Text. World*, 1930, 78, 1115.

The cloth passes over drying cans and is just touched by a revolving brush that raises and loosens the nap as it passes to the plates. Over the first three plates of the machine the back of the fabric is in contact with the plates. After these first three plates the goods pass through a two-roller nip to extinguish any sparks, then over four guide rollers to a second set of three plates in such a way that the face of the fabric comes into contact with the hot plates. The fabric then passes through another two-roller nip to a water box where the goods are wetted out. If desired, the desizing process may be carried out in the water boxes. The plates may be heated by gas, coal, oil or other fuel. Goose-neck bars are placed on each end of the machine to hold the goods down on the plates. With this type of machine there is a continuous run without intermediate winding up of the goods, allowing the day's production to be more than doubled. C.

Sulphonated Castor Oil Products: Manufacture and Analysis. *TIBA*, 1930, 8, 1091-1097.

The manufacture of sulphonated castor oil products, including Turkey red oil, Monopol soap, and other products is outlined and the systematic analysis of such products is described. C.

Textile Soaps. R. Manschke. *Leipziger Monats. Text. Ind.*, 1930, 45, 33-34, 82, 293-294, and 331-332.

A general article on textile soaps, dealing mainly with wool, but containing a short reference (p. 82) to soaps for cotton, linen, and silk. C.

Wetting Agents: Polarity. Relation to Chemical Constitution. A. Bertsch. *Chem. Abs.*, 1930, 24, 4262-4263 (from *Bol. assoc. ital. chim. tes. e col.*, 1930, 6, 76-77).

With sodium oleate in water the —CO_2Na groups of the surface layer tend toward the interior, while the rest of the hydrocarbon chain is directed toward the gaseous phase. If a third liquid or solid phase is added the action of sodium oleate as a monopolar body with respect to this fails, as there is no other active group for the third phase. When treating textiles, a bipolar or doubly active substance is therefore always necessary for obtaining the maximum effect of the surface forces, such as the sulphuric ester of ricinoleic acid present in the simplest form in Turkey red oil, where one of the two polar groups is represented by —SO_4H, and the other by —CO_2H. The efficiency depends on the chemical constitution of the polar groups, increasing from the methyl ester to the amyl ester, and decreasing to a maximum in the triglyceride. A textile fibre falls with the greatest rapidity in an aqueous solution with the amyl ester and the least with the triglyceride. The tension of the boundary surfaces is lowered by bipolar preparations that can be brought to the maximum efficiency by varying the chemical constitution. C.

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

"Slack Loop" Washing Machine. Rodney Hunt Machine Co. *Text. World*, 1930, 78, 901-902.

The "slack loop" bleach-house washer for the continuous wetting out, rinsing, and washing of woven and knitted fabrics in the rope is designed to process the goods without stretch or distortion, and may be used in either peroxide or chlorine bleaching. It is stated that utilisation of the counter-current flow principle makes a great saving in the amount of water used, and in conjunction with the slack loop principle insures thorough and efficient rinsing. The washer is provided with a wringer for giving the goods a final squeeze as they leave the machine. It is also equipped with "White Seal" rollers with drip flanges and anti-friction bearings; folding cleat roller; spring pressure over top roller; new inclined type, non-leaking suds box with two-way discharge valve; and unloading doffer roller. C.

Soap in its Relation to the Scouring of Wool. *Dyer and Cal. Printer*, 1930, 64, 29-31.

A series of bulletins dealing with wool scouring is being issued. They show that a commercial sodium oleate is the soap most suitable for scouring raw wool, and that potash soaps have no advantages to compensate for their greater cost. Other subjects dealt with are the natural impurities of raw wool and the extent to which they should be removed in scouring, the process of scouring itself, and, finally, a comparison of scouring formulæ and plant practices. This article considers the question of the different types of impurities in wool and the methods of their removal. Pulled wools present a different problem. Scouring materials must be used on them in such a way that most of the lime is eliminated before soap is applied. There is great difference of opinion as to the properties of well-scoured wool, and a standard test of cleanness would relieve the burden of supervision which is necessary under control by individual judgment. The most accurate and reproducible method is to find by ether extraction the percentage of natural grease which remains in the wool after scouring. W.

Scouring Agents. J. Schofield. *Wool Rec.*, 1930, 37, 751-753, 819-821, and 889-892.

It is very advantageous for a textile soap to be freely soluble, especially at low temperatures. If in wool scouring much residual soap is left, the spinning property is prejudiced. The practical difficulties in the general adoption of ammonia soaps are enumerated. Potash soap is next considered. On the oil or fat side of a soap the possible chemical compositions are infinite, but the oil soaps are more soluble than the fat soaps. In the majority of textile operations it is more important to have a soap capable of easy and complete washing out than one possessing a superior milling quality. According to the particular detergent problems presented, different types of soap are needed. The utility of olein-soda soaps in scouring wool goods is demonstrated, and economical recipes for making olein soap are given, an alternative method being described for when large quantities are needed. The process of emulsification is explained. In the operation of scouring, the proper formation of an emulsion cannot occur if there is too much dirt, or if there is too little soap. On the other hand, over-thick scours lead to retained matter in the pieces, and this residual stuff—grease or soap, etc.—means interval dyeings in piece-dyed goods, bad finishings, etc. Working without a proper scouring pool in the bottom of the machine is bad practice. The temperature of the scour is also considered, and the effect of not scouring immediately soap or grease milled pieces. W.

(G)—Bleaching

Blue-stained Cotton: Bleaching. A. S. Roberts. *Melliand,* 1930, 1, 1813-1814.
Directions are given for removing the blue tinge from Blue Bender, Blue Marlboro', and Blue Texas cotton by treatment with formic acid. In addition to the acid the bath contains soap and a small addition of Laventin BL. C.

Bleached Cotton: Blueing. R. Hünlich. *Melliand,* 1930, 2, 74-75.
The differences between blued and unblued whites and the process of blueing are discussed. If the blue is not too obtrusive it gives the impression of a pure white, whilst unblued whites often have a yellowish tinge. Ultramarine, Prussian Blue, smalt, and certain coal-tar dyes are all used for blueing purposes. C.

Loose Cotton: Bleaching. W. Mitfessel. *Melliand,* 1930, 2, 84-85.
Scutcher laps, which are preferably made more fluffy than usual, are packed into a bleaching vat provided with a simple circulating mechanism. A sketch shows the layout of the machine; a vat of normal size will hold about 45 laps each of some 40 lb. weight. A wetting-out liquor containing 0·5 to 1 oz. of Nekal BX per 7 galls. of liquor is prepared in a separate tank, boiled to effect complete solution, and pumped into the vat; the ratio of liquor to material should be about 10:1. After 2 hours' circulation the goods are allowed to remain overnight in the liquor. The next morning the liquor is drawn off, the cotton is rinsed thoroughly, and is bleached by circulating through it for 4 hours a liquor containing about 0·5 oz. of active chlorine per gallon. This treatment is followed by thorough rinsing, souring with sulphuric acid, rinsing, and, if necessary, blueing. The laps are finally removed from the vat by rope and pulley mechanism, loosened somewhat by hand, hydro-extracted, opened on a rag picker, and dried. Cotton bleached in this way shows a pure white, does not yellow on storing, and has better spinning qualities than cotton bleached by the kier boiling method. C.

A New Italian Bleaching Process. G. Schröder. *Leipzig. Monats. Text.-Ind.,* 1930, 45, 408.
It is now known that the Italian cotton spinning mill "Stabilimenti Crespi" at Crespi, near Mailand, has developed a new bleaching process which is now used for the whole production. The process employs ozone and hitherto has remained practically a secret one. It is now stated that the ozoniser used is of the "Otto" type and that the machines are delivered by the "Compagnie Française du Blanchiment Electrique." This company has recently erected a plant in the neighbourhood of Paris. The power required varies from 12-25 watts for 1 g. of ozone produced. In order to obtain this efficiency in the Crespi Works the air is first cooled and dried. The cotton goods are first boiled as in the usual processes and are then treated with the ozonised air. The results obtained exceed expectations as no process yields so good a white as the ozone process. The mechanical and chemical characters of the fabric are not affected and the loss in weight is less than in any other process. The cost of bleaching is reduced by the new process. L.

Bleaching Linen with Ozone. *Text. Weekly,* 1930, 6, 361.
In ozone bleaching it should be possible to handle the goods lightly and avoid the distortion of the weft threads which occurs in kiering fabrics in rope form.

A process is described in a recent patent (E.P.337,305) whereby ozone is used for bleaching linen. The fabric, in open width, is guided by rollers through a closed chamber which has a water seal at each end. A flow of ozonised air (at right angles to the direction of the fabric) bleaches the goods which are in a wet condition. The effect of the ozone is greatly accelerated by simultaneously exposing the fabric to ultra-violet rays. The result of the ozone treatment is not immediately apparent, but it causes impurities to be removed easily in the subsequent washing. L.

Bleaching and Stripping of Wool Materials. A. J. Hall. *Text. Merc.*, 1930, 83, 281.

During the past three years certain discoveries relating to the behaviour of dyed wool towards sulphur dioxide and sodium bisulphites have opened up a new field of inquiry. The original discoveries made by A. T. King immediately found application in tests for determining the stoving fastness of wool dyes. Later, King extended his work to the bleaching of raw wool and the stripping of dyed wool. The bleaching of the wool with sulphur dioxide has been investigated by J. L. Raynes, who showed that the bleaching action was largely dependent on the presence in the wool of moisture. The theory of bleaching wool with sulphur dioxide not being in accordance with all the known facts, a perfectly satisfactory explanation of the bleaching process has yet to be formulated. King suggests that whatever the chemical composition of the natural colouring matter present in wool, it may behave towards sodium bisulphite in a manner similar to that of the azo dyes derived from beta-naphthol, that is, it may be especially reactive to bisulphite of a particular composition. The question of the bleaching of raw wool is discussed, with special reference to E.P.332,389 of A. T. King. The effect of temperature has to be taken into consideration. W.

Bleaching Silk and Silk Mixtures. *Dyer and Cal. Printer*, 1930, 64, 141-144.

The operation of removing the colour of silk together with any impurities it contains when silks or half-silks are to be dyed in light shades, is not a simple process, as silk cannot be roughly handled or subjected to the action of strong chemicals. Silk glue (sericin) is a substance which completely surrounds the actual silk filament, the fibroin, in the natural state. In treating the silk to remove the sericin, it is necessary for the fibroin to remain uninjured. The degumming process is described, with particular reference to the soap used. The fibroin properties must be taken into account in the selection of chemicals for bleaching. After weaving, the fuzz is removed, and the silks put through a crabbing machine. The degumming of the fabric is carried out in the same manner as the degumming of the yarn, the only difference being in the type of apparatus employed. The general procedure is the same for half-silks. Experiments made on the use of substitutes for soap in degumming half-silks are mentioned. In degumming operations the use of soft water is essential. The nature of the bleaching process and of the chemicals used will vary in accordance with the nature of the goods treated. Chlorine and hypochlorites will bleach silk, but their action is too powerful. Peroxides and sulphur dioxide are used, the manner of their application being discussed. Precautions must be taken as to the temperature of the bath and the wetting down of goods. After the bleaching, the simple but important operation of washing follows. A method of testing bleach liquor is described, and observations made on the bleaching of tussah. Stress is laid on the great importance of controlling the temperature. W.

Practical Methods for the Investigation of the Processes in the Kier. Part II. *See* Section 5D.

(H)—MERCERISING

Benninger Chainless Mercerising Machine. *Text. World*, 1930, 78, 1349-1350.

The new machine consists essentially of a three-roller impregnating or padding box, a stretching device, and a washing and caustic-recovery apparatus. If so desired, a double impregnating box can be supplied. Each padder consists of a sheet-iron trough for holding the caustic, a three-roller nip, two cloth-stretching rollers of unique design at the entrance of the pad, and a series of adaptable stretching rollers with progressive thread for keeping the cloth smooth during impregnation. The caustic is forced into the trough at several places simultaneously. Pressures up to 30,000 lb. are possible and a special device allows instantaneous release of pressure. A recent improvement is a compensating device which takes up any slackness between the padder and the stretching device and which indicates on a dial the tension of the cloth. The stretching device consists of 12 curved stretching rollers 7 in. in diameter, running in ball bearings and driven by spur gears and chain from the washing machine. Washing and caustic recovery are accomplished in nine successive chambers which utilise the counter-current principle of washing. An oil-pressure speed regulator permits a range of speed of from 12 to 50 yds. per minute. C.

(I)—DYEING

Cotton and Rayon Mixed Fabrics: Dyeing. H. Hoz and E. Bauder. *Textilber.*, 1930, **11**, 616-617.

As a result of experiments it has been found that in dyeing mixed fabrics of rayon and unmercerised cotton the quality of cotton used is of first importance, and manufacturers should use grades with good dyeing properties. A sufficient twist has also a good effect on the results as penetration is then less and the yarn appears better covered. The type of rayon used has also considerable effect on the results; mixed fabrics of Bemberg rayon and cotton are more difficult to dye than viscose-cotton unions, since Bemberg rayon has a much higher affinity for direct dyes as compared with cotton than has viscose rayon. Thus, cottons of maximum affinity are required for union with Bemberg rayon whilst Zehla rayon and a few others have lower dyestuff absorption powers and grades of cotton of lower affinity can be used for combination with them. Manufacturers are recommended, before starting any new line of mixed fabrics, to have dye tests made to determine whether the rayon and cotton which it is proposed to use are compatible. The article concludes with a list of dyes which have been found by experiment to be most suitable for these goods and with practical directions for three general procedures suitable respectively for plain fabrics, hosiery, and goods penetrated with difficulty or giving level dyeings with difficulty, and mixed fabrics of Bemberg rayon and cotton. Six patterns of fabrics made from Egyptian cotton and Bemberg rayon and dyed according to the third process are provided. C.

Dye Jig Variable Speed Driving Mechanism. R. Sansone. *Leipzig. Monats. Text.-Ind.*, 1930, **45**, 298-299.

A device which enables the rate of passage of the cloth through a jigger to be adjusted to the type of cloth consists of an expansion pulley running above the jigger in well-oiled ball bearings and below it, on the shaft of the electro motor, a pulley which actuates the expansion pulley by means of a belt. The arrangement is completed by a small pulley which serves as a tension pulley. The circumference of the expansion pulley is very easily altered by means of a hand wheel. The change to this type of drive can be made by the dyer himself without great cost. A pattern book should be kept giving beside each pattern the optimum speed, and for this purpose the shaft of the expansion pulley is equipped with a revolution counter, whilst the hand-wheel screw may be provided with a scale to show the corresponding position of the wheel. C.

Indanthrene Dyes: Application. G. Rudolph. *Kunstseide*, 1930, **12**, 358-364.

The preparation of dyebaths with indanthrene dyes is described and tables are given showing the most suitable conditions for the preparation of the bath and the dyeing process, and the type of after-treatment required with the different members of this class of dyestuff. Fastness properties are briefly discussed. C.

Jigger Dyeing Machine. G. Adler. *Textilber.*, 1930, **11**, 626.

The machine is especially designed for rayon, silk, and similar delicate fabrics. The smooth, slow start-up is effected by means of a friction coupling, all rollers are equipped with ball bearings, and the delivery roller is positively driven, so that there is no tension on the cloth in the direction of the warp. The jigger is driven as a rule by a directly coupled motor. C.

Organic Solvent Dyeing and Finishing Assistants. N. D. Harvey and E. W. Reid. *Melliand*, 1930, **1**, 1806-1809.

A general article on the uses in the textile industry of ethers of ethylene glycol such as the monoethyl ether (cellosolve) and the methyl and butyl derivatives, diethylene glycol and its ethers such as the monoethyl ether (carbitol), the chlorinated hydrocarbons, dichloroethyl ether and ethylene dichloride, and triethanolamine. C.

Cellulose Acetate Mixed Fabrics: Dyeing. H. Brandenburger. *Leipziger Monats. Text. Ind.*, 1930, 45, 259-260, 296-297, and 332-333.

