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THE TEXTILE INSTITUTE
ST. MARY'S PARSONAGE, MANCHESTER

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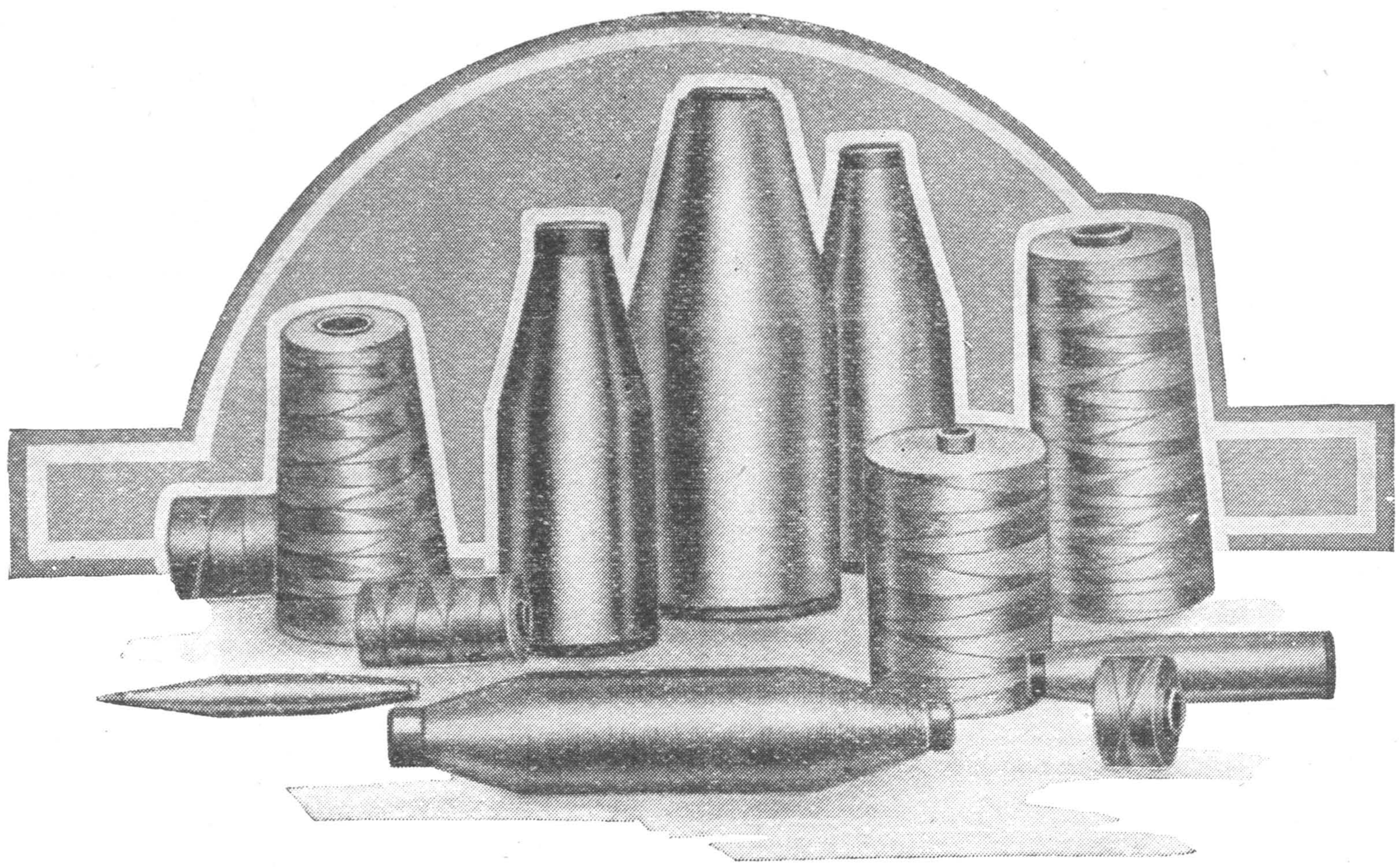


THE JOURNAL OF THE TEXTILE INSTITUTE

Vol. XVIII JANUARY 1927 No. 1

PROCEEDINGS

Lancashire Section

Luncheon Meeting at the Institute, 5th November 1926, Col. F. R. McConnel in the chair.

INDUSTRIAL CONDITIONS IN ITALY

In introducing the Lecturer, Captain G. W. Sherston, to the members, Col. F. R. McConnel, who presided, said that the subject of industrial conditions in the Italian textile trade was of very great importance from the point of view of Lancashire manufacturers, and that any information which Captain Sherston could offer would undoubtedly prove interesting.