A general article dealing with the properties of cellulose acetate rayon and the dyeing of mixed fabrics containing it. In the course of the article the opinion is expressed that from the dyeing point of view efforts should be made to avoid the use of linseed oil sizes. Should linseed oil be present the goods should be subjected to prolonged treatment at 50-60° in a bath containing 5-8 g. of Lanapol Soap TE per litre. A small addition of ammonia increases the swelling power of the rayon and assists the process of purification. Alternatively, treatment with ammonia and tetrapol at about 40° is recommended, as also is treatment in a bath containing 0·5-0·7% of Aktivin, 1-1·5% of Marseilles soap, and 2-3% of Lanadin W calculated on the weight of the goods. C.

Skein Dyeing Machine. O. T. Dehle. *Text. Merc.*, 1930, 83, 309 and xiv.

The three processes of dyeing, washing, and hydro-extracting may all be carried out without intermediate handling of the skeins in the new three-in-one skein dyeing machine. The machine consists of a cylindrical sheet metal tank enclosing a reel provided with radial arms arranged in pairs to hold removable skein supporting frames. During the dyeing process the reel is rotated at a slow speed and dye liquor is pumped from a trough at the bottom of the tank and directed on to the skeins. The streams flow in gentle volume in arched form on to the skeins, eliminating all chances of blowing or roughening the silk. After dyeing the dye liquor is drawn out and the skeins washed by treating in a similar way with warm and then with cold water. After removing the water from the tank the skeins are extracted and dried by rotating the reel rapidly at about 200 revolutions a minute. C.

Viscose Rayon: Dyeing. C. E. Mullin and F. H. Cadwell. *Cellulose*, 1960, 1, 10-13, and 47-49.

A review and discussion of the various factors, particularly temperature and hydrogen-ion concentration, which influence the level dyeing of viscose rayon. C.

Viscose Rayon: Dyeing with Direct Dyestuffs. C. E. Mullin. *Silk J.*, 1930, 7, No. 76, pp. 44-45.

A discussion of the effects of variations of the reaction, salt concentration and temperature of the dyebath in the dyeing of viscose with direct dyestuffs. C.

Yarn Dyeing Apparatus. R. Golbs. *Leipziger Monats. Text. Ind.*, 1930, 45, Fachheft 2, 74-76.

Brief descriptions are given of the following apparatus of the Zittau Maschinenfabrik—Apparatus for dyeing two warp beams standing on end, which is also suitable for cheeses and in which, by means of a special arrangement, four small beams (each carrying 20-25 kg. of yarn) can be dyed together in one kettle, apparatus for dyeing four beams simultaneously, in which preliminary and after-treatments can also be carried out, a warp beam centrifuge, the "Bloos" continuous warp dyeing apparatus which works in conjunction with a warp sizing and drying machine and is particularly useful when it is desired to prepare beams quickly for weaving, and apparatus with a packing cylinder and centrifuge, in which loose material, cylindrical cheeses, and yarn bundles can be dyed and subsequently centrifuged without removal from the cylinder. C.

American Padder Dyeing Machine: Application. R. Curtis. *Melliand*, 1930, 2, 102-107.

A general account is given of the American padder, its use, advantages and disadvantages in dyeing rayon goods and union fabrics of rayon, silk, Celanese, or cotton, and the estimation of the cost of pad dyeing. C.

Formic Acid: Application. H. E. Millson. *Melliand*, 1930, 2, 241-246.

A general article on formic acid, its manufacture, properties, and uses in dyeing and finishing. C.

Hosiery: Dyeing. N. D. White. *Melliand*, 1930, 2, 79-83.

A general article on the production of multi-coloured effects on hosiery. C.

Hosiery: Dyeing and Delustring. N. D. White. *Text. World*, 1930, 78, 1520-1521.

A three-fibre mixture, consisting of cuprammonium rayon, silk, and mercerised cotton, has found considerable favour for the manufacture of hosiery to be dyed in solid shades. In dyeing this type of hosiery it is advisable to boil off and dye in the same bath. The bath is prepared with the proper amount of olive-oil soap, or boil-off oil calculated on the proportion of silk in the goods. The dyestuffs are weighed, dissolved in boiling water, and strained into the bath. Direct dyes are best for this purpose, as they dye the rayon and the mercerised cotton very nearly the same shade. Carefully selected direct dyes will also dye the silk to some extent, and acid colours may be added to bring the silk to pattern. Mixtures containing viscose rayon may be treated in practically the same manner or dyeing may be done by the two-bath method. Cellulose acetate rayon is widely used in mixtures to be dyed in vari-coloured patterns. Silk hosiery may be delustred by treating with barium sulphate reduced to a paste with Turkey red oil and dissolved in boiling water. Cellulose acetate rayon may be delustred by raising the temperature of the soap bath, in which it is dyed, above 180° F. All rayons can be delustred quite effectively by working for 30 min. at about 120° F. in a bath of aluminium sulphate at 5° Tw. or higher. Various delustring compounds are available. C.

Pigments: Application in Textile Industry. C. F. Göhring. *Spinn. u. Web.*, 1930, 48, No. 18, pp. 14-20.

The difference between a pigment and a dyestuff is briefly explained. Pigments used in the textile industry may be divided into two classes—(1) those applied in the finished state, and (2) pigments produced in the fibre. Examples of the first class are metallic powders, zinc oxide, cadmium sulphide, and ultramarine. Examples of the second class are iron oxides, Prussian blue, basic lead chromates, Scheele's green, indigo, Indanthrene dyes, and aniline black. Methods of application are discussed. C.

Rayon Twills: Dyeing. J. D. Chaky. *Amer. Dyes. Rep.*, 1930, **19**, 609-610.

Rayon twills were dyed on the jig with various Sky Blues in order to test the tendency to produce warp streaks. Brilliant Sky Blue G, 5G, R, 2RM (G.D.C.) when dyed with the addition of Glauber's salt in a bath acidified with acetic acid produced the most even results, 2RM giving the best results as far as the elimination of warp streaks is concerned. The great drawback to these colours is their lack of fastness. Certain acid colours of the Polar colour group give good results when dyed with the addition of Glauber's salt and acetic acid, but these colours are not fast to washing on rayon. The author recommends the use of specially selected substantive dyes, dyeing in the slowest possible way, and adding the dye solutions in small portions with the omission of salts at high temperatures, for the elimination of warp streaks. C.

Stockings: Dyeing. H. Müller. *Spinn. u. Web.*, 1930, 48, No. 18, pp. 20-21.

Rules are given for the dyeing of stockings and a preliminary boiling-out process for oil-stained goods is outlined. The selection of the dyestuffs and the preparation of the dye bath are briefly discussed. C.

Substantive Dyes: Adsorption by Cotton. H. Boxser. *Melliand*, 1930, **2**, 98-101, 278-281.

The effect of electrolytes, temperature, and wetting agents on the colloidal condition of substantive dyes in solution, and hence on their adsorption by cotton, has been investigated. Most electrolytes cause agglomeration of the dyestuff particles which are then more readily adsorbed by the cotton fibre. These electrolytes are, therefore, exhausting agents. Temperature is a very important factor in determining the molecular condition of substantive dyes in solution. At the boil a portion of the dye is molecularly dispersed but by cooling, destabilisation occurs and maximum exhaustion is attained. Cotton only adsorbs with reasonable fastness those dyes which exist as colloids in solution, and quicker and greater adsorption takes place from the more colloidal members of the group of substantive dyes. Wetting agents cause greater exhaustion of substantive dye solutions, a property which is not as pronounced when they are present with electrolytes. C.

Fabrics Indigenous to Peru. G. A. Foster. *Chem. Abs.*, 1930, **24**, 3374 (from *Anales. asoc. quim. Argentina*, 1929, **17**, 221-229).

Prehistoric samples of fabric showed that indigo, cochineal, and a dye of alizarin nature were used. W.

A Study of Dye Adsorption. J. Rehner, jun., and A. E. Stearn. *Amer. Dyes. Rept.*, 1930, **19**, 465-468.

The prevailing opinion for many years has been that the dyeing of vegetable fibres is a purely physical phenomenon, implying a physical adsorption of the dye by the fibre. Justification for a mechanical theory is probably to be found in the chemistry of cellulose. The fixation of dyes by mordants has been the subject of much debate. Experiments with proteins, carbohydrates, and mordants are described. The generality of the phenomenon of *p*H change and the fact that these changes in ampholytes by the addition of acid and basic dyes at corresponding *p*H values, though in opposite directions, are of similar orders of magnitude seem to preclude the possibility that the activity coefficients in the original solutions are different in the mixture, the result being that the H-ion concentrations before and after mixing are the same, although the potentiometrically determined activities are different. It is difficult to conceive of any hypothesis which should attribute to these two types of dyes the selective power of raising on the one hand, and lowering on the other, the activity coefficient of the H-ion in the experiments performed. An attempt to explain the *p*H changes on the basis of hydrolytic adsorption has, for many of the proteins, been shown to be without foundation. A summary of the conclusions arrived at is appended. W.

Grease-dyed Wool Goods. *Text. Argus*, 1930, 7, 881.

In connection with the preparatory processes for textile materials, it is essential to give a careful examination to cloths in the grey before they are given any processing proper whatever. The need of thorough preparation of goods previous to dyeing is stressed. In the case of certain low worsted materials there is often no previous scouring and this is known as dyeing in the grease. The advantages and disadvantages of this method are set forth, it being stated that the latter far outweigh any good points. W.

Recent Trends in Wool Dyeing. W. W. Chase. *Text. World*, 1930, 77, 1237-1238.

In dyeing wool attention has been focussed largely on the production of fast shades. Chrome processes are being supplemented by methods employing vat and naphthol colours. For the application of chrome dyestuffs the bottom-chrome method is the oldest and best known. The use of ammonium acetate is being investigated. Where bright shades of good fastness to light are required, specially selected acid colours are often employed. The use of vat colours has a high potential value. The indigosols, or water-soluble vat colours, are used for producing light shades of superior fastness to light. The naphthol colours provide a range of fast, bright shades, including orange, red, scarlet, and maroon. W.

Dyeing and Finishing Costume Cloths. H. Jennison. *Wool Rec.*, 1930, 37, 617.

A brief description of the dyeing of costume cloths and some of the more important troubles arising from pieces containing makers' faults. When dyeing suitings or dress goods requiring exceptional fastness, chrome fixed colours are essential, which call for more complicated treatment than the acid wool colours. The process of the London Shrunk finish is referred to. W.

Fastness in Men's-wear Goods. "Tinctoria." *Text. Argus*, 1930, 7, 21-22 and 53-54.

Probably the greatest factor in making a choice of dyestuffs, whatever the state in which the wool is dyed, is the question of fastness to light. With the heavier cloths, the amount of exposure, and possibility of action to a considerable number of influences which the cloths are frequently expected to withstand, is incredible. Where other fibres than wool are employed these must be satisfactorily fast, this applying also to the various operations through which the pieces will have to pass before they are put on to the market. The case of cotton in mixture cloths and fastness to cross dyeing is discussed at length. Another use of dyed cotton is for selvedge work. If goods are to be rubberproofed they must be watched to see that certain foreign substances are entirely excluded. The actual proofing process may have its effect on the strength of the material if any trace of copper is present. To secure the elimination of grease and acid it is essential for the cloths to be thoroughly scoured. As the colours employed for dyeing slubbing, yarn, etc., must be of the very fastest type to almost all influences, the choice is limited to the mordant colours and some of the indigosols. W.

The Production of Insoluble Azo Colours on Textile Fibres. B. D. Varma. *Dyer and Cal. Printer*, 1930, 63, 509-510 and 575-576.

The ice colours are discussed, particularly the red dyes. The naphthol colours are a very recent development. In 1912 the anilide of β-oxynaphthoic acid was marketed under the name of Naphthol AS, and with its substitution of β-naphthol the azoic colours, as a class, came into the forefront of modern dyeing materials. Its advantages are many, including fastness to perspiration. Naphthol AS has been followed up by other similar products, the most important of these being enumerated here. The colours that can be formed by using the Naphthol AS products are also given and their application to cotton goods described. The bases used in the developing bath are given, together with their chemical constitution, these bases all having to be diazotised. There are instructions for the preparation and use of diazo solutions. The principal difference between the newer process and the old method of dyeing yarn with paranitraniline lies in the fact that no drying of the yarn after preparation is now necessary. If the prepared yarn is well squeezed, the feeding quantity will be about 400-600 c.c. for each bundle of 2 lb. of yarn. The best impregnation is done in a liquoring machine, for example, the Obermaier apparatus. Consideration is given to the questions of the preparation of the material for impregnation, the impregnation and developing baths, the diazotising temperature and the stability of the bath. W.

Lustre Unions. *Wool Rec.*, 1930, 38, 419-421.

The lustrous animal fibres are notorious for the variations of their dyeing properties. Lustre wools for the production of linings and similar fabrics are rarely dyed in loose form, but commonly as sliver, yarn, and piece goods. The atrophied wool has a greater affinity for direct cotton dyestuffs than normal wool, and this is utilised by the dyer for the production of level dyed material. The greatest difficulty is that of obtaining moderately level effects where pale shades are desired. Lustre wools are employed for fabrics of the Palm beach type, and the processes of shrinking and dyeing these are described. The question of the tendering of fabrics made from cotton warps dyed fast to cross-dyeing along with mohair or lustre wools is discussed. W.

Application of the Oldest Vat Red. G. Raeman. *Dyer and Cal. Printer.* 1930, 64, 87-88 and 147-149.

The merits of Chrome Fast Garnet R, Chrome Fast Bordeaux B, Eriochrome Bordeaux C, and Eriochrome Bordeaux B are discussed. In order to get the best fastness to milling from these Garnet and Bordeaux dyes, at least half as much chrome as colour must be used. The presence of D.O.V. helps to increase the fastness and also prevents the chrome from tendering the wool. The properties of Acid Chrome Red B, Acid Alizarine Grenade R, and Monochrome Red 5G are considered. The oldest of the vat reds was first prepared in 1905 and marketed as Thioindigo Red B. Its formula is given in comparison with that of Indigo. Instructions are given for the making up of the stock vat for this and for Ciba Pink B. The condition of the vessel in which the preparation of the stock vat is performed is very important. This is discussed with special reference to the presence of steam. A typical procedure for the use of a dye liquor in an open vat is given. Hard water seems to be of actual advantage in dyeing some of the vat colours. Lime and/or magnesium are said to reduce the alkalinity of the bath and so increase the affinity of the wool for the dye. After dyeing, it is well to give the usual hot acid treatment. Formulæ for the stock vats of Thioindigo Red BG, of Ciba Red B, and of Duranthrene Red BN are given. Salmon shades, Indigosol Red HR, Asoic Reds, and Combination Reds are also considered. The results of an exposure test show the fastness to light of certain colours. W.

Machine Dyeing of Loose Wool, Sliver, and Yarn. H. Chadwick. *Dyer and Cal. Printer*, 1930, 63, 199-200, 261-263, and 323-324.

A present tendency is to use in increasing quantities wool dyed with fast colours, so that when the spun yarns are incorporated in materials, the colours are unaffected by subsequent piece-finishing operations. Fabrics employing dyed yarns in their construction can be divided into two main classes, those in which the piece effects are produced by coloured threads, and those in which they are produced mainly by the use of mixture yarns. The fastness qualities of the dyestuffs used are of great importance. The establishment of a dyehouse to deal with material in the pre-weaving stages of manufacture adds considerably to the efficiency of a plant. Three types of loose wool dyeing machine are described, details of the "Simplex" machine being illustrated. The type of wool treated in this machine is generally of the coarse, unscoured variety. Frequently washing or scouring before dyeing is essential, and in certain cases the wool may require bleaching after washing. Three classes of dyestuffs are used. Where an exacting standard of evenness is demanded, the installation of a Callebaut and De Blicquy dyeing machine for loose wool is recommended. W.

The Production of Insoluble Azo Colours on the Fibre. B. D. Varma. *Dyer and Cal. Printer*, 1930, 64, 23-26.

The chief source of trouble with insoluble azo colours in their application to cotton fibres is the bleaching process, some colours, however, being uninfluenced by kiering. Researches have been made into the reasons for the change of shade during the hot-treatment and the changes in fastness due to hot-treatment. Very severe treatment is, however, necessary to produce any marked change with the better combinations. The control of padding baths is referred to. The application of the naphthols to animal fibres is discussed, with regard to their chemical nature, the adhesion and fastness of naphthols to wool, and damage by caustic alkali. The naphthol colours offer the following special advantages—simple mechanical arrangements, small oil consumption, little waste in winding, saving of steam and labour, large and rapid output, and cheapness of the dyestuffs. In addition, cotton can be dyed in every stage of its manufacture. Reference is made to naphtholates, and the use of naphthols in calico printing is discussed. W.

The Dyeing of Indigo Blue Serges. D. Carter. *Text. Mfr.*, 1930, 56, 109-110.

Wool is dyed with Indigo in almost all stages of manufacture, but its application to piece goods is the branch dealt with here. The fastness and beauty of shade produced by Indigo are largely governed by the condition of the vat, the method of working, and the condition of the material before dyeing. Scouring and other preliminary processes are of great importance. In many cases dyeing and finishing faults in worsted piece goods have been attributed vaguely to the presence of oxidised olive oil. One or two peculiar effects that have been traced to the water used in Indigo dyeing are described. Finally, the problem of stains and the question of additions to the Indigo vat are considered. W.

Application of Vat Colours. D. McGill. *Dyer and Cal. Printer*, 1930, 63, 447 and 511 512.

The application of vat colours to the dyeing of piece goods is dealt with here. A thorough "bottoming" of the goods preparatory to vat dyeing is absolutely necessary. Cloth for vat dyeing should be wetted out through a solution of a diastase. The advantages of using Rapidase are stressed, and other points in the preparation of the cloth mentioned. The three main types of vat colours in common use—anthraquinone, indigoid, and indigosols—and their properties are described. There are four distinct methods of applying vat colours—(1) Padding the reduced dyestuff and finishing the goods on a continuous machine. (2) Padding the reduced dyestuff and further reducing and finishing on the jig. (3) Padding the unreduced dyestuff, reducing and finishing on the jig. (4) Jig dyeing. These four methods of applying vat colours are considered in detail. W.

Notes on Sulphur Colour Dyeing. E. Davidson (E. I. Du Pont de Nemours & Co.). *Dyer and Cal. Printer*, 1930, 63, 520-521 and 574.

There is no other class of dyestuffs in general use of which so little is known. Some of the most important points in the dyeing of these colours are briefly considered, with special reference to their solubility. Because of the wide differences in solubility, there is difficulty with regard to compound dyeings. The question of the amount of soda ash needed is discussed, this being intended to keep the bath in an alkaline condition. Any large excess has a tendency to hold the colour off the fibre. Temperature problems are very important, as a great deal of shade variation experienced in the dyeing can be traced to variations in the dyeing temperatures. Automatic temperature control devices will, as a rule, pay for themselves in a short time. After the dyeing proper, some sort of oxidation is necessary on everything except the direct dyeing sulphur blues, and even these are improved by it. Air oxidation is preferable, and where this is not possible, water oxidation is the best method. Proper washing is essential and economy in this is always in the long run most expensive. The question of tendering is discussed, with particular reference to sulphur blacks. W.

The Diagnosis of Colour Faults in Finished Goods. *See* Section 5C.

Investigations upon the Cause of the Change of Shade of Certain Naphthol AS Combinations under the Influence of Moist and Dry Heat. *See* Section 5C.

(J)—PRINTING

Aniline Black Steamer: Control. P. P. Sasanov and N. N. Petrov. *Textilber.*, 1930, 11, 636 (from *Ber. Textilind., Moscow*, 1930, Nos. 1 and 2).

The difference in temperature in the neighbourhood of the walls and in the interior of the Mather-Platt steamer when goods padded with Aniline Black or printed with vat dyes are running through, which is ascribed by Reinking to heat of reaction, is ascribed by the present authors to the moisture content of the goods, the heat of swelling of the cellulose playing a considerable part. A difference in the elasticity of the steam of pure water (contents of the steamer) and of a salt solution (surface of the goods) is to be regarded as one of the causes of the superheating of the steam. An apparatus for taking samples of steam from the steamer for analytical purposes is described. The samples are condensed and, among other tests, hydrochloric acid and aniline are estimated in the condensate. The use of an apparatus to prevent superheating of the steam is recommended and its construction is described. C.

Stencil Prints: Production and Advantages. *Spinn. u. Web.*, 1930, 48, No. 34, pp. 10-12.

The apparatus required for stencil printing is much simpler and cheaper than that required for hand printing or for spray printing. The colour paste for stencil work requires very little thickening and, with the exception of dyes which require to be printed from alkaline solutions, any of the colours used in ordinary hand spray, or machine printing may be used. Suitable formulæ are given. The size of the repeat may be considerably greater in stencil than in hand printing. The designs may be cut from enamelled stencil paper or zinc foil, or traced on bolting cloth and the parts required to be impermeable to the dye coated with enamel. C.

Variamine Blue Salt B and Fast Violet Salt B: Application. W. H. Cotton. *Melliand*, 1930, 1, 1810-1813.

Eight patterns are provided of prints obtained with Variamine Blue Salt B and Fast Violet Salt B, two new Fast Colour Salts, and details are given of the processes by which they were obtained. Both salts can be used in conjunction with all the naphthols but give the brightest colours with Naphthol AS and somewhat redder shades on Naphthol AS-D. Both salts can be readily discharged and Variamine Blue Salt B can be readily resisted with aluminium sulphate. By adding one of the red Fast Colour Salts to the white resist very fine red resists are obtained. Coloured resists under Variamine Blue Salt B can also be obtained with vat colours or Indigosols. C.

Hand Block Printed Calico: Styles. J. McCartney. *Text. Mfr.*, 1930, 56, 336-338.

The tools required by a block printer are of the simplest kind. The blocks are of five main types—(1) Ordinary wooden blocks, on which the design to be printed is raised in relief; (2) blocks upon which the design is made by using copper strips and pins, set into the blocks and raised from the surface about $\frac{1}{8}$ in.; (3) cast blocks—the design is first cast in metal and then screwed firmly on to the face of the block; (4) composite blocks of wood, copper strips, etc.; (5) felted blocks. For block printing purposes there are four main styles—(1) Direct printed styles, in which the colour is printed on directly; (2) dyed styles, whereby mordants are applied locally and colours afterwards applied by dyeing; (3) discharge styles—the ground colour is dyed first and other colours or whites printed on afterwards to cut away the ground colour, leaving the printed portions white or coloured as may be required; (4) resist styles—white or coloured mixtures are printed first in order to resist the action of the dye, which is applied afterwards, the printed portions remaining white or coloured. The methods used in each case are described and suitable classes of dyes are indicated. C.

Rapidogen Colours. I.G. Farbenindustrie A.-G. *Leipzig. Monats. Text.-Ind.*, 1930, Fachheft III., 45, 112.

These colours represent the latest development in methods of printing with insoluble azo colours. Like the Rapid Fast colours they are mixtures of diazotised bases and members of the Naphthol AS series in powder form. They are more stable than the Rapid Fast colours. It is not necessary to steam or hang up for several hours after printing. Development is effected by a short passage through a hot acid bath. A fairly wide choice of colours is now available. They may be applied by the spray-printing method. L.

Printing of Wool with Indigosols. Durand and Huguenin. *Text. Mfr.*, 1930, 56, 380.

In the printing of woollen material with the indigosols, considerable difficulty may be caused owing to the staining of the white ground during the oxidation process. By developing the colour with a solution of a persulphate and a strong mineral acid this fault may be entirely overcome (G.P.486,174, Durand and Huguenin). The print colour is prepared, adding the indigosol to a 1/1 solution of British gum. In the case of dyestuffs that only oxidise with difficulty, an addition may be made of from 5 to 20 g. of ammonium persulphate per litre. After printing the goods are steamed damp for ½ hour, as is usual for wool, and then developed in a bath containing from 10 to 20 g. of potassium persulphate and 10 to 25 c.c. hydrochloric acid (or the equivalent amount of sulphuric acid) per litre at a temperature of from 50° to 70° C., well washed, and finally soaped. W.

Indanthrene Padding Process in the Dyeing of Piece Goods. *Dyer and Cal. Printer*, 1930, 63, 636.

The difficulties of dyeing on the jigger by the three known processes for indanthrene colours (IK, IW, and IN) are enumerated. A considerable improvement in levelling is obtained by reducing the affinity of the indanthrene for the fibre at the beginning of the process. In the indanthrene padding process, instead of using the vatted dyestuff, the cloth is impregnated on the foulard with the dye in its unreduced condition, in suspension, and then vatted on the jigger. This can only be effected with the paste varieties of the indanthrenes, the most suitable types being the "fine paste" brands. The impregnation process, which may be regarded as a combination of the indanthrene padding process and the ordinary jigger-dyeing method, is fully described. W.

(K)—Finishing

Coloured Stripe Shirtings: Finishing in India. *Text. Weekly*, 1930, 6, 28 and 35.

The bleaching and finishing of woven coloured-stripe shirtings is very well done in India, particularly in Bombay. Most of the shirtings are back-filled, some requiring a heavy back, and others just assisting. A good lustre is always required. With low quality cloths the finisher in England has certain advantages over the finisher in Bombay as the pieces turned out from the looms are more evenly woven and take a nicer back, at the same time making it easier to keep the face side of the cloth free from starch. Goods filled in England mellow by crossing the water and should be left a little on the firm side to allow for this. The usual routine in Bombay mills is as follows—bleach, mangle, dry, back-fill, damp, stretch, calender, make-up, and bale The ingredients used for back-filling are—maize and wheat starches, farina, sago, tapioca; white and yellow dextrines; Turkey red oil, mercine glaze, green olive oil soap, and country soap; glycerine (commercial), resin size, China clay, French chalk. Tinting preparations are ultramarine, tinting blue (green shade), Edge's, and tinting violet. Woven coloured-stripe shirtings are worn generally next to the skin in India, so that it is necessary to cut out all drugs likely to cause skin irritation. The selection of materials is disucssed and suitable formulæ are given. C.

Perfumed Textiles: Finishing. D. A. Laird. *Text. World*, 1930, 78, 1111, and 1163.

Various opinions of the use of industrial aromatics for correcting the objectionable odour often observed in finished goods are quoted. A pleasant smell rather than an odour of perfume is recommended. Sweet pungent odours produce unfavourable effects on the employees and may not appeal to the personal taste of the purchaser. C.

Hosiery Pressing and Finishing Machine. British Textile Finishing Machines Ltd. *Silk J.*, 1930, 7, No. 76, pp. 52-53.

The new automatic hosiery pressing and finishing machine consists essentially of two pairs of vertically-disposed steam-heated press plates and an endless track or runway with two parallel sides joined at both ends by semicircular segments. Duralumin forms are fixed to carriages which run on ball bearings and are conveyed round the runway by a chain. The movement of the carriages is controlled by an ingenious arrangement of stops which all act in unison with the intermittent action of the press plates, and are operated from and by the press mechanism. The forms are filled with hose at the front of the machine and pass forward with the chain around the semicircular end of the track until the first one comes to rest next to the closed press plates. By the time nine forms have accumulated together the press plates open to permit the pressed forms to pass out and the new forms to pass in. When the forms have been in process in the first press and then in the second press, they emerge at the delivery end of the machine still in close formation in a group of nine. When they are clear of the press plates, eight of the forms are held by an automatic gear, but the first carriage is allowed to travel forward to a given point further along the track, where it automatically releases the second carriage. This procedure is repeated until the whole of the carriages are spaced out at a uniform distance. All the time this separating process is proceeding the succeeding lot is being pressed, the duration of the pressing being timed to coincide with the assembly of the forms at the feed end and their even spacing out at the delivery end. The principal object in spacing out the carriages after they emerge from the press plates is to ensure that they come to the operative one at a time, and at set intervals which permit the stripping and reloading to take place without wasted effort and with no loss of time. Both operations are carried out while the carriages are in motion. For the pressing of garments, highly-polished duralumin forms with hinged arms are fixed to the carriages. Only two garments are pressed in each pair of plates at a time. C.

Textile Finishing Machinery. —. Nitsche. *Leipziger Monats. Text Ind.*, 1930, **45**, Fachheft 2, 70-74.

Reference is made to the use of calenders with 12 to 16-fold chasing mechanism and to Goliath calenders. A chainless high-production mercerising machine recently put on the market is described; the machine is equipped for step-wise impregnation, the cloth being treated progressively with mercerising liquor of increasing concentration and decreasing temperature, with a special arrangement for regulating the lateral tension on the cloth between the padder and the stenter frame, and with a new type of curved expander bar. A felt calender which is equipped with a special felt drying drum, an open width dyeing machine for indanthrene dyes, and a machine for stretching rayon knitted goods are other new machines which are briefly described. In the dyeing machine, impregnation, reduction and fixation of the dye, and after-treatments such as acid treatments and soaping can all be carried out. The goods are padded several times under pressure with a vat dye paste to which Præstabit Oil V has been added, after which they are treated in the same machine with a hydrosulphite caustic soda bath. In the stretching machine all the movements of hand stretching are simulated mechanically. The machines are the work of C. G. Haubold A.-G., Chemnitz. C.

Vistra Dress Fabrics: Finishing. *Textilber.*, 1930, **11**, 619-620.

Vistra rayon is eminently suitable for the manufacture of the present fashionable printed dress fabrics and a general account is given of the preparation, printing, and finishing of such goods, together with two patterns of printed cloths The fabrics may have a wool, muslin or a silk finish. C.

Cellulose Acetate Fabrics: Finishing. A. C. Tate. *Melliand*, 1930, **2**, 111-117.

A general article on the dyeing and finishing of cellulose acetate fabrics, intended to assist finishers who are handling this material for the first time. According to a table indicating how different weights and weaves are generally handled, twills, taffetas, satins, failles, and poplins may be jig-dyed; ninons, taffetas, crêpes, failles, and poplins may be winch-dyed; and voiles, ninons, and crêpes may be tub-dyed. Tentering and drying, the occurrence of bowed weft and slack edges, calendering, and the use of the button breaker to break down a set effect which may develop in certain types of fabric, are other matters dealt with in the article. C.

Finishing Machinery Range Drives. W. S. Brown. *Melliand*, 1930, **2**, 256-260, 390-393.

A general article on the design and operation and some advantages and disadvantages of range drives for finishing machines. A range drive includes two or more separately driven units or machines. These separate drives are arranged with inter-control so designed that the proper degree of synchronism under changing over-all speeds and other varying conditions is ensured. By running finishing machines in series or ranges intermediate handling is obviated. C.

Knitted Goods: Pressing. *Spinn. u. Web.*, 1930, 48, No. 39, pp. 9-12.

A discussion of the selection and operation of presses for knitted goods, the organisation of the pressing department, and methods of controlling production and checking the output of individual operatives. C.

Boiling and Crabbing Woollens. G. Rice. *Text. Amer.*, 1930, 53, No. 1, pp. 27 and 51.

The steam or lustre finish given to woollens usually tends to improve the quality of their felted condition as well as to brighten them. The finish which is obtained is different from that resulting from polishing. A type of two-cylinder steam finishing machine seen in operation in a French woollen finishing mill is described and illustrated, and an account given of the dewing process. W.

Wide Shears for Floor Coverings. Curtis and Marble Machine Co. *Text. World*, 1930, 77, 2305.