The Lecturer said—I would like to point out as a preliminary that my two visits to Italy were paid in March and July this year, and possibly, therefore, conditions may have altered somewhat since I was last there; also my visits were brief—the first covering one week and the second only two days. It was not possible therefore to get as much detailed information as might otherwise have been possible. I happen, however, to have a very great personal friend—an Italian—who is a director of one of the largest and most successful cotton concerns in Italy, having some 400,000 spindles and 4,000 looms, and all the necessary finishing plant as well, in different parts of the country. This gentleman was good enough to take me round two of their mills and to show me all there was to see, and in this respect, perhaps, I was unusually privileged, because I believe the Italians are somewhat jealous of showing foreigners what they are doing. I have no hesitation in saying that I was immensely impressed with what I saw.

I will deal in the first instance with the mills themselves. The particular ones I saw are some 20 miles north-west of Milan; we motored up there along the newly constructed Milan-Como Road—a magnificent road which runs in a straight line for about 30 miles. It is 60 feet wide, with a beautiful concrete surface, and confined to motor traffic only. There are no crossings whatever, and a tax is collected from those using the road. This is only one of many such roads which are now constructed or in course of construction. This question of roads in Italy is one which would fill a fairly comprehensive lecture in itself, but I cannot dwell upon the subject to-day, as there is not time. In thinking of industrial conditions, at any rate those that I saw in Italy, it is important, in the first instance, to get the atmosphere of the country into one's head. Italy always conjures up deep blue skies and brilliant sunshine in one's mind, rather the reverse, in fact, of the climate in which we are privileged or otherwise to spend a good deal of our time. In Lancashire, for instance, one would hardly expect to find a mill yard laid out something on the lines of a miniature park with a profusion of flowers and large magnolia trees, imparting an extremely pleasant scent to one's nostrils; however, that is a brief, but accurate, description of the mill yard we drove into.

The first mill we walked through was one of about 50,000 spindles, both ring and mule, chiefly the former, spinning principally American cotton into counts from 20's to 38's twist, and similar counts of weft. This mill is connected to a weaving shed, which I gathered consumes most, if not all, of the production of the mill. The machinery of the mill and shed is entirely English and kept thoroughly up-to-date. Although the mill is only about 20 years old, a lot of the machinery is dated as recently as 1924, and this has replaced similar machinery from the same firm or firms; the originals have been scrapped as not being quite up-to-date. The cotton used was of a high grade—$1\frac{3}{16}$ in. staple, and there appeared to be one mixing only for the range of counts mentioned above. It gave one the impression that they were not particular to a few points per pound in the cotton they used.

The hands appeared to be thoroughly efficient, and everything gave one the impression of being very business-like and clean. The yarn being produced was certainly quite satisfactory, and inside the mill one might have been in Lancashire.

The whole mill is fitted with what appeared to be a very efficient spray system of artificial humidity. I was informed that it was an American patent which they had had installed for some considerable time, and that it had worked extremely satisfactorily. The atmosphere certainly left little to be desired.

The wages paid at that time—lire being 120 to the £—averaged 108 lire per week of 48 hours, or about 18s. They employ, almost entirely, female labour, and a similar wage is earned whether in the spinning or weaving department. When I was in Italy this particular combine were working two shifts of eight hours each. I was informed that certain concerns were working three shifts of eight hours each.

The weaving shed connected to this mill contains, as I was told the majority of Italian sheds do contain, a large number of automatic looms of various makes. In this particular shed there were about 60 looms constructed by a Dutch firm, on the shuttle-changing principle, but these apparently have not been found too satisfactory. The majority of the looms in this shed were Northrops. They were making a large variety of cloths from the ordinary plain shirtings to some intricate jacquard cloths containing a fairly large proportion of artificial silk. Weavers running plain looms run two only, and are paid approximately 108 lire a week, as I have already stated; one weaver, on the other hand, will run 8 to 10 automatic looms, according to her efficiency, and the extra wage paid for running these additional looms was only 3 or 4 lires per day. Tacklers were running sets of 60 looms; I could not ascertain exactly what they were earning, but as far as I could make out they would average between £2 and £2 10s. per week in English money. Looms were running similar speeds to the Lancashire looms. I timed one loom of 40 in. reed-space, and it was doing approximately 190 picks to the minute.

We walked from this shed to a fine-spinning mill, which was situated in even more delightful surroundings than the one I have attempted to describe. The whole of this mill is on the same level, and is divided up into three portions; all the machinery is thoroughly up-to-date and of English make. They were spinning up to 100's twist on a ring frame, a sample of which I have here. The cotton being used was grown in Italian Somaliland, and was an extremely good substitute for Egyptian. Most of the yarn spun in this mill they doubled themselves, and the whole production is sold. There is no doubt it was all very high-class stuff, and as regards quality, capable of competing anywhere. They complained that in fine combed qualities they found it difficult to compete with English yarn, many so-called combed qualities being offered at less than they can afford to produce them. None the less it is a fact that they are themselves producing more and more the finer qualities of both yarns and cloths that they previously procured in this country.

Both the mills and the weaving shed I have described are driven by electrical power, which is generated privately in the mountains by water and brought 100 kilometres by cable to the mills. They have a large privately owned transforming plant which reduces it from 6,000 to 500 volts. An unusual adjunct is a very elaborate private wireless station, which I was informed they use chiefly to communicate with their other mills in different parts of the country.