These new shears are capable of handling carpets and rugs up to 18 feet in width, in accordance with the tendency towards manufacturing seamless floor coverings in greater widths. The added weight and bulk are difficult to handle in shearing and require a machine which will crop before burling and inspecting as well as give the finishing cutting. The new shears are equipped for brushing in order to clear the back and to raise the pile on the face for shearing. Some models are equipped with two brushes on the face which serve to open out the tufts. Other adjustments and improvements are described, the result being that the fabric as it leaves the shears, is practically completed. W.

Processing Lightweight Woollens. *Wool Rec.*, 1930, 38, 797-801.

Lightweight woollens are still being produced in fairly large quantities, particularly those that have a clear face finish. The processes in the production of these goods are described in detail, with particular reference to the different methods employed with high quality and lower quality goods. W.

Organic Solvent Dyeing and Finishing Assistants. *See* Section 4I.

Formic Acid: Application. *See* Section 4I.

Hosiery: Dyeing and Delustring. *See* Section 4I.

(L)—Proofing

Fabrics for Rubberising: Specifications. S. G. Byam and L. R. Bailey. *Text. World*, 1930, 77, 3510-3512 and 3776-3778; 78, 187-189.

A full discussion of the quality, width, thread count, weight, length of cuts, tensile strength, freedom from fabric defects, content of sizing material in grey goods, content of copper, manganese and iron, and fastness of dyeing specified for fabrics used in the automobile and general proofing industry. The limits for metals that are known to catalyse the decomposition of rubber are placed at—

	Automobile Cloths		For General
	Grey	Dyed	Proofing
Cu %	0·001	0·003—·005	0·002
Mn %	·0005	·001	·001
Fe %	—	—	1·100

Details are given of analytical tests. C.

Textile Fabrics: Waterproofing. H. J. Brawn. *Brit. Chem. Abs.* B, 1930, 65 (from *Chem. Ztg.*, 1929, 53, 913-914).

Cadmium oleate, prepared by saponifying olein with moist, precipitated cadmium hydroxide at 60°, separates as a yellow waxy product retaining 30% of water; by drying with stirring on a sand bath at 120-130° it is obtained as an anhydrous, pale brown solid which is soluble in most organic liquids (benzine, xylene, toluene, amyl acetate, etc., with increasing viscosity to form almost colourless gels at suitable concentrations), but is insoluble in acetone and ethyl acetate, and only sparingly soluble in ethyl or butyl alcohol or trichloroethylene. A milky, stable, colloidal dispersion is obtained by saponifying in the presence of ammonia (cadmium oleate 70, 25% ammonia 400, water 780 parts), which is very suitable for waterproofing stone, fabrics, etc. The anhydrous salt is compatible with ethyl- and benzyl-cellulose lacquers, but these are not improved by the addition. Cadmium palmitate and stearate are less soluble, hard, whitish solids. C.

European Methods of Waterproofing Fabrics. H. Jaeger. *Melliand*, 1929, 1, No. 1, pp. 123-128; No. 2, pp. 253-258.

The processes and machines successfully used in this field are described in detail, with special stress upon improvements in the new machines and the advantages of continuous operation. Processes are given which have been found practicable for the undermentioned fabrics—(1) Cotton clothing materials. (2) Hunting linen, sackcloth, wind breakers, and better grade tent cloths. (3) Lower and lighter grade goods of the above types. (4) Cotton sail cloths, hemp or flax tent material, sackcloth and covers. (5) Cotton, hemp, and jute cloth with a filling finish for sackcloth and wagon covers. (6) Coloured sail cloths, cotton, hemp, and flax horse blankets. (7) "Chemical green" impregnation on cotton and linen sail cloth. (8) "Chemical green" on sail cloth for wagon covers. (9) Simultaneous application of paraffin and dyeing to sail cloth. (10) Paraffin on sail cloth without pre-dyeing. Methods for making the following preparations are described—Acetate or formate of alumina solutions, aluminium acetate, acetate of alumina, aluminium formate, soap solutions and impregnating with copperoxydammonia. Instructions are given for oil impregnating on a continuous equipment and for the treatment of woollen fabrics. W.

5—ANALYSIS, TESTING, GRADING, AND DEFECTS

(A)—Fibres

Oiled and Unoiled Cotton: Spinning Test. J. J. Brown. *Melliand*, 1930, **2**, 46-51.

Two lots of five bales each of $1\frac{1}{8}$ inch strict middling Mississippi Peeler cotton were processed in two parallel lines of machinery, one lot being oiled, after leaving the vertical opener, with 0·3% of Breton Minerol E, using the high-pressure Breton Minerol Process equipment, whilst the other lot went through unoiled. In the blow room, the visible waste was 1·296% for the oiled and 1·183% for the unoiled cotton, the difference being due to the fact that more shale, leaf, and dirt were thrown out. The total waste was 4·442% for the oiled and 4·082% for the unoiled stock. In the cardroom, the total waste was 10·14% for the oiled and 11·27% for the unoiled cotton. The invisible waste was 0·55% higher for the unoiled cotton. The comber waste was 13·48% for the oiled and 13·67% for the unoiled cotton. The amount of fly and dust was reduced at least 30%. There was less overhead cleaning and operatives found that the machines on oiled cotton were easier to keep clean and ran better. The oiled cotton made better roving and there was a decrease of 54% in ends down on the intermediate frames, 58·6% on the fine frames, 42·8% on the spinning frames, and 38% on the doublers. The yarn made from unoiled cotton changed more readily, both in weight and breaking load, with atmospheric conditions than did that from oiled cotton. The breaking loads of the singles yarns were 39·68 lb. for the unoiled and 37·83 lb. for the oiled cotton; the corresponding weights were 17·78 and 17·48 grains. No difference in the appearance of the singles yarns could be seen with the eye but in the doubled yarns the oiled two-fold had a slightly smoother appearance than the unoiled. C.

Fibre Bundles: Rigidity. S. Tchoubar. *Revue Text.*, 1930, **28**, 1213-1219 and 1379-1383.

A system of testing for the determination of the value of vegetable fibres for textile purposes involves determinations of resistance to rupture, fineness, and rigidity. Tests for the determination of rigidity, using a bundle of fibres, are described and typical results are given for cotton, rayon, linen, jute, and other vegetable fibres. In one test, after Roehrich, a loop is made to droop under its own weight and the angle observed; the free length is 25 cm. and the weight 0·1 gm. The other test is based on Peirce's oscillation measurement of torsional rigidity but uses a bundle, e.g. 0·1 gm. of viscose, 15 cm. long. C.

Spinning Test Sample: Minimum Weight. W. S. Fedorov and W. M. Rybakov. *Trans. Sci. Res. Inst. Text. Ind., U.S.S.R.*, 1930, No. 2, pp. 1-28. (In Russian, with English summary.)

Spinning tests are reported on 2 kilo., 4 kilo., and 100 kilo. samples of "First Sort Normal" cotton (staple 33-34 mm.), "Medium" (28-29 mm.), and "First Sort Extra" (26-27 mm.). There was good agreement in the factors determined, viz. counts, lea strength, their product, and variability, but small samples gave somewhat lower percentages of sliver than the large samples. These percentages may, however, be adjusted by correction factors that have been worked out. C.

Water Content of Wool in Relation to the Humidity and Temperature of the Surrounding Air. S. N. Kowalewsky. *Melliand*, 1930, 2, No. 4, pp. 539-542.

The relation between the water content of wool and the humidity of the air is a question of importance for industrial as well as agricultural reasons. An experiment is described to find the law which governs the changes in weight. As a result of the investigations, it was proved definitely that the weight of the sample of wool differed at the same temperature and humidity of the air in the room, which means that the water content of the wool differed also under these conditions, and that this difference can be as high as 1·5%. The cause of these differences can be two-fold, and is shown in the tables which accompany this article. Long before these experiments were carried out systematically, an entirely empirical method was used which permits ascertaining the water content of washed wool based on the temperature and humidity of the air. The question is discussed as to whether this formula gives results exact enough to be used in the practical analysis of the water content in wool. The formula reads $R = \frac{W}{3{\cdot}85\,(1+0{\cdot}006\,t'')} + S$, wherein R is the water content of the wool, W the relative (prevailing) humidity of air, t'' the temperature of the air, $K=3{\cdot}85$ the coefficient, and S the correction. A table is given showing the water content of Merino wool in comparison with five other qualities of wool according to actual analytical tests, compared with the values computed with the aid of the above formula. W.

The Term "Character" as Applied to Merino Wool. *See* Section 1B.

(B)—YARNS

Two-fold Cotton Lace Yarns: Lea Strength. J. Barr. *Melliand*, 1930, 2, 17-20.

Strength results obtained on lace yarns over a period of years show that the width of 80 threads of a yarn of given count, expressed as a decimal fraction of 1 inch and multiplied by 147, will give a result that might be considered representative of strength in lb. per lea for the count of yarn involved. C.

Washed Cotton and Silk Yarns: Insulating Properties. H. H. Glenn. *Melliand*, 1930, 2, 264-266.

A comparison has been made of the insulation resistances of cotton-insulated and silk-insulated wire at various relative humidities from 65-90% and down again to 65% before and after washing the textile materials. A marked improvement is obtained in both silk and cotton, the cotton being improved to such an extent that it becomes a better insulator than the commercial silk in general use. The removal of the soluble salts also reduces the sensitivity of the alternating current characteristics of the textiles to changes in atmospheric humidity. The cost of washing silk and cotton is usually less than 5% of the cost of the material and incorporation of the improved textiles in Bell System apparatus is proceeding rapidly. Apparatus for testing the insulation resistance of washed textiles is described. C.

Testing the Strength and Elongation of Yarn. E. Müller. *Melliand*, 1930, 2, No. 5, pp. 658-660; No. 6, pp. 787-790.

The several factors that influence the strength of yarn can be divided into resistances of two orders; the first relates to the strength and other properties of the individual fibres and their number in the cross-section of the yarn, and the second to the twist imported to the yarn. If one of these two groups is lower than the other in any yarn, then its whole strength does not find expression. The problems of the effect of excessive twist, of thick and thin places in yarns and of fibres in cross sections are discussed. Figures are given to illustrate a breaking strength formula as applied to different fibres. According to a resolution passed in 1912, the European conditioning houses agreed upon fixed quality terms derived from the strength and elongation of real raw silk. No normal values have hitherto been set up for wool. The breaking strength both of yarns and fabrics is dependent upon their moisture content, and this must be taken into consideration during testing. A method of testing the strength and elongation of yarn by snapping it between the hands is described. These methods are not as satisfactory as testing with automatic precision instruments (strength testers). The following factors influence the final results indicated by a strength tester—(1) the speed at which the yarn is subjected to tension during the breaking test; (2) the distance between the two clamps which secure the two ends of the yarn; (3) the humidity conditions of the testing chamber and of the material being used. It is preferable to have these instruments driven by power. The distance between neps and precautions to prevent the yarn slipping in the clamps are important. W.

(C) FABRICS

The Diagnosis of Colour Faults in Finished Goods. F. L. Goodall. *Soc. Dyers and Col.*, 1930, 46, 263-267.

This article is not concerned with faults in actual dyeing processes, but with faults which arise before and after dyeing. In tackling an investigation into any fault, it is necessary to get together as many particulars as possible with regard to it, and to consider all the varying treatments which the goods have had. Experiments on small samples of material, with the object of reproducing the fault, should next be made, and confirmatory evidence obtained. Apart from the process of dyeing, all normal processes involve the use of alkali. Practically all piece-dyed goods are slightly acid, whilst slubbing or loose wool dyed pieces are slightly alkaline. The effects of residual alkali on goods before and after dyeing are discussed. Incomplete removal of alkali is the commonest cause of unexpected colour failure, another one being sulphite faults, which are closely related to a previous residual alkali fault. Two tests are described, these, in addition to the ordinary stoving test, forming a means of reproducing and of understanding the production of innumerable faults in which sulphur is concerned in some form or other. An instance is given of the effect of atmospheric sulphur dioxide on alkaline goods, there being other carriers of sulphur dioxide which may give rise to similar faults. By far the commonest cause of sulphite faults lies in wrapping paper used for packing and storage. An easy method of detecting the presence of sulphur or sulphite in this is given. To test thoroughly the fastness of a dyed pattern to sulphur dioxide under all conditions, a more drastic test is necessary, involving the use of either the four sulphite solutions hot, or a hydrosulphite solution. Hydrosulphite will reduce other classes of colours besides the azo colours so far considered, its field of action being very large. The misapprehension as to the connection of this fault with exposure to light in general is explained. W.

Fading of Stored Textile Materials. *Wool Rec.*, 1930, 38, 733-735.

Yarn, particularly knitting yarn, sometimes fades after being packed in bundle form in paper. Since paper pulp is not vigorously washed, there will probably be a small amount of sulphite retained by it. This combination of paper and sulphite will slowly liberate very small quantities of sulphur dioxide, which, in the presence of small amounts of alkali contained in the dyed wool, will produce a fade effect. This change takes place in the dark. There are many ways in which sulphur dioxide may come into contact with dyed material, probably the most obvious being that where it is present in the atmosphere owing to chimneys, or fumes from coke or gas stoves. As sulphur dioxide may naturally be derived from stove goods, these should be stored in separate rooms to dyed goods. There are other sources of sulphur dioxide that furnish this compound very slowly, and consequently aid the fading that would occur by exposure to light, one of these being sulphur left on cotton which has been dyed with sulphide dyestuffs. Neutral sodium sulphite, which is sometimes formed, has a much more injurious effect, with certain dyestuffs, than sulphur dioxide. Since alkali is necessary to cause the latter type of fade, it is better to ensure that this is entirely removed from the material before stoving. The goods may be treated for this purpose with dilute acid, either acetic or sulphuric. Where the liquid method of stoving is employed the faults of the sulphur dioxide fade type do not occur. W.

Investigations upon the Cause of the Change of Shade of Certain Naphthol AS Combinations under the Influence of Moist and Dry Heat. K. Scholl. *Melliand*, 1930, 2, No. 3, pp. 387-390.

Former investigations have confined themselves to a certain extent merely to determining the changes within the coloured medium itself. Here an attempt is made to find an explanation for the processes within the dyed fibre by an examination of the colour lake, thereby leaving the cotton fibre partly out of consideration. These experiments are described and explained. They show that the change of shade of the Naphthol AS dyeings on cotton can only be a purely physical process connected with the size of the particles of the colour lake and with the aberration and absorption of light caused thereby. They also prove that the change of shade caused by the action of dry heat on dyeings with Naphthol AS is due to sublimation of the colour lake. It is also shown how the dyeings treated in various ways present themselves under the microscope. The fastness of the dyeings changes with the size of the particles of the colour lake. The fastness to light is improved by the action of moist heat, and reduced by the action of dry heat. This change in the fastness properties is to be noticed also in dyeings on rayon, silk, and wool. W.

Report on Crinkly Condition in Lot of Crêpe-de-Chines of Quality A × A. W. M. Kuhn. *Melliand*, 1930, **2**, No. 6, pp. 812-813.

The character and position of the wrinkles in these goods, the curved picklines, the intactness (unbruised) of warp and filling threads and their uniformly thorough absorption of the dye matter in places where the wrinkles appear, would indicate that a faulty drying, tension, and handling method was applied by the dyer after the dyeing operation. As the goods were probably shrunk in the process of dyeing, if they were not dried uniformly before tentering when in this state of contraction, they could not possibly pick up at even tension in tentering. W.

Bursting Strength Tester. L. Schopper. *Melliand*, 1930, **2**, No. 6, pp. 858-860.

This apparatus is intended for determining the bursting strength and stretch properties of cloth, paper, cardboard, and all other kinds of ductile materials in sheet form. The principle is to subject a circular area of the test sample to the force exerted by compressed air until it bursts. The amount of air pressure required to burst the sample is measured and the coefficient of bursting strength measured in pounds per square inch or in kg. per sq. centimetre. The instrument is described in detail and mention made of another instrument which forms a valuable supplement to it, this being designed for measuring the weight of convexity (bulge) formed by the sample before bursting. W.

Fabric Defects Caused by Water. H. C. Roberts. *Text. World*, 77, 1756-1757.

Defects frequently occurring in mills doing wet finishing, dyeing and bleaching, are streaky goods, spots and stains, resists and over-dyed pieces, off shades, and yellow bleached goods. The water used in processing the fabrics is often the prime cause of these troubles. Three typical cases are cited where the water used was at fault and led to defects in wet finishing and dyeing processes. This is discussed under the headings of scum on knit fabric, difficulty in dyeing and dyeing union fabrics. W.

Fabrics for Rubberising: Specification. *See* Section 4L.

The Selvedge. *See* Section 3C.

(D)—Other Materials

Practical Methods for the Investigation of the Processes in the Kier. Part II. Minajew and Juschkow. *Leipzig. Monats. Text.-Ind.*, 1930, 45, 407-409, 443-444, and 478-479.

As a result of their experiments the authors put forward the following method for estimating the amount of caustic alkali and soda ash in kier liquors. Excess of decinormal sulphuric acid is added to 10 c.c. of the lye in a 300 c.c. conical flask. Purified air is passed through the cold liquid for one hour, in the apparatus described, in order to remove carbon dioxide. The solution is then made weakly alkaline by the addition of a known amount of decinormal caustic soda and finally titrated to phenolphthalein with decinormal sulphuric acid. A direct titration of the diluted lye is also made, using phenolphthalein indicator. Example—

(1) By direct titration of the lye with $N/10$ sulphuric acid and phenolphthalein an alkalinity of 7·9 c.c. was found, corresponding to 3·04 g. per litre, calculated as caustic soda.

(2) Addition of excess sulphuric acid, followed by the passage of air and addition of excess caustic soda—40 c.c. $N/10$ sulphuric acid were added and after bubbling with air 35 c.c. $N/10$ caustic soda were required to make alkaline. Each titration

with $N/10$ sulphuric acid required 4·23 c.c. Consequently, 40+4·23=44·23 c.c. $N/10$ sulphuric acid were used. The 35 c.c. of $N/10$ caustic added were found to be equivalent to 34·82 c.c. $N/10$ sulphuric acid. Hence the caustic alkali and carbonate used up 44·23—34·82=9·41 c.c. $N/10$ sulphuric acid. This is equivalent to 3·61 g. per litre, calculated as caustic soda. Consequently, in one litre—Caustic alkali and carbonate=3·61 g.; caustic alkali + half the carbonate= 3·04 g.; half the carbonate=0·57 g. (The carbonate is calculated as caustic soda.) L.

Standardised Machine for Laboratory Washing Test. *Melliand,* 1930, **2**, No. 6, pp. 812-813.

The Launder-Ometer, the standardised machine for laboratory washing tests, is to-day in general use. Some of its more important functions are the following—(1) for accelerated washing tests with reference to mechanical action; (2) for testing colour fastness of fabrics with reference to washing; (3) for testing detergents; (4) for laboratory dry cleaning tests; (5) for leather dyeing tests; (6) for fulling tests; (7) for laboratory dyeing of vat and sulphur dyes. A short history of Launder-Ometer development is followed by a description of the perfected machine. Four tests for fastness to washing are given. W.

The Toussaint (T.C.B.) Photo-electric Photo-colorimeter. H. Reeve Angel & Co. Ltd. *Text. Rec.*, 1930, **47**, No. 564, pp. 65 and 67.

The Toussaint colorimeter entirely eliminates the human eye, and consequently removes all the risks of error due to personal factors from colorimetry. The principle and working of the T.C.B. photo-electric photo-colorimeter are described, its operation depending upon the action of the photo-electric cell, which is extremely sensitive to light. W.

6—DESIGN

(B)—Structure of Fabrics

Designing Woollen Fabrics. *Melliand,* 1930, **2**, No. 6, p. 875 (from *Am. Wool and Cott. Rep.*, 1930, **30**, 7).

The origin of "Lovat Mixtures" is explained, the author giving percentages of the different dyed colours in Lovat Mixture No. 1 and No. 2. Mixture No. 1 has a great percentage of dark yellow drab and stone drab, whereas mixture No. 2 has an overwhelming percentage of light blue. An experiment is explained by means of which a three-colour blotch effect is obtained, the article concluding with a short description of novelty effects obtained with two-ply yarns twisted with reverse twist. W.

7—LAUNDERING AND DRY-CLEANING

(A)—Cleaning

Fat Solvents in Washing. *Text. Mfr.*, 1930, **56**, 376.

The mode of action of fat and oil solvent compounds, kier oils, etc., has always been understood as one of emulsification of the solvent by the soap or other agent used. The author of this article doubts the truth of this and also the advantage of using such oils, especially in conjunction with wash liquors. For cleansing of oil stains by hand their use is advantageous and to be recommended also to prevent oil washed out of very dirty garments from entering the clean parts. Experiments carried out show little difference to exist between the oil removing action of common soap and of a bath containing any of these detergents. The facts point to the conclusion that the emulsifying action of these baths is very low, especially as when very oily material is washed in the usual laundry machines the oil washed out separates from the liquor and is found coating the interior of the machines. L.

Textile Soaps. *See* Section 4A.

8—BUILDING AND ENGINEERING

(C)—Steam Raising and Power Supply

An Electrical Control System for Boilers. Siemens & Halske. *Leipzig. Monats. Text.-Ind.*, 1930, Fachheft III, 45, 115-118.

Describes the Siemens-Halske method of automatic control for boilers. The steam production is continuously adjusted to requirements and the fuel and air supply are automatically maintained in the most favourable proportion. The system may be adapted to suit different types of boilers and different methods of stoking: Remote control of the stoking is possible. The functioning of the boiler is continuously indicated on an instrument board and the automatic control may be corrected at any time by hand. L.

The Automatic Control of Steam and Water Valves. *Dyer and Cal. Printer*, 1930, 63, 285.

This system consists in opening and shutting large valves by electricity instead of by hand. The valve is operated by a motor which is controlled from a switchboard, which may be placed in any convenient position. The best known system is the Dean, its principal features from an operating standpoint being the instantaneous stop obtained and the elimination of overtravel or drift as affecting the closed position of the valve. These are obtained in an exceedingly ingenious manner. The details of the mechanism involved are explained and illustrated. A complete self-contained system for automatically maintaining a constant liquid level in storage tanks is also illustrated. W.

(D)—Power Transmission

New Machinery and Processes. J. P. Freund. *Text. World*, 1930, 77, 1026-1028.

This article deals with the BTA adjustable-speed motor as applied to full-fashioned knitting machines. The maximum speed at which a knitting machine can be run economically depends upon the type of goods being produced. The ideal motor must meet the following requirements—it must be adjustable at a wide speed range; it must be an a.c. machine in mills supplied by power companies with this type of current; it must be designed to have good power-factor characteristics; and it must be simple and strong in construction, with a minimum of control. The BTA, polyphase, a.c. brush-shifting motor and its characteristics are fully described and its advantages summarised. W.

Non-electrifiable Driving Belt. R. C. Moore. *Melliand*, 1930, 2, 380.

The danger from static electricity on belt drives is eliminated by using a belt in which a row of copper wire stitching along each edge makes contact with the driving pulleys at all times. Static charges which normally collect on the outer surface of the belt are thus led off through the belt by the stitching and it is only necessary to see that the machines are well grounded. Belting made in this way is permanently static proof. C.

Textile Machinery Lubrication. *Text. World*, 1930, 77, 3140-3142, and 2470-2473.

Proper lubrication of textile machinery results in increased power consumption, increased service from equipment and improved products. The writer deals with the problems of lubricating carding machinery, gill boxes, Noble combs, cam motions, drawing, roving and spinning frames, mules, and silk throwing machinery. Throwing-mill machinery will normally give little or no trouble if the lubricant has been properly applied. Instructions are given for the lubrication of tram rings and the care of belts. Lubrication of weaving machinery should be carried out with a view to preventing the oil from coming in contact with the yarn or goods at any stage of the process. The type, frequency, and manner of lubrication will depend to a great extent upon the nature and construction of the weaving elements which are involved. There is very little so-called automatic lubrication in the weaving mill and hand oiling is still the prevalent custom. Jacquard machines require considerable care in their lubrication. The problems of lubrication in the dyehouse, and the lubrication of finishing machinery are considered, and the importance of the careful storage and handling of lubricants is emphasised. W.

(G) HEATING, VENTILATION, AND HUMIDIFICATION

Water Content of Wool in Relation to the Humidity and Temperature of the Surrounding Air. *See* Section 5A.

(I)—WASTE DISPOSAL

Treatment of Trade Wastes, a Necessary Feature of Stream Pollution Control. W. W. Hodge. *Public Health Eng. Abs.* (U.S.), 26th July 1930, **10**, S, 79 (from *West Virginia University Tech. Bulletin*, No. 3, p. 75).

The harmful effects of wastes from mining and manufacturing industries are considered. Chemical, biological and engineering research has led to the recovery of valuable by-products from industrial wastes such as those from pulp and paper mills, tanneries, wool scouring plants, gas and coke plants, packing houses, sawmills and oil refineries. The co-operation of waterworks men, factory executives, and State and university technical men with the State Water Commission in reducing stream pollution in West Virginia is urged. A bibliography is included. D.

The Working up of Alkaline Waste Liquors from the Manufacture of Viscose. K. Tanemura and T. Kohno. *Chem. Zbl.*, 1930, **2**, 651 (from *Cellulose Industry*, 1930, 6, 13).

The authors investigate the most favourable conditions for the removal of viscose and sulphur compounds from the alkaline waste liquors from the manufacture of viscose and for the regeneration of the hydrogen sulphide. The alkaline liquors cannot be simply acidified as the cellulose still in solution would be precipitated and clog the clarifying filter. Zinc or iron sulphate, which remove the impurities by precipitation and thereby render the solution filterable, must be added. Zinc sulphate is more suitable than iron sulphate. If the precipitating bath already contains zinc sulphate then the acid spinning bath can be used for the neutralisation of the alkaline liquor. D.

Waste Water Problems in the Paper and Cellulose Industry. Haupt. *Technologie u. Chemie d. Papier- u. Zellstoff-Fabrikation*, **27**, 65 (supplement to *Wchbl. Papierfabr.*, 1930, 61); *Chem. Zbl.*, 1930, **2**, 959.

Mechanical purification of the waste waters of the paper and cellulose industry is necessary and the recovery of utilisable materials is often possible. The retention of dissolved impurities causes more difficulty. Even when the concentrated liquors are evaporated certain amounts of dissolved organic substances still arrive in the streams, but these promote fungus growth only in cases of insufficient dilution. The fact that the recuperative power of a stream is limited has not always been observed by the industries in the case of plant extensions. but excessive requirements with regard to the degree of purity of the waste waters must be avoided on account of economic considerations. D.

Viscose Factory Effluent: Utilisation. K. Tanemura, T. Kohno, and S. Miyoshi. *Chem. Zentr.*, 1930, **ii**, 2330 (from *Cellulose Ind.*, 1930, 6, 23-24).

By the introduction of hydrogen sulphide into sodium hydroxide sodium sulphide is first produced and then sodium hydrosulphide which does not turn phenolphthalein red but colours Methyl Orange yellow. Waste alkali from viscose manufacture contains about 1% of β plus γ cellulose. The γ-cellulose remains in solution when the liquor is saturated with hydrogen sulphide, but the β-cellulose is partially precipitated by the sodium hydrosulphide. The hydrosulphide from the waste alkali is otherwise equal to the commercial product and may be used for the desulphurising of viscose rayon. C.

9—PURE SCIENCE

Rubbed Fabrics: Surface Strain and Relaxation. P. E. Shaw and R. F. Hanstock. *Proc. Roy. Soc.*, 1930, Ser. A, **128**, 474-480 and 480-487.

(1) *The case of the rubbing together of like solids*—When two identical non-conductors, whether of ebonite, or celluloid, or silk, are rubbed together, each becomes charged in a systematic way. The charges are attributed to differential strain on the surfaces, caused by the rubbing. A new method of investigating surface strain is thus provided. Also, as the rubbing solids are identical chemically, triboelectric phenomena can be more easily and directly studied than when, as is usually the case, unlike materials are used. Recovery from strain can be completely attained by rise of temperature. Since rubbing necessarily raises temperature locally, strain and partial relaxation from strain proceed simultaneously.

Experiments in vacuum give results similar to those in open air, so it is concluded that the effects are entirely due to changes on the solid surfaces and not, even in part, to the action of films adsorbed on the surfaces.

(2) *The case of unlike solids*—As in the preceding paper strain effects caused by rubbing solids together are studied by the charges arising on the solids. Metals rubbed with ebonite, or with like metals, are studied. Relaxation temperatures found for surface strain on copper and iron are given. An effect which simulates strain, inasmuch as the triboelectric state of a solid surface is changed by the process of rubbing it with a fabric, is shown to be due to the deposition on the surface of organic films from the fabric. Surface strain and imposed organic films are two complicating factors in the investigation of frictional electricity. It is possible to minimise the first factor by carrying strain to the limit, and to avoid the second by avoiding fabrics and other doubtful organic bodies. C.

Cellulose: Electrodeposition. J. Rosman. *Cellulose*, 1930, **1**, 30-34.

Cellulose is dissolved in cuprammonium hydroxide to give a viscous mass and this is electrolysed in a closed cell containing suitable electrodes. Cellulose, apparently in the form of hydrate, begins to separate at once in colourless films, flakes, or layers of almost rubber-like consistency depending on the current density. The copper deposited on the cathode and the ammonia driven off from the hot bath are recovered. The gelatinous deposit of cellulose is practically chemically pure and is non-cellular and non-fibrous in form. It is more soluble in cuprammonium solution than the original cellular or fibrous cellulose, withstands boiling in water for exceptionally long periods, and may be nitrated to form pyroxylin. The electrodeposition method may be used for the preparation of imitation leather and the manufacture of photographic films. Patented processes are described. C.

Cellulose: Identity of Products from Different Sources. L. E. Wise. *Cellulose*, 1930, **1**, 5-8.

It is suggested as a working hypothesis that there is one characteristic chemical substance, cellulose, which is present in the cell walls of the higher plants. The properties of the cellulose obtained from wood, flax, bamboo, and various other plants are discussed, and it is pointed out that the products after chlorination or bromination followed by sulphite or ammoniacal treatment are not necessarily pure cellulose but may consist of mixtures of different resistant polysaccharides. The properties to be considered in identifying cellulose, doubtful cases, and the relation between cellulose and lichenin are discussed. C.

Degraded Celluloses: Alpha-cellulose Content and Solubility in Potassium Hydroxide. H. LeB. Gray, C. J. Staud, and J. T. Fuess. *Ind. Eng. Chem.*, 1930, **22**, 1018-1020.

Series of oxidised celluloses and of hydrocelluloses were prepared using acidic potassium permanganate and hydrochloric acid solutions, respectively. The alpha-cellulose content and solubility in hot 10% potassium hydroxide solutions were determined. The relationship $y^2=697{\cdot}2+45x-0{\cdot}526x^2$, where y=potassium hydroxide solubility and x=alpha-cellulose content, was found to hold satisfactorily in both series down to 75% alpha-cellulose. The curve expressing this relationship is given. C.

Nitro-cellulose Coated Viscose Sheet: Preparation and Properties. H. A. Levey. *Cellulose*, 1930, **1**, 18-20.

The manufacture of viscose sheeting for wrapping purposes is outlined. This sheeting is lacking in water and moisture resisting qualities, but these may be imparted by a coating of cellulose nitrate on the viscose surface. The method of coating is briefly described. The cellulose nitrate coating when dried is of a thickness of about 0·0001 in. and has only an insignificant effect on the inflammability of the sheet. Such coated sheets are not completely impervious to the passage of water but this condition is more closely approached by incorporating in the cellulose nitrate solution suitable resins and gums as well as certain waxlike substances. Comparative tests of resistance to moisture penetration are discussed. C.