Having seen all this, I was taken to see their attempt at what is known in this country as industrial welfare, and I must confess I was astonished at what I saw. As I have already mentioned, they employ female labour, and this labour is drawn from a radius of about 30 kilometres round the village in which the mills are situated. Two years ago this particular firm constructed a large hospice which I was taken to see. Nothing is left to the imagination in the construction, lay-out, and arrangement of this building. It is an unusually large three-storied red-brick building in which are housed 500 girls. There are three magnificent dormitories, two of which contain 200 beds each and one 100. These dormitories are exceptionally lofty and airy, with unusually large windows, outside which are chip blinds to keep the sun out. The tiled floors are scrupulously clean, all beds are white and the bed-linen spotless. There are nine nuns in charge of this hospice. The dining hall is also a large and comfortable place, and the food, some of which I saw, was excellent. There is a private chapel attached to this hospice, also a private theatre, where the nuns help the girls to organise amateur theatricals, &c.; an elaborate array of cubicled bathrooms, with hot and cold water and shower baths; a very well-equipped laundry—in fact, everything that could possible be required. The girls are taught useful occupations in their spare time, such as cooking, dressmaking, and household duties, &c., by the nuns. Outside the hospice, but practically adjoining it, lives a resident doctor, in a very attractive villa, attached to which is an operating theatre and a very well-appointed surgery. Finally, at the other end of the village their own children's hospital was pointed out to me as we passed. This institution is not run entirely on charitable lines—the girls pay a nominal fee. It may be suggested that the firm has an ulterior motive in providing this accommodation, &c.; this is undoubtedly so to a certain extent, but everything has been arranged on an unnecessarily lavish scale, and there is no doubt that it must be a fairly considerable charge on the business.

A few words from the commercial point of view. We are all aware, I think, that the code of commercial morality throughout the world has undergone a change since the war; even in this country, I am sorry to say, we sometimes hear of and come across things which make us open our eyes and sit up to think. I had no experience of Italians from this point of view until fairly recently, and I am bound to say from my short experience that extreme caution is necessary in selecting your customer. The very best terms obtainable are 30 days, and 60 or 90 days is quite common. Perhaps the fairest description would be that the Italian is inclined to be very dilatory, due possibly to the delightful warm climate he lives in—and wants constant and careful attention to keep him up to the mark, and if things do not work his way he has a habit of blaming everyone and everything except himself. There are, of course, different degrees, and it is only fair to say that the very best firms, having obtained the longest possible terms from you, will fulfil their obligations promptly and punctually.

I am quite aware that one is treading on very dangerous ground in mentioning anything in connection with politics at such a gathering as this, but it is impossible to speak about Italy without some reference to the political aspect and the one man who is responsible for the state of affairs that exists to-day. Before I went to Italy I was somewhat prejudiced by what I had read in papers, and I rather had the impression that something approaching a reign of terror existed in the country. I very soon realised, however, through personal observation that this sort of talk was, to use a colloquialism, absolute "bunkum." The Italians to-day are an extremely hard-working, happy and prosperous people; they are imbued with an intense love of their country, and are perfectly resigned to following Mussolini wherever he may lead them. When all is said and done, results speak for themselves, and perhaps the experience of my Italian friend is as good an example as any of the organisation that sprang up with the advent of Fascism. Having shown me the conditions that exist in their mills—conditions which would have impressed anybody, and which I have attempted to describe to you, he told that one day in 1919 he was rung up on the telephone to be informed that the Red Flag was flying on their mill. He and his father motored out to meet the workpeople, and talked to them, but with no result. This Red Flag incident synchronised with the appearance of Mussolini and Fascism, and in less than a week the conditions which I saw sprang into existence, and as long as the present *régime* lasts there seems every reason to suppose they will continue. It is worth mentioning that prior to Mussolini taking over the reins of Government, all the public services were appallingly run. The railways were not only being run at a very heavy loss, but trains were seldom less than an hour late, railway servants were insolent, and the rolling stock was filthy. All that was changed, and to-day, although the rolling stock leaves a good deal to be desired in the way of cleanliness, trains are invariably punctual, officials are civil and helpful, and, most important of all, the railways are a profitable undertaking. I do not think anyone who has been to Italy and endeavoured to study conditions there can possibly dispute that Italy is extremely fortunate to have produced such a man as Mussolini at a very critical period in her history. I do not suggest for one moment that such methods would apply in this country, because I know they would not, but I do suggest that we might usefully take one or two leaves out of her book. Surely it is time we woke up to the fact that if we are to make up for all that we lost during the war, and all that we have lost since, we should clear away the disruptive elements that are impeding our progress, stop falling out amongst ourselves, put our house in order, and set to work in real earnest.