Cellulose Gels: Structure. K. Atsuki and H. Sobue. *Brit. Chem. Abs.* **A**, 1930, 993 (from *Proc. Imp. Acad. Tokyo*, 1930, **6**, 161-164, 165-167).

The spontaneous coagulation of viscose is assumed to be due to electric discharge and dehydration of the disperse phase by the alkali and salts which are either present initially or separate spontaneously from the dilute solution of sodium cellulose xanthate employed. The interfacial tension between the disperse phase and the medium has also some influence on the coagulation. Observations are recorded which show that the interfacial tension increases with the dilution of the sol and that the structure of the resulting gel is affected by syneresis. The results of investigations of the syneresis of viscose can be expressed by Liepatov's formula. C.

Starch: Röntgen Spectrum. J. R. Katz and L. M. Rientsma. *Z. physikal. Chem.*, 1930, A **150**, 60-66.

Investigations of the physico-chemical equilibrium between the modification of starch with the *V*-spectrum (α-starch) and the modification with the *B*-spectrum (β_B-starch) are described. Röntgen-ray investigations indicate a heterogeneous equilibrium. At higher temperatures the α-starch is the stable form, and at lower temperatures the β_B-starch is the stable form. C.

Starch: Paste Formation. J. R. Katz and L. M. Rientsma. *Z. physikal. Chem.*, 1930, A **150**, 67-80.

Two stages of paste formation may be differentiated. The first stage represents the final state reached when wheat is treated with large amounts of water at 60° to 62·5° C., or with small amounts of water at 100° C.; it corresponds to the changes during baking of wheat starch. The second stage of paste formation is reached on heating with large quantities of water at 90° to 100° C. In the first stage of paste formation the granules are swollen and in the second they change to bubbles filled with aqueous starch solution. Since the Röntgen diagrams do not change, the transition from the first to the second stage must be ascribed to some other process than a change from β- to α-starch. Changes in the inner structure of the starch granules are suggested. C.

Viscous Liquids: Surface Tension Effect. W. M. Grosvenor. *Science*, 1930, **72**, 244-245.

Air bubbles were made by violent agitation of Nujol with air and a small portion was studied under the microscope. Various bubbles of diameters about 4 μ to 6 μ were observed and were found to shrink and finally to collapse when the diameters reached about 1·5 μ. Calculation from the surface tension of Nujol indicates that if the ordinary surface tension values hold for these bubbles the pressure within the bubbles rises to a value of about 8 lb. per square inch above atmospheric, when the bubble begins to show continuously observable shrinking, and rises to about 16 lb. above atmospheric pressure at the time of collapse. The resulting increase in the amount of air thus forced into solution produces a slight increase in growth of the larger bubbles present. These results shed light on the ready clarification of syrups, lacquers, and other highly viscous solutions in which minute bubbles could not be expected to reach the surface in any reasonable length of time. They may also help to explain various phenomena in mineral froth flotation, the supersaturation of liquids with gases, and the sudden "bumping" of superheated liquids. C.

Stretched Cellulose Ester Film: X-ray Structure. K. Eckling and O. Kratky. *Physikal. Ber.*, 1930, **11**, 1654 (from *Naturwissensch.*, 1930, **18**, 461-464).

If a film of a plastic cellulose derivative is swollen and stretched, and then converted into cellulose without destroying its form, the resulting product gives a fibre diagram with Röntgen rays. The mechanism of the deformation is complicated, and no simple direct relation exists between the arrangement and breadth of the interference bands of the regenerated cellulose and the stretching force. There is a tendency to attribute the production of fibre structure in the stretching of cellulose esters to an arrangement of rod-shaped crystallites. An equation showing the effect of tension on such crystallites is deduced. C.

***Aspergillus Niger;* Fermentation of Sugars by——.** L. W. Kotowski. *Chem. Zentr.*, 1930, **ii**, 2000 (from *Arch. Sciences biol., Moskau*, 1930, **30**, 303-308).

The author has tested the conditions of formation of citric acid in the fermentation of sugars by *Aspergillus niger*. Greater yields were obtained with saccharose than with fructose or glucose. The best results were obtained with well developed fungi by increasing the ammonium nitrate content of the Currie-medium to 5 g. per litre and adding small amounts of zinc chloride. The velocity of citric acid formation is also dependent on the concentration of the sugar solution and is highest at a concentration of 20%. The yield reaches 65% of the sugar after

2 days and probably 90% in 10 days. By culture of the fungi at low temperatures (25°), it is possible to obtain cultures that are most active at such temperatures. If the air is replaced by carbon dioxide the citric acid formation is brought to a standstill without affecting the inversion and other enzymic processes. At least 40% of the citric acid arises from the invert sugar and not from the saccharose. C.

Cellulose, Regenerated Cellulose, and Chitin: Zymolysis. P. Karrer. *Kolloid Z.*, 1930, 52, 304-319.

The resistance to attack by snail cellulase of different cellulose materials decreases in the order cotton, filter paper, mercerised cotton, regenerated celluloses, acid treated cellulose. Careful bleaching does not seriously affect the resistance of cotton cellulose. Viscose rayons spun under tension are more resistant than those not subject to tension. This difference in resistance is probably due to differences in the packing of the crystallites and hence to differences in the surface exposed to attack. Röntgen investigations show that there is a connection between resistance to decomposition by the enzyme and the orientation of the structure units. Viscose rayon of irregular cross-section is less readily attacked by cellulose than viscose rayon having cross-sections of smooth circular outline. The shape of the cross-section is related to the salt concentration of the precipitation bath and it is found that the decomposition produced by the enzyme decreases with increasing salt concentration of the bath. Curves are given showing the relation between decomposition and salt concentration for magnesium sulphate, sodium sulphate, and ammonium sulphate baths. Lilienfeld rayon is readily attacked by snail cellulase. The resistance of rayons is not directly connected with their strength, surface potential, or titre. The velocity of decomposition of cellulose by a given amount of the enzyme varies with the concentration of the enzyme solution. Similar investigations of the enzymatic decomposition of chitin are briefly discussed. C.

Cellulose Preparations: Iodine Number. K. Hess, K. Dziengel, and H. Maass. *Ber. deut. chem. Ges.*, 1930, 63, 1922-1927.

The method of determining the molecular weights of cellulose preparations from iodine numbers, as used by Bergmann and Machemer, involves assumptions regarding the uniformity of the material, regularity of reaction of the material, and the mechanism of the oxidation process for which no confirmation can be obtained. Tables are given showing the effects of different reaction periods on the value of the iodine number and the results obtained in successive determinations on the same sample when the material is simply washed or washed and dried between the treatments. These results show that iodine number determinations are not suitable for the determination of molecular weights. C.

Copper: Determination. F. Ephraim. *Ber. deut. chem. Ges.*, 1930, 63, 1928-1930.

Neutral or acetic acid solutions of salicylaldoxime give with copper solutions a voluminous, pale greenish-yellow precipitate corresponding to the formula $(C_7H_6O_2N)_2Cu$, containing 18·95% copper. The precipitate settles quickly and may be filtered with a crucible and weighed directly. Salicylaldoxime forms complexes with other metals in alkaline solution and with nickel and cobalt in neutral solutions but these are not precipitated with the copper complex if the reaction is carried out in acid solution. Methods for the qualitative and quantitative determination of copper by means of this reagent are described and results are tabulated to show the high degree of accuracy obtainable in the presence of various metals. A proportion of 1 part copper in 500,000 parts water gives a distinct opalescence with the reagent. C.

Cellulose: Constitution. H. Staudinger, K. Frey, R. Signer, W. Starck, and G. Widmer. *Ber. deut. chem. Ges.*, 1930, 63, 2308-2316.

Various theories of the constitution of the cellulose molecule are reviewed and a brief account is given of unsuccessful attempts to prepare a homologous series of polymerised cellulose derivatives for the study of the size of the cellulose molecule. C.

Cellulose: Mercerisation. H. Boxser. *Amer. Dyes. Rept.*, 1930, 19, 601-604.

A discussion of the mercerisation and the micellar structure of cellulose in the light of the results of recent research work. C.

Cellulose: Solution in Copper-ethylenediamine Hydroxide. C. Trogus and I. Sakurada. *Ber. deut. chem. Ges.*, 1930, 63, 2174-2179.

The solution of cellulose in copper-ethylenediamine solution is studied and compared with the solution of cellulose in cuprammonium hydroxide. The two solution processes follow the same qualitative laws but show quantitative differences. Higher copper concentrations are required with the ethylenediamine to produce the same degree of combination. The effects observed may be explained by assuming that the stability of the copper-ethylenediamine complex is greater than that of the copper tetrammine complex and that the amount of the cellulose-copper anion formed is determined by the stability and the concentration of the corresponding copper base. C.

Cellulose Acetate: Molecular Weight and Viscosity. H. Staudinger and H. Freudenberger. *Ber. deut. chem. Ges.*, 1930, 63, 2331-2343.

The cellulose molecule is partially decomposed by treatment with acetic anhydride in the presence of zinc chloride. By varying the temperature a homologous series of poly-triacetyl-celloglucan-diacetates may be obtained up to a polymerisation degree of 150. Studies of the viscosity of solutions of these polymerides and the relation between viscosity and molecular weight are discussed. The results point to the existence of long fibrous molecules and indicate that the molecular weight of the original native cellulose is greater than 24,000. The lower members of the series dissolve without swelling to form solutions of low viscosity and the viscosities of these solutions are proportional to the concentrations. With the higher polymerides the viscosities of the solutions are only proportional to the concentration in very dilute solution. In more concentrated solutions the viscosity increases more rapidly than the concentration owing to the mutual hindering action of the macro-molecules. This occurs when the range of action of the molecule exceeds its specific volume, in which case the solution is in the gel state. Calculations of the range of action of the molecules and the concentration limits between the sol and gel solution states are given for different degrees of polymerisation. C.

Cuprammonium Cellulose Solution: Viscosity. J. L. Parsons. *Cellulose*, 1930, 1, 200-203.

A review of recent work on the viscosity of fibrous cellulosic material in cuprammonium hydroxide solutions and its significance to the pulp and paper industry. C.

Cellulose Nitrate; Sorption of Vapours by——. W. J. Jenkins and H. B. Bennett. *J. Phys. Chem.*, 1930, 34, 2318-2329.

A new apparatus of simplified design, which includes all the advantages of the sorption balance with the further advantages of strength, ease of handling, and the use of large quantities of adsorbent, is described and shown in diagrams. The use of this apparatus for the measurement of the sorption of acetone by many types of nitrocotton under various conditions of temperature and pressure is described. The results show that while the extent of the sorption increases as the difference between the temperature of the absorbent and the liquid decreases, for constant differences of temperature, the sorption remains very nearly the same. The amount of acetone sorbed by cellulose nitrate depends only slightly on the direction in which the equilibrium is approached. The sorption of acetone by stable cellulose nitrate increases with increasing content up to a maximum and then decreases. Samples of cellulose nitrate of the same nitrogen content give within experimental error the same acetone sorption values quite independent of their viscosities in solution. C.

Cellulose Nitrate; Sorption of Vapours by——. L. Rubenstein. *J. Phys. Chem.* 1930, 34, 2330-2342.

The results of measurements of the sorption of vapours of acetone, methyl acetate, ethyl acetate, methyl ethyl ketone, and methyl alcohol by cellulose nitrate of varying nitrogen content are discussed. When the absorbent is maintained at 30° C. and the liquid at 20° C. it is found that in the cases of the two esters and the two ketones the sorption increases up to a maximum and then decreases. Except in the case of acetone sorption the equilibrium depends to some extent on the manner in which it is reached. In the case of methyl alcohol, with the cellulose nitrate at 40° C. and the liquid at 20° C., the sorption continuously decreases with increasing nitrogen content. The time taken to attain equilibrium with the vapours of solvents of cellulose nitrate depends on their boiling points. The reversibility of sorption phenomena and the relation between sorption and the viscosity of cellulose nitrate solutions are discussed. C.

Starch: Saare Test. —. Sprockhoff. *Brit. Chem. Abs.* B, 1930, 77 (from *Z. Spiritusind.*, 1929, **52**, 358-359.)

The Saare test is a means of testing the viscosity of a starch and its ability to form a mucilage of good quality. For the test, 9 g. of air-dried (20% of moisture) potato starch are made into 200 g. of paste with water of known temperature. Immediately after mixing, a disc of 22 mm. diameter is sunk into the paste to a fixed depth, and the determination made of the weight necessary to withdraw the disc from the cold mucilage 24 hours later. The Saare values reach a maximum when the temperature of mixing lies between 72 and 75°, and thereafter decrease with great rapidity. The values also show marked increases when the concentration of the paste is raised. With quantities of starch corresponding to 7 and 7·66 g. of dry substance, the Saare values are 58·6 and 99·2. This sensitivity to small variations in concentration necessitates the use in the test of starch weighed according to the amount of dry substance present. Even then the sources of error due to temperature and concentration are too great, and the determination of the quality of starch by viscosity measurements is considered preferable. C

Starches: Tenacity. —. Parlow. *Brit. Chem. Abs.* B, 1930, 388 (from *Z. Spiritusind.*, 1930, **53**, 14-15, 56.

Detailed methods are described for the determination of the tenacity of starches by the Lavaczeck viscosimeter and by a simpler and cheaper form of viscosimeter devised by the author. The latter apparatus is an improved form of that of Stern, and has the advantage that the starch solution is prevented by an arrangement from falling in drops from the lower end of the capillary through which it flows. An unbroken flow of starch solution is obtained and the surface tension effect which increases the time of flow is excluded. The viscosity readings are not directly proportional to the tenacity owing to the viscosity increasing more with the higher concentrations than corresponds to the higher content of starch in solution. The values obtained are not absolute and both types of viscosimeter require to be standardised by the normal starch of Wolff, which can be obtained from the Research Institute of the Starch Industries (Germany). The tenacity of the normal starch is taken as 100%, and, according to the measurements made, a starch showing values below 120% is of inferior quality, 121-150% is normal, and above 150% is considered excellent. C.

Starch Paste: Formation and Properties. I. Nowopokrowsky and N. Tschebotarewa. *Kolloid Z.*, 1930, **52**, 302-304.

Starch paste consists of a suspension of amylopectin shells in a colloidal solution of amylose. The two constituents may be separated from pastes that are not too thick by filtration through an ordinary filter paper. The amylose may be separated from solution by saturating the solution with magnesium, potassium, or ammonium sulphate. Collodion adsorbs amylose from solution. Amylose forms blue amylose iodide with iodine in the presence of water. Amylopectin gives a blue-violet colour with iodine. The adhesive power of starch paste is due to the presence of amylopectin. Amylose iodide gives a blue colloidal solution with water from which it is readily precipitated by electrolytes. Potassium iodide and a few other salts change the blue colour to violet, and in large concentrations to red, producing simultaneous coagulation of the amylose iodide. During the process of paste formation a concentrated solution of amylose is first formed inside the amylopectin shells. When, through diffusion processes, the concentrations of amylose inside and outside the shells are the same the latter shrink and break. The intact starch granule probably consists of dehydrated and compressed layers of polysaccharides in different stages of dehydration with possibly a colloidal solution of amylose in the centre. C.

Starch Paste: Formation. Cellulose: Mercerisation. J. R. Katz and J. C. Derksen. *Z. physikal. Chem.*, 1930, A, **150**, 81-89.

The formation of a paste of wheat starch with aqueous sodium hydroxide results in the production of a V-spectrum. A definite minimum concentration of sodium hydroxide is necessary before the conversion from β_A- to α-starch begins, then in a short interval the amount converted increases with the concentration of the alkali. Analogous effects are observed in the mercerisation of cellulose with aqueous caustic soda. The effects in both cases are probably due to similar isomerism of the polysaccharide. C.

The Use of the Microscope in the Textile Industry. VIII. J. M. Preston. *Text. Mfr.*, 1930, 56, 358-359.

The eighth article in the series deals with ultramicroscopy with reference to practical uses. It contains a theoretical introduction concerning the principles of dark ground illumination. Particular reference is made to the first application of the ultramicroscope (Siedentopf and Zsigmondy's) by Schneider and Kunzl in 1906, detailed attention being given to the proper method of lighting, especially with a view to recognising the fibrillar structure of the cellulose fibre. The improbability of ever viewing the actual micelles in an undamaged cellulose fibre is owing to overlapping of the images, in spite of the fact that the micelle dimensions lie inside the range of ultramicroscopic visibility (200 to 5 $\mu\mu$). Photographs are reproduced of (1) flax fibre focussed in the middle layer, showing a parallel structure; focussed near the surface, only the spiral arrangement of the fibrils is seen. (2) Tussah silk, showing a parallel arrangement. Cultivated silk is stated to be similar in structure with fainter spiral definition. (3) Merino wool (swollen) showing spindle-shaped cortical cells arranged lengthwise. (4) Viscose rayon consisting of parallel rays and points of light. (5) Cuprammonium rayon focussed in middle layer showing net structure; acetate rayons present fine granular appearance with occasional larger points of light. (6) Flax fibre showing effect of severe mechanical damage as a complete disorganisation of the parallel structure. Slight mechanical damage is revealed by a change in direction of the parallel lines at the nodes. From the above it is stated that the ultramicroscope provides a more convenient and most reliable test for distinguishing between rayons of different sources. A brief review is given of the technique underlying the practical application of the ultramicroscope to the examination of fibres. A combination of the cardioid or paraboloid types of condenser with an "azimuth" diaphragm to determine the orientation of the object is stated to be suitable for the purpose. L.

Mechanism of Heat Flow in Fibrous Materials. J. L. Finck. *Bur. Standards J. Res.*, 1930, 5, 973-984.

Tests were made on jute, cotton, flax, wood fibre, etc., using the "flat hot plate" apparatus with guard ring. From an insulation standpoint alone, there is practically no choice between the different commercial grades of each material. Each material was tested when packed at different densities. As the denisty is progressively increased the insulating value, in each case, increases to a maximum, and then falls off again as density is increased further. Thus there is a critical density at which the fibre should be packed in order to obtain maximum insulating power of the material. A further result of this work is that greater insulation is obtained from a sheet of fibrous material when the fibres are packed at right angles to the direction of heat flow than when packed parallel to this direction. L.

Moisture in Cellulose. *Text. Weekly*, 1930, 6, 411.

The moisture content of a cellulose material indicates the nature of some of its other properties. The higher the moisture content the greater the affinity for dyes, for example, mercerised and non-mercerised cotton. It is probable that the cellulose is in a more highly dispersed form and has a greater reactive surface, which is more responsive to dye solutions, acids, alkalis, and oxidants. The work Ogwri and Nara (*J. Soc. Chem. Ind. Japan*, 1930, 33, 267B) is referred to regarding the manner in which the moisture is retained by a cellulose fibre. L.

New Cellulose Esters. *Text. Mfr.*, 1930, 56, 377.

Maleic anhydride without the aid of a catalyst is claimed to convert cotton yarn directly into a cellulose ester capable of resisting direct cotton dyes (E.P.315,434). Another remarkable cellulose ester prepared by Von Frank and Mendrzyk (*Ber.*, 1930, 63, 875) by heating cellulose with a solution of cinnamyl chloride in pyridene, resists saponification by alkalis and is stable at high temperatures, i.e. is suitable for withstanding dyeing with vat dyes and boiling off with alkalis and is unaffected by careless ironing even at temperature of 270° C. L.

Reaction of Formaldehyde Derivatives with Cellulose and Cellulose Monomethylene Ether. F. C. Wood. *J. Soc. Chem. Ind.*, 1930, 49, 1079.

An account of a paper in which the author describes the action of formaldehyde and derivatives on cellulose and soda cellulose. New experiments were described showing that the moisture content and the rate and extent of drying determined whether a dye-resisting or a dye-absorbing product was obtained. A new reaction was described in which the methylene group replaces two hydrogen atoms in neighbouring hydroxyl groups. With cellulose, a monomethylene derivative is obtained, this being the first stable cellulose derivative to contain only one hydroxyl group. L.

Sunlight: Colour Sensitivity Curves. U. Schmieschek. *Kodak Abs. Bull.*, 1930, 16, 309 (from *Phot. Ind.*, 1929, 27, 970).

In reply to a criticism to the effect that spectrograms made by a source of arbitrary colour temperature are useless in practice, the author describes a patented arrangement using a rotating sector which will give spectograms as though exposed to a source of uniform spectral energy. C.

Physics of the Living Cell. Part I. R. Fürth. *Science Abs. A*, 1930, 33, 534 (from *Phys. Zeits.*, 1929, 30, pp. 951-957; Disc., 957-958. Paper read before the Deut. Physikertag., Prague, Sept. 1929).

The task of biophysics is that of investigating the physical processes occurring in the living cell, and as in atomic physics the fine structure of atomic constitution is dealt with, so in biophysics the fine structure of living matter should be the subject of investigation, for which suitable physical methods of investigations are required For the determination of the partition of potential, metal electrodes are not applicable and special electrodes of KCl in agar-agar (as first suggested by Ettisch and Peterfi) allow the use of electrodes of only 0·01 mm. diameter which are manipulated under the microscope. For measurement of potential, current instruments, even with a sensitiveness of 10^{-10} amp., are not applicable as even this small flow of current leads to polarisation and cell destruction. Therefore, for the purpose of potential measurement an electrostatic relay employing a double grid valve is used. This instrument is described and has a sensitiveness of 1 mV and a range of 0·1 V. A second indirect method of investigation is by the direct introduction into the cell of a "test body," as provided by particles of dyes of dimension 10^{-7} to 10^{-5} cm., whose movements are studied by means of an applied electric field, by observation of their Brownian motions and by their mechanical penetration. To determine the charge upon the particles the diffusion of dye particles, under an applied potential, is measured and various experimental arrangements to permit this are discussed, the method being based on the Nerst-Einstein diffusion formula. Various types of suitable apparatus are illustrated with reference to their construction. Further the measurement of the electrical constants of the cell material must be determined and, as only a very small quantity of material is available, difficulties are encountered which are overcome by a method of measurement of the conductivity based upon the value of the decrement for resonant h.f. oscillations and by a method based on the orientation of a platinum ellipsoid between two condenser plates in a homogeneous electric field. W.

Modern Chemistry and Textile Processing. J. Nüsslein. *Melliand*, 1929, 1, No. 6, pp. 926-929; No. 7, pp. 1101-1103.

For some time the chemical industry has been striving to develop better working methods in the textile industry by offering new products and suggesting new methods, in this way following up previous efforts which were chiefly along mechanical lines. These developments are considered with special reference to the scouring process, to spinning troubles, to difficulties in dyeing and to carbonising. Also new products are discussed as applied to the cotton, rayon, and allied industries. W.

Multiple Standard Colorimeter for *p*H Determinations. S. L. Leiboff. *Ind. Eng. Chem.* (*Anal. Edit.*), 1930, 2, 194.

This colorimeter was especially designed for matching colours of unknown solutions where a single standard cannot be used, particularly in colorimetric hydrogen ion determinations of wide range. The colorimeter is described and the arrangement for the determination of *p*H explained. W.

A Comparison of Aktivin with Hypochlorites. *Dyer and Cal. Printer*, 1930, 64, 22-23.

Aktivin (a derivative of paratoluene sulphonic acid) is steadily growing in popularity for certain textile processes. It will not give so good a white as the hypochorite bleach under any practical conditions, largely due to its much slower rate of decomposition, but this is in its favour from the point of view of tendering. Its comparative stability is remarkable. The relative activity of certain catalysts is considered, as regards the manner in which hypochlorous acid and aktivin are affected. Two of the most promising applications of aktivin are in the simultaneous bleaching and desizing of cotton and artificial silk mixtures, or all-artificial silk goods, and in the chlorination of wool. Methods of bleaching, desizing, and chlorination are described. W.

The Creasing Tendencies of Viscose: Effect of Swelling. A. J. Hall. *Text. Argus*, 1930, 7, 972.

The softness and creasing tendencies of artificial silks are factors of marked importance, and, following up research work where he showed that stretching will decrease both the softness and the resistance to creasing of an artificial silk yarn, A. J. Hall details in the current issue of the Society of Dyers' and Colourists' Journal further work on the effect of swelling agents on these properties of viscose silk. The present work has had for its object the determination of whether or not swelling produced serious changes in the resistance of the artificial silk to creasing. It is, of course, well-known that during the processing of artificial silks there are various operations through which the silk passes which might give a swelling effect. Viscose yarns (Courtauld's "A" quality, 3,500 denier) was swelled by means of—(1) 5% caustic soda for five hours and then washed off with cold water and soured with 1% hydrochloric acid and thoroughly washed and dried at 50° C. (2) 110° Tw. phosphoric acid immersion and then freed from acid suitably, and dried. (3) 88·3° Tw., sulphuric acid for four hours, and suitably freed from acid. The creasing properties were then examined, and from the graph and figures obtained it was seen that the swelling results in an increased affinity for direct dyes, and slightly decreases the elasticity and resistance to creasing of viscose silk, except in the case when swelling is produced by means of phosphoric acid. It was also stated that the author had not discovered any substance which would decrease the tendency to creasing of viscose. W.

Reducing Properties of Wool. R. Haller. *Brit. Chem. Abs. B*, 1930, 49, 856 (from *Helv. Chim. Acta*, 1930, 13, 620-628).

The behaviour of wool fibres towards different oxidising agents has been investigated. The two powerful oxidising agents, chromic acid and potassium dichromate in aqueous-alcoholic solution, are partly adsorbed without undergoing reduction. Alkaline Fehling's solution is unaffected and no blue colour is developed with an alkaline solution of Indanthrene Yellow R. The reduction of a 0·01% solution of potassium nitrate to nitrite observed by Schellens is due to bacteria, not to the wool itself. Wool bleaches a solution of Methyl Green, but itself becomes slightly coloured, and this effect is not due to combined sulphur. Wool will absorb 50% of its weight of iodine from an alcoholic solution giving a unique solid compound, fast to water and extraordinarily fast to light. Part of the iodine is reduced to hydriodic acid, which remains in the bath. Curves showing the rate of adsorption of iodine by wool from solutions of different concentration are given. W.

The Effects of Cystine Diet on Keratin Composition in Rabbit Wool. J. Barritt, A. T. King, and J. N. Pickard. *Biochem. J.*, 1930, 24, 1061-1065.

Angora buck rabbits have been fed for three months on a normal diet and on diets with the addition of varying amounts of cystine obtained from wool hydrolysate. In general, a large increase in the sulphur content of the fur of individual rabbits has been found between the two successive three-month periods, January to April, and April to July, in the controls as well as in the cystine-fed animals. The maximum increase observed was 18% and this occurred with rabbit No. 301 on normal diet throughout. While the fleece weights are generally less for the shorter second period, the fleece weight ratios for the two periods are substantially the same with the cystine-fed animals as with the controls. W.

Equipment which Removes Pitch and Tar from Wool. Mezzera & Co. *Text. World*, 1930, 78, 1245.

This plant, which employs trichlorethylene as the solvent, consists of a washing and depitching drum, a still and condenser for recovering the solvent, two closed tanks for holding the trichlorethylene, filter, and pumps. The process is described. It is claimed that this is more satisfactory than the normal scouring process, is without injurious effects on the wool fibre, and that the solvent used is neither inflammable nor dangerous to the workmen. As the loss of solvent amounts to about 6% on the weight of wool treated, it is comparatively inexpensive. W.

Recent Achievements in Dyestuff Chemistry. Dyestuffs Industry Development Committee. *Text. Argus*, 1930, 7, 886.

During recent years five outstanding developments in dyestuffs chemistry have taken place, namely, naphthol ice colours, caledon jade green, duranol and celatene colours, indigosol products and soledon colours, three of these being British discoveries covered by British patents. W.

Chromium Plating in Textile Machinery. Chromium Corporation of America. *Text. Mfr.*, 1930, 56, 290.

The coefficient of friction of chromium is 30% lower than that of any other metal and because of its ability to withstand corrosion is particularly adapted for use in the textile industry. Chromium plate is less expensive than many other non-corrosive metals, it does not crack or chip like porcelain, it is easy to clean and will not tarnish and resists oxidation to 1350° F. It is thus applicable to printing rolls, schriener rolls, drying equipment, tensions, guides and miscellaneous equipment. It is especially effective over steel, copper, or nickel. Its uses when applied to the copper rollers used in the textile printing industry, to embossing plates, to schreiner rolls, to drying cans and to dyehouse equipment are commented upon. Records of chrome-plated tensions have given 100 to 500% more efficiency than unplated steel. W.

10—ECONOMICS

American Cotton Mill: Waste Recording. *Melliand*, 1930, 2, 6-9.

An article on the reduction of waste in cotton mills, in which a table is reproduced showing the waste record for a period of 9 months in a Southern States mill of approximately 15,000 spindles and 324 looms, manufacturing sheeting and using cotton averaging strict low middling $\frac{3}{4}$ to $\frac{7}{8}$ inch. A second table shows the number of stoppages of 1,134 looms on night and day work, and their causes, whilst a third table shows the weight of each of 24 bales of cotton as received and after 24 hours in the opening room. C.

Hosiery Mills: Economics. W. Baum. *Melliand*, 1930, 1, 1629-1633; 2, 52-61, 181-186, 493-499, and 637-643.

A series of five articles dealing with standardisation in the hosiery industry through time and motion studies. The individual articles cover (1) labour standards and their fixation, (2) a critical analysis of wage incentive plans, (3) modern methods of controlling the efficiency of learners and experienced operatives, (4) a budget control system especially designed for the various departments of a hosiery mill, and (5) modern trends in the handling of labour. C.

Indian Cotton Industry: Organisation. A. S. Pearse. *Indian Text. J.*, 1930, 40, 498-504.

The main features of the author's Report on the Indian Cotton Industry are reproduced. C.

Japanese Cotton Industry: Statistics. M. Paske-Smith. *Int. Cotton Bull.*, 1930, 8, 380-387.

Statistics are given showing the number of companies, factories, spindles, and looms of the Japanese cotton industry, the output and export of yarns and cotton cloth, imports of cotton cloths at Shanghai from Japan, the United Kingdom, and the United States, and Japanese exports of cotton hosiery, rayon fabrics, and rayon yarns. Changes in recent years are discussed. C.

Lancashire Cotton Industry: Consolidation and Co-operation. Sir K. D. Stewart. *Text. Weekly*, 1930, 6, 85-86.

The functions and limitations of co-operative institutions are discussed and the disadvantages of price-fixing policies are emphasised. Co-operative effort is most valuable when devoted to the gathering of information in the form of research and statistics, and for discussion and exchange of ideas. The results of co-operative efforts in the cotton industry have brought out a mass of facts and recommendations but the co-operative institutions can only hand these on to their members for action and cannot effectively act themselves. For effective action, consolidation along the lines of the Lancashire Cotton Corporation is required. This Corporation is making progress with cheap yarns and it is hoped that a much larger proportion of Indian cotton will be used in Lancashire in the future. C.

U.S. Obsolescence Studies. W. Fawcett. *Amer. Dyes. Rept.*, 1930, **19**, 301-302.

Information has reached the United States that the Japanese manufacturers who have been singularly successful in capturing a competitive market, do not charge off regularly and systematically for machinery obsolescence. Interest in the question has thus been aroused and the subject has become one for special inquiry, the method of which is briefly described. The surveyors think it is possible that a "replacement cycle" may be revealed—an average "expectancy" for important developments or improvements in a given class of machinery or equipment. W.

The Production of Woollen Goods. S. Kershaw. *Text. Merc.*, 1930, **82**, 127, 182, and 225.