Discussion

The Chairman said—We have had a very interesting and most useful address, which fully illustrates the importance of studying the methods adopted by our friends in foreign countries. We have previously had some most interesting reports in connection with America and Germany, and it is really extraordinary how much all these reports have dealt with the welfare of employés. I think it is generally considered in America that the attention which is paid to the welfare and encouragement of their workers is one of the great causes why they are spared some of the disastrous effects we suffer from in England. They make conditions satisfactory for the workers not simply because they must, but because they like to do so. Everyone works in a friendly and amicable manner. In Germany thay may not at present have the best machinery, but certainly in France and evidently, from what Captain Sherston says, in Italy they are using the very best machinery and ruthlessly scrapping the old. Of course, the trade conditions in England make the adoption of such a course extraordinarily difficult. We are struggling along without making profits, and therefore must refrain from doing many things we should much like to do. But still the lesson is there. Whenever possible we must instal the best machinery and run it to the best advantage.

Professor W. E. Morton (Manchester) said—I have very great pleasure indeed in proposing a vote of thanks to our lecturer for his most interesting address. Last year I also had the pleasure of visiting Italy, among other countries, for the purpose of studying industrial problems from the textile point of view. What the speaker has described to-day I saw myself in almost exact replica, except that I confess I did not witness such a wonderful example of a welfare scheme as he has mentioned. The most significant point brought out in these lectures is that all foreign countries appear to be looking to the example of America. Why should Italy, instead of organising her industry on similar lines to ours, turn to America? You talk to an Italian, and the English he speaks has quite a distinct American accent. He goes to America to learn his business, or at any rate the organising side of it. The same condition obtains in Germany. I have met a great many Germans, and they all spoke what English they had with a decided American accent, and occasionally with typical American phrases. It seems to me that there is food for thought in this. I admit that in the case of Germany there is a good deal to be said for their particular circumstances influencing them in the choice of the country to which they turn for information, but nevertheless the point is one well worth consideration by British manufacturers and traders.

Mr. J. Hollas (Preston) said—I am sure we are all very much indebted to Captain Sherston for the illuminating address he has given us. I would like to know whether the weft is almost all ring-spun, and whether the Italians make artificial silk wefts. I find that Lancashire competes better with Italy in regard to artificial silk wefts than artificial silk stripes. In medium numbers of artificial silk stripes a value is offered by Italy, in some cases, better than is offered by Lancashire. Perhaps this is due to the automatic looms. Further, I should like to learn whether the business of spinning, weaving, and finishing are run as one unit or as separate businesses separately accounted. In conclusion, I have very great pleasure in seconding the vote of thanks to Captain Sherston, and in expressing my personal gratitude for the valuable information he has given us.

The Chairman put the motion to the meeting, and the vote of thanks was carried unanimously by acclamation.

Captain Sherston, replying, said I do not really require any thanks, but certainly would like to thank you for listening to me so patiently. I am afraid I cannot answer all the questions that Mr. Hollas asked. There is one I can answer, and that is that most of their weft is spun on the ring frame. I have brought back some 80's with me for your inspection. I did not see any artificial silk weft, and I did not ask about it; neither did I inquire about the question of separate accounting with regard to the different ends of the business. What I do know is that the different businesses are not adjoining one another as regards locality in the case of the particular factories I visited, because the finishing works are in Milan and the other units are also separated one from the other. I will endeavour to obtain the other information asked for by correspondence.

Yorkshire Section

Meeting held in the George Hotel, Huddersfield, 23rd November 1926, Mr. F. L. Moorhouse in the chair.

COLOUR FADING IN TEXTILES

A paper on "Colour Fading in Textiles" was delivered by Dr. S. G. Barker and Mr. H. R. Hirst, of the British Research Association for the Woollen and Worsted Industries, at a meeting of the Yorkshire Section of the Textile Institute held at the George Hotel, Huddersfield, on Tuesday, 23rd November. Mr. F. L. Moorhouse, Chairman of the Huddersfield Chamber of Commerce, presided, and there was a large attendance. The Chairman said that during the last twelve months there had been a lot of trouble in the textile industry owing to colour fading. There had been a considerable amount of difficulty in getting colours on to textiles that they could guarantee and that would stand absolutely fast. The final arbiters were the buyers of cloth—the men and women who wore it. When wearers paid a fair price for cloth of good material they had every right to expect that the cloth would keep its colour under reasonable exposure when being worn. Unfortunately this had not been so during the last two or three years. He was glad that they were having brought before them by the

British Research Association for the Woollen and Worsted Industries the question of colour fading. He hoped the time would come soon when sellers of cloth and other textile materials could, without hesitation, place before their customers goods guaranteed to withstand ordinary exposure to weather.

"Colour Fading in Textiles"

The fastness to light of dyed fabrics is a subject which has been discussed from time immemorial. The precise definition of a fast dyestuff is somewhat difficult. The Germans tackled the subject years ago, and their investigations have resulted in tables of fastness of dyestuffs. The American Association of Textile Chemists and Colourists had recently instituted a similar scheme, and the work was being carried out at the Bureau of Standards, Washington. In this country, noted for its dyers and dyed fabrics, little had been done in the matter, and the work had been left to individual workers rather than had any concerted and systematic effort been made. The need for such work in England was obvious, and about eighteen months ago the British Research Association for the Woollen and Worsted Industries determined to tackle the question scientifically and systematically as far as wool is concerned.

The Association in equipping its optical laboratory for such work were pioneers in the matter, and were the first to establish an institution purely for research work on fugitiveness of colour on dyed fabrics. It had to-day an equipment and staff equal to the task, and laboratories equipped with all the latest and most up-to-date appliances. The lack of actual sunshine had not deterred them, as they had tropical agencies situated at the observatories at Kodaikanal, Trivandrum, and the Indian Institute of Science, Bangalore, in South India, and also at Colombo, Ceylon. The directors of the observatories in India and Ceylon expose their patterns under ideal conditions, and supply hourly meteorological data regarding sunshine, clouds, temperature, humidity, &c., throughout each test. The work is done, therefore, under the strictest supervision. The Association has also its own fading stations in Leeds and at Wetherby in this country, so that it could claim to have a world-wide organisation for conducting tests.

At the outset it became apparent that the problems facing them resolved themselves into two distinct and yet closely related spheres, namely, chemical and physical investigations of fading. Dyestuffs might fade by chemical means, namely, the effect of alkalis, acids, and such natural causes as perspiration, &c. In this regard the chemical department had completed wide investigations, which include the effect of residual iron, the effects of mildew, acidity, and alkalinity, &c. Recent work by A. T. King, of the Research Association staff, showed that sulphur dioxide under particular conditions can produce alterations in dyestuffs out of all proportion to their presumed standards of fastness to stoving, and that the latter may be a very unreliable guide to the degree of fastness to sulphur dioxide.

On the physical side the actual problems seem to fall under three main headings—

(1) The choice of standard illumination for fading tests.

(2) The fastness and durability of a coloured fabric to the influence of external conditions.

(3) The determination of the exact shade of a colour and its numerical representation, including the question of proper illumination of the pattern when under test.

The extreme variability of sunlight itself as an illuminant renders it extremely unreliable as a fading medium for standard tests. There was no international standard method for expressing the fastness of various colours to a standard source of light. The usual method in dyehouses was to expose dyed patterns along with certain well-known dyes to sunlight, either in a clear atmosphere or in the atmosphere near the factory, and for colours for use in the tropics patterns were sent out for exposure. In testing the fastness of dyestuffs to sunlight the old method of nailing patterns to the office window was obsolete. The Association had utilised a box specially designed by their optical department. This box was well ventilated, open to outside atmosphere, yet affording protection to the patterns from rain, dirt, &c. The patterns are so fixed that they are freely in contact with the atmosphere on all sides. Hygrometric readings are taken upon instruments inside the box, whilst the patterms are protected in front by Vitaglass.

First and foremost in the difficulties experienced was the fact that no standard source of daylight was available for comparative tests to be made. It was obvious that this standard source of light should approximate in properties as closely to daylight as possible. Humidity plays an important part in colour fading. Actual experimental results showed greater fading in the English stations than in the tropics for the same periods of time. This could not all be attributed to difference in sunlight constitution. Further, different tropical stations gave for the same period amounts of fading almost proportional to the relative humidity of the atmosphere prevailing during the period of exposure. Precise experiments on the humidity effect had been made and are still proceeding, but it could be stated that the form of the curve relating fading loss of colour to humidity closely followed that for absorption of water on wool fibres. It reached a saturation value at about 75 per cent. relative humidity, after which additional humidity seemed to have little effect. This important point is now under close investigation. The setting up of any standard test, therefore, for fastness of dyestuffs must also include a prescribed standard set of conditions of humidity.

No fading lamp existing to-day had a controlled humidity, nor can a desired set of conditions be imposed for any test. Until this is done every caution must be taken in accepting results. The method of viewing patterns adopted by the Association was described, and various types of daylight lamps were critically discussed, and finally mention was made of the new daylight spectacles introduced by the Association. These spectacles, when worn, gave a good approximation to standard daylight in viewing dyed fabrics if these were illuminated by an ordinary opaque electric light bulb. For office work they eliminated the use of a large daylight lamp in viewing small patterns, but for viewing large pieces a greater volume of light might be required, and is provided by the standard lamps.

In conclusion the Lecturers made a strong plea for co-operation of the dyers in this work. It was an essential that such tests be carried out scientifically, and the attack now made upon the problem by the British Research Association had already led to definite results of the greatest practical value. It was a matter for congratulation that a Research Association such as the British Research Association for the Woollen and Worsted Industries should lead the way in this country in standardisation of dyestuffs.

Among numerous questions, a manufacturer asked if colours could be made faster so that they could sell in foreign countries where the humidity varied considerably? Mr. Hirst said that certain work had been done in this direction, but not by the Association he represented. They were leaving that problem until a later date.

"Have any investigations been made regarding the mixing of colours ? Does one colour react on another in the mixture ?" was another question asked. Mr. Hirst, in reply, said that most of the work that had been done indicates that each colour acts independently and fades on its own.

Another speaker said that a few years ago a spinner in the West Riding sent samples to Australia. The patterns were sent back with a letter stating that within fourteen days the colours had faded. A later letter from Australia stated that the Germans were getting into the Australian market, and that they were guaranteeing their colours to be fast. He asked if the ordinary colours that were being used to-day could be guaranteed. Dr. Barker, replying, said that the manufacturer who was guaranteeing his colours as being absolutely fast was asking for trouble. As a result of their investigations they would be able to guarantee that cloth would not fade so long as it was not taken outside certain conditions of humidity. If they guaranteed that, it would be as far as they would be able to go. As things stood at present, all they could say was that no colour was absolutely fast. Frequently where the dyer was blamed for colour fading he was blameless. Colour would be fast under certain conditions but not in others. The Association had been gathering data of the average humidity in all parts of the world, and in the course of time manufacturers would be able to turn up statistics and find what the humidity was in the countries that wanted their patterns. By this method, manufacturers would be able to make their goods so that they would not fade in the countries to which they were sent.

Another question was—"Is there likely to be any standard of fading adopted or any standard of fading that can be recommended for general purposes ?" Dr Barker—"You want to know whether a dyestuff will be fast during the various processes of manufacture, and during the subsequent wear in the light and so on ?" "Yes." Dr. Barker—During the last eighteen months we have been devoting ourselves mainly to the question of light, but we have recently drawn up a programme of subsequent work in which we have determined that light is but one small part of the problem. Provided that sufficient funds come along, we have arranged to appoint extra staff to tackle the problem from every point of view. At the present moment we are limited by finances only. If we can get money we can put in the work and we can "deliver the goods."

On the motion of Mr. H. Binns, Chairman of the Yorkshire Section Committee of the Textile Institute, the Lecturers and the Chairman were heartily thanked.

London Section

VISIT TO THE IMPERIAL INSTITUTE

Saturday, 27th November 1926

At the invitation of General Sir William T. Furse, K.C.B., D.S.O., the London Section of the Institute paid a visit to the Imperial Institute on Saturday, 27th November. A large number of members attended. The party met at 3 p.m. at the East Entrance of the Public Galleries, and were received by Dr. Goulding on behalf of the Director. The new galleries were inspected, special attention being paid to the textile exhibits, both raw and manufactured, and appreciation was expressed at the reorganised planning of the display, the products of each colony being suitably arranged near a diorama, wonderfully realistic, illustrating the chief industry, around which were pictures, maps, &c., and small models of recent engineering undertakings in the colony. Later in the afternoon the Imperial Institute entertained the party to tea, after which Sir William Furse explained that it was his intention to make provision for experts to examine the samples in their possession of Empire products at will, and in detail. Exhibits would be arranged showing views, dioramas, raw products, processes of harvesting, preparing and marketing the finished product in order. He went on to say that he regarded the Imperial Institute as a great factor in bringing home to Englishmen the importance of the Dominions beyond the seas, and that he would always be pleased to welcome such parties as were present that afternoon. Replying to a brief vote of thanks proposed by the Chairman of the London Section, Mr. Edwin Wigglesworth, Sir William said that he and the staff of the Imperial Institute were servants of the Empire, and that if they neglected to perform any possible service whatsoever, they were but miserable creatures. He hoped that the example of the Textile Institute would be followed by every other organisation which had an interest in the raw products of the Empire.

NOTES AND NOTICES

The Council of the Institute

At the ordinary meeting of the Council held at the Institute headquarters on Wednesday, 19th January, there was a good attendance, with the Chairman (Mr. John Crompton) presiding. The cash statement and accounts to end of December completed the record for the last financial year. Although, by comparison, the statement was satisfactory, yet there is a wide difference between a purely cash record and the financial record of the year's operations after completion of the audit and adjustment of accounts. The revenue account and balance sheet were not available, the audit not being completed. Any discussion or consideration of the financial position had therefore to be postponed until next meeting, which, by the way, is to take place at Bradford on the afternoon of Monday, 28th February, by invitation of the Yorkshire Section Committee. The President (Mr. Wm. Howarth, J.P.) is due to address a meeting at Bradford on the evening of the date mentioned, and those members able to remain for the evening meeting are invited to do so. The Council decided that the Research, Testing, and Inventions Advisory Committee should be resuscitated, and instructed the General Secretary to call a meeting at an early date. The list of applications for membership presented at the meeting included three for Life Membership, and in accordance with previous resolution, the Finance Committee was authorised to invest the subscriptions; and in connection with investments, it was formally agreed that £500 from Diplomas Account be invested forthwith. The Secretary reported further with regard to arrangements for the Annual Conference at Bolton next Whit-week, and was instructed, whilst appreciatively acknowledging a letter received from Mr. C. H. Clark, of Boston, U.S.A., regarding the formation of a Club of Members of the Institute in the U.S.A., to offer a hearty invitation to any U.S.A. member to attend the Bolton Conference and accept hospitality in regard thereto.

London Section Activities

The London Section Committee at a meeting on 13th December 1926, decided that, if sufficient support were forthcoming, a dinner-dance should be held on the night of 1st April 1927. The industrial situation had been considered too serious in October to permit the holding of the usual annual dinner, and the function was therefore deferred to the New Year, when it was hoped that better general conditions would prevail. Although arrangements have not been definitely concluded, it is at present proposed to hold the function at the Hotel Great Central, Marylebone, where, it will be remembered, the Institute held a most successful dinner on the occasion of the Empire Textile Conference at Wembley. The London Section Committee extends a cordial invitation to members of all sections of the Institute to attend this dinner-dance, and intention to take tickets, which will not be more than 12s. 6d. each, should be intimated to the Secretary of the London Section, at the Institute's London rooms, 38 Bloomsbury Square. It is hoped that this social gathering, which in some respects will be a novelty to the Institute, will be as successful as the London Section Annual Dinners of the last two years.

The British Association Meeting at Leeds

For the past three years the Institute has been in touch with the British Association for the Advancement of Science in an endeavour to secure consideration of papers, and subjects for discussion, of a textile character. It is felt that while other applied sciences, such as Agriculture and Engineering, have undoubtedly achieved greater stability and can show perhaps a larger coterie of workers, yet Textile Technology, now that this Institute has its charter, has received confirmation of its claim to be an applied science. Thus it is desirable that some meed of recognition by the premier scientific organisation of the kingdom should be sought, always bearing in mind, of course, the constitution of that organisation. Accordingly the British Association was approached, primarily, in 1925 with a view to ascertaining that organisation's attitude. The Institute was heard with courtesy, and it was indicated that the method to adopt was to approach the Recorders of the separate sections of the Association either with suggestions of topics for discussion or to ask for special consideration of papers on textile technological subjects. As an outcome of further negotiations on these lines, a subject for joint discussion between the sections for Physics, Chemistry, and Botany was submitted from this Institute as follows—"The Mechanism of Sorption and Swelling by Amorphous Colloids as Compared with Fibres and other Cellular Colloids." Unfortunately the character of the 1926 meeting of the British Association at Oxford was such that less time was available than usual for joint discussions, and as Oxford, by reason of its situation, was not particularly likely to attract a textile attendance, it was decided not to arrange the discussion proposed. But the Institute was given to understand that, as the 1927 meeting was to be in Leeds, fuller consideration would then undoubtedly be given to textile affairs. At the moment a definite setting aside of time and occasion for textile matters is indicated, and it is hoped that this Institute may be accorded that recognition which a request to lend assistance in the organisation of what promises to be a valuable and informative series of discussions would afford.

The Journal of the Institute: Library Sets

Experience of the past four years has been that a number of National and University Libraries have requested supply of complete sets of this *Journal*. To comply with these requests has been a task of some difficulty, as in the stock of early volumes serious shortages and gaps appeared, but by the courtesy of members approached privately and by advertisement (see page xiv this issue) up to now the requests have been met. Recently a letter from India has been received asking for a set of the first ten volumes, and as no issues are in hand for 1913 and 1914 (Volumes IV. and V.) the set cannot be sent complete. It is hoped that the occasion will be regarded of such importance as to move a member to be generous enough to supply the need.

Institute Membership

At the January meeting of the Council the following were elected to membership—H. F. Bamji, The Dawn Mills Co. Ltd., Fergusson Road, Bombay 13, India (Chief Electrical and Mechanical Engineer and Bleacher); W. Carr, 78 Asquith Avenue, Morley, Leeds (Assistant Carding Overlooker); H. Cook, 88 Dewar Street, Dunfermline (Factory Mechanic and Textile Teacher); A. D. Davies, 16 Central Avenue, Garden City, Kilbirnie, Ayrshire (Manager); H. Dawson, c/o H. Dawson & Co., 74 Coleman Street, London, E.C.2 (Wool Broker); J. H. Devey, 2 Windsor Avenue, Ashton, Preston (Weaving Manager's Assistant); G. G. I. Grant, 78 St. Leonard's Street, Dunfermline (Tenter and Assistant Teacher of Weaving); E. Meister, Dresden-A, 24 Sedanstrasse, nr. 27 (Professor at the Technical High School, Dresden); A. M. Reekie, 19 Blake Street, Brucefield, Dunfermline (Tenter and Assistant Weaving Teacher); J. Rostern, 83 Ulundi Street, Radcliffe, nr. Manchester (Teacher of Textiles and Head of Department); S. Schofield, Kinders House, Greenfield, nr. Oldham (Flannel Manufacturer); W. P. H. Sinclair, Scottish Woollen Technical College, Galashiels (Research Student); C. V. Streenivas, Nanded, N.G.S. Ry., India (Assistant Weaving Master, Osmanshahi Mills); Saw Tun, c/o The Deputy Director of Agriculture, Myingyan Circle, Meiktila, Burma (Cotton Technologist); A. Thornley, 27 Lowton Street, Radcliffe, nr. Manchester (Textile Designer and Teacher of Cotton Weaving Subjects); A. Webster, 134 Woodsley Road, Leeds (Research Chemist); Sir Henry Whitehead, Saltaire Mills, Shipley (Worsted Spinner and Manufacturer);

F. N. King, 19 Castle Road, Keighley (Research Student); T. M. Lees, Galabank Mills, Galashields, (Woollen Manufacturer).

The following members of the Institute were elected to Life Membership—. M. C. Andrews, Orsett, Derryvolgie Avenue, Belfast; W. Howarth, Springlawn, Heaton, Bolton; J. R. Lockie, Ascog, Meikleriggs, Paisley.

REVIEWS

"The Chemical Age" Year Book, Diary, and Directory for 1927. Benn Bros., Ltd., London, 10s. 6d.

The 1927 edition of this well-known Diary and Directory contains in addition to the usual matter a list of Stock Exchange prices and a summary of important events of the year. The last-named item provides a short history of 1926, month by month, and is a useful record of conferences, elections to professorships and directorships, awards of the medals of learned societies, changes in the constitution of public companies, certain important legal decisions, trade exhibitions, &c., and is a welcome addition to the Diary. All the standing matter has been brought up to date and, although the various "Directories" would be much more useful if the addresses of the firms mentioned were included, the general value of the publication is much higher than in preceding years. A minor point, but one that may be important in a year book, is that a calendar for the preceding year is as necessary as that which is supplied for 1928. A list of bank holidays for the current and succeeding years would also prove a desirable additional feature. —J.E.F.

Textile Recorder Year Book, 1927. John Heywood Ltd., Manchester (1,004 pp., 7s. 6d. nett).

The 1927 edition of this well-known Year Book bears very favourable comparison with any other of the similar publications dealing with the textile trade. In addition to the matter contained in last year's issue, a special section has been added dealing with novelty yarns and giving details of production of various twists, gimps, knopps, cloud, and chain yarns, together with mechanical details of the machinery employed. It is very difficult to criticise a publication of this description other than favourably, as so much has been attempted that it is unfair to concentrate attention on any one section which may in the eyes of an expert be incomplete or even slightly inaccurate. Perhaps the publishers may consider the suggestion that in a desk book of this kind one should be able to find the dates of the various wakes and holidays of spinning and manufacturing districts in both Lancashire and Yorkshire. To visit Bradford on business during Bowling Tide or Radcliffe during Wakes Week are unpleasant and unprofitable experiences which may easily befall a stranger, and which could easily be obviated by the inclusion of a list of holiday occasions. It is possible that a statement as to the working of the silk tax, especially the method of claiming drawbacks, might have proved a useful reference section for more than one branch of the industry, but no doubt the publishers have attended to this matter in their Directory of the Silk and Artificial Silk Trade. —J.E.F.

The Purification of Industrial Waters. By The Patterson Engineering Co. Ltd., Windsor House, Kingsway, London, 5th edition.

A well-written book of 107 pages by one who evidently knows his subject. It is printed on good paper, with readable type, and it is very well illustrated. The writer has successfully avoided any appearance of advertisement in producing a book which is a valuable contribution to the subject of water purification. It would have added to the value of the book if the description of the tests for "water softening" had been included in the text, instead of giving a photograph of the apparatus only.

The author, or authors, are to be congratulated on producing a book which is sufficiently interesting in itself in spite of the fact that it is mainly a description of the plant of one particular firm of "water softening" engineers.—P.B.

The Silk and Rayon (Artificial Silk) Directory and Buyers' Guide of Great Britain. Compiled by A. H. Hard. Published by John Heywood, Ltd., London and Manchester (21s nett).

It may be generally accepted that if a thing is worth doing it is worth doing well. That this Directory has increased in size is testimony to the increase in the industry for which it provides a key; that it is in constant demand may be attested by the reviewer from personal experience, and it may be safely held that to compile such a Directory was worth doing. Has it therefore been well done ? So well done that it can stand honest criticism of its weak points! Firstly, it errs on the side of dealing too lavishly with artificial silk and not equally definitely with the natural fibre. The lure of the synthetic fibre we all recognise, but the compiler of such a directory should strive to resist this enchantment; of the first seven items in the book six deal with artificial silk alone. Its second fault lies in the distribution of the advertisements; a plea will be made again and again for consistency in this matter, despite the reply that advertisements are "the gintleman that pays the rint." It is annoying to the user of a Directory or for that matter to the reader of a journal to find editorial matter first on one side of the page and then on the other; this matter is constantly being complained of to the reviewer by readers of journals