A short résumé is given of the growth of the woollen and worsted industries in Yorkshire; while the worsted industry may be considered as an entity in distinguishing it from cotton, or even woollen, yet there are now two branches of manufacture, the Bradford or English, and the Continental. From identical materials processed on these two systems, two different yarns are made, the Continental being more spongy than the English and more suitable for the dress goods at present selling freely. The system is also much better for converting the short wools of the Dominions into tops and yarns, and in this connection the question of the relationship between weight and warmth in clothing is discussed. As regards present conditions of trade in the wool industry, a plea is made for blending to take place earlier, so that cotton may be used in carding, or cotton slivers for association in porcupine drawing and cotton yarns for twisting with wool yarns. Allusion is made to the most typical worsted and woollen processes, wool combing and carding. W.

Marketing of South African Wool. South African Wool Council, April, 1930. *Text. Argus*, 1930, **7**, 950.

This report provides a very able summary of the wool marketing organisation throughout the Union of South Africa, and a very careful analysis of the respective advantages and disadvantages of sale by auction and sale by private treaty. The Committee recommends that all wool should be offered by public auction, and that records should be kept, and made public, of every transaction, whether by auction or private treaty. Eight recommendations of the Committee are given in full, two relating to public records and three to co-ordinated offerings. Other recommendations involve the appointment of a Standing Committee to co-operate with the wool selling brokers to secure uniformity in methods of marketing, and to make further inquiries into specific questions. W.

Alignment Charts for Wool Textiles. H. T. C. *Text. Mfr.*, 1930, **56**, 41.

Graphs showing the rise and fall in the prices of wool and tops, imports and exports, etc., are familiar in the textile industry. The author here deals with graphical methods by means of which calculations may be facilitated, results obtained quickly, and rapid checks provided. Examples are given illustrating calculations dealing with the prices of scoured wools from raw wool prices and yields, or vice versa. W.

British Dyes: Output. Association of British Chemical Manufacturers. *The Dyestuffs Act*, Pamphlet, 1930, 24 pp.

The views of the dye makers as to the progress made under the Dyestuffs (Import Regulation) Act, 1920, are outlined. The industrial and other difficulties which have militated against the development of the industry are enumerated and it is concluded that, in spite of these, the Act has largely succeeded in achieving its main object and that a well-organised, technically efficient and virile industry now exists. There is still, however, considerable headway to be made, before the industry can meet the full requirements of the colour users. Some data relating to output and prices are recorded. C.

Raw Cotton: Consumption. J. A. Todd *M/cr. Guard. Comm.*, 1930, **21**, 469.

A survey is made of the world's cotton consumption, by countries and varieties, from 1920 to 1930. The past season is remarkable in that, for the first time in history, the consumption of outside growths during the second half of the season was more than that of American, namely, 6,067,000 bales as against 5,940,000 bales. C.

British Dyes: Output. J. Morton. *Dyes and Textiles in Britain*, 1930. Pamphlet, 43 pp.

The conditions of dye-making in Great Britain at the present time are compared with those in 1914 and the great difficulties with which the industry has had to contend are discussed. These difficulties are illustrated by the history of the development of the manufacture of Indanthrene Brown R and G, in this country. In reply to the criticism that the dye industry has been nursed at the expense of the textile industry it is pointed out that the policy of the German manufacturers has been to charge excessive prices for their products until the equivalent British products have been ready for sale and then to drop prices suddenly to below those charged by the British producers. It is estimated that on the imports of one colour alone between 1922 and 1928 the amount actually paid represented an excess of £85,916 over what would have been a high economic price. A further point to be remembered is that statistics show that the decline in the textile industries has been less in dyed and printed goods than in grey and bleached goods, and hence the support given to the home dye industry does not appear to have been a deterring factor. The part played by the Dyestuffs Act in the development of the dye industry is explained and reasons are given for a recommendation for the renewal of the Act. C.

11—INDUSTRIAL WELFARE, INDUSTRIAL PSYCHOLOGY, AND EDUCATION

Further Observations of Pulmonary Asbestos with Special Reference to Asbestos Dust and the Curious Bodies found in the Lungs. W. E. Cooke and C. F. Hill. *J. Roy. Micros. Soc.*, 1930, 50, 15-19.

The infinite varieties of asbestos differ in their chemical composition and physical characters. In this case Canadian Chrysotile is dealt with. The dust generated during the process of manufacture consists of fragments of fibre and slender translucent spicules split off from it; it contains also the black, brown, and blue fragments seen in the raw asbestos. Sections of lung examined showed an enormous amount of fine black granular dust, much of this being carbonaceous. There were also two striking features, the almost complete absence of the very fine translucent spicules of fibre which make up the great proportion of asbestos dust in factories, and the presence of large fragments varying in length from 5 to 360 microns. The finding of these large particles of asbestos dust is in striking contrast to any other fibrotic lung condition, the fibrosis in this case being due to mechanical rather than chemical injury. In every necropsy in pulmonary asbestosis, in addition to the fine granular dust and larger fragments of asbestos, other bodies are present. Investigation suggests that they consist of central nuclei of asbestos spicules upon which colloidal aggregates of blood proteins, plus, possibly, soluble fractions of asbestos and in the case of chrysotile workers, iron salt, have been adsorbed and moulded by currents in the bronchi and alveoli. The probable method of their formation is described. The conditions which apparently must obtain for their formation are the presence of plasma proteins and fine spicules of insoluble or difficultly soluble material. These conditions are ideally found in asbestos workers, therefore the curious bodies, if found in any numbers, are probably pathognomonic of pulmonary asbestosis. W.

Noxious Vapours: Toxicity. Sir T. Legge. *Inst. Chem. Lecture, "Lessons Learnt from Industrial Gases and Fumes,"* 1930, pp. 23.

A table is given of the toxicity of mixtures of various chemical fumes with air, showing the immediately lethal concentration, the limits for exposures of $\frac{1}{2}$ to 1 hour, 1 hour, and prolonged duration. C.

Occupational Cancer: Occurrence in America. I. Heller. *Bull. Hygiene*, 1930, 5, 759 (from *J. Ind. Hyg.*, 1930, 12, 169-197).

The results are reported of a search for occupational cancers in America in those industries recognised to cause such troubles. The risk in connection with exposure to gas tar, to distillation products of coal and to mineral oils is discussed. It is considered that mineral oils vary in carcinogenic activity according to their olefine or unsaturated hydrocarbon content. Scrotal cancer among mule spinners was found to be insignificant in the United States. The lubricating oils used on the spindles are, however, carefully refined with sulphuric acid. This treatment produces oil suited for high speed machinery, which will not oxidise in the high humidity of the spinning room; it also effectively removes unsaturated hydrocarbons, so rendering the oil harmless. C.

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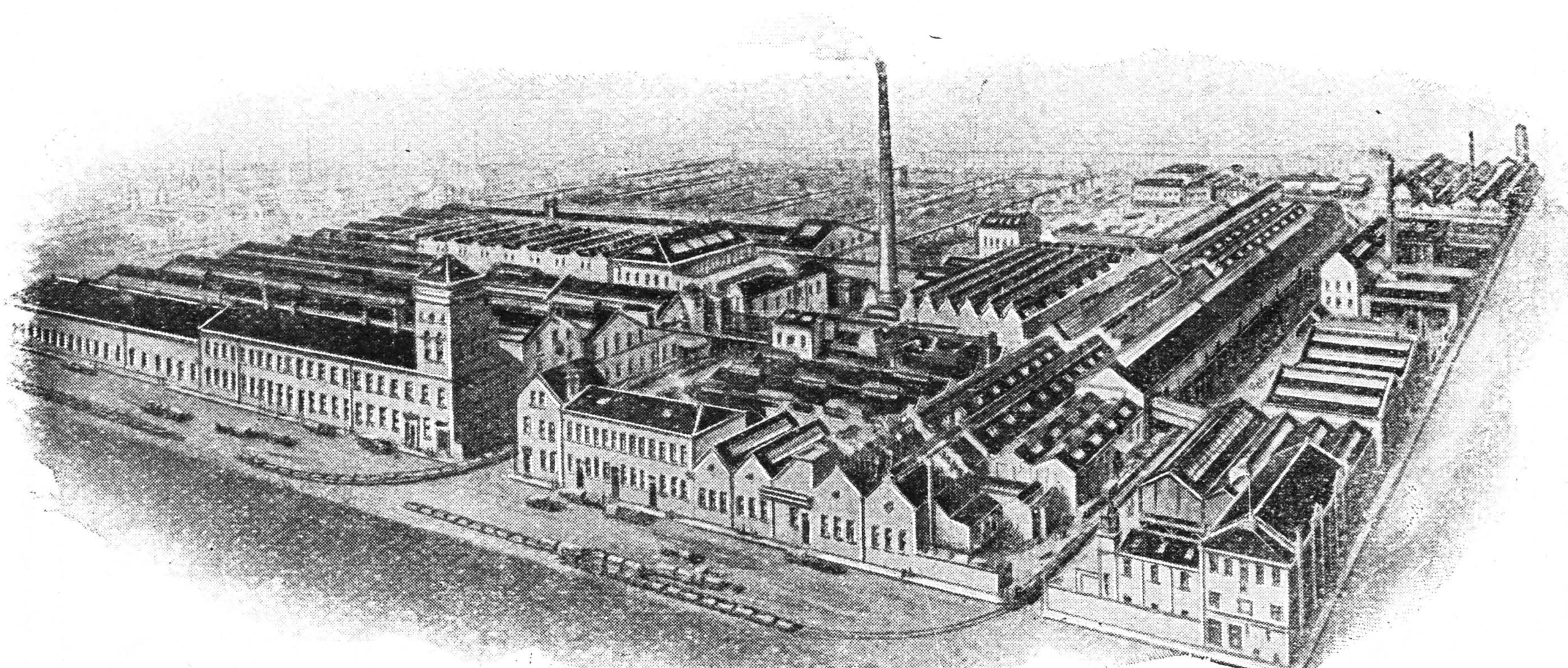

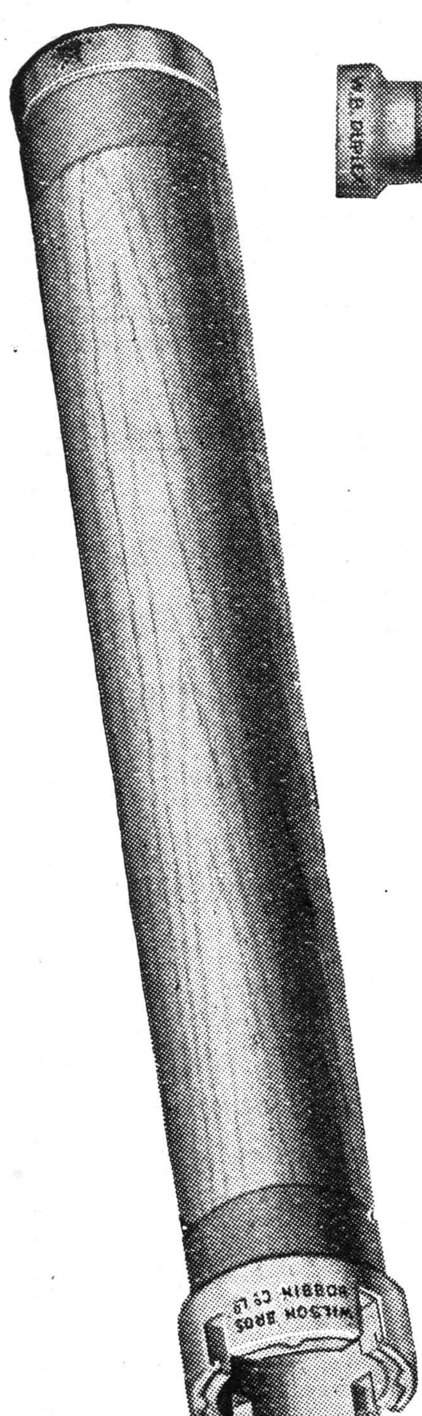

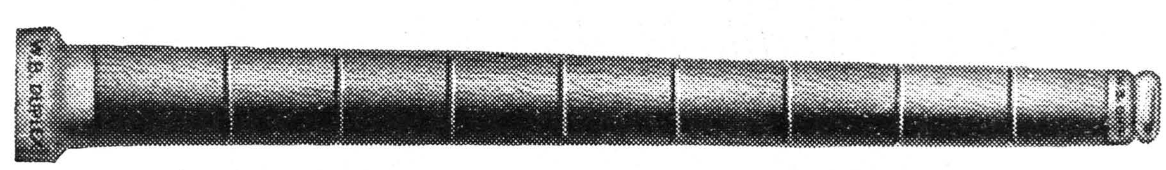

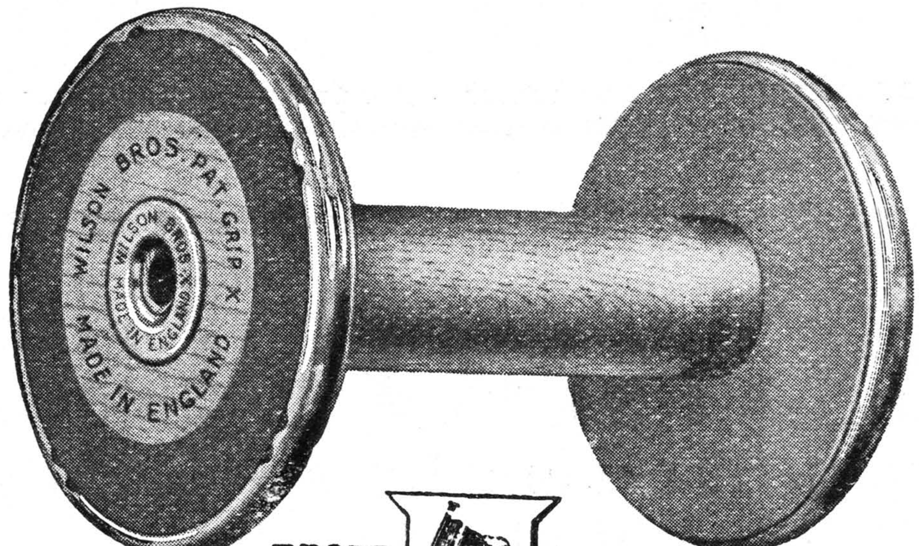

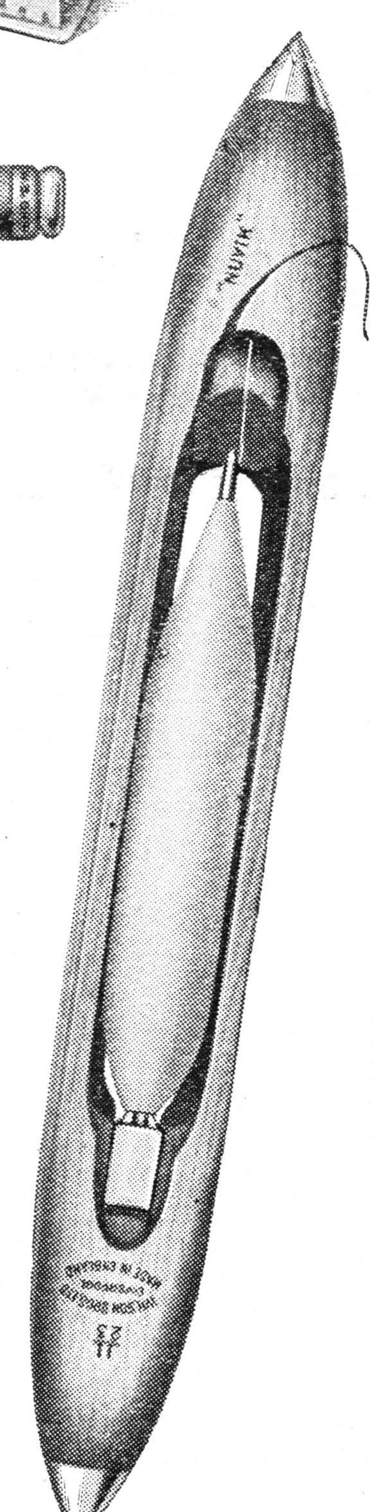

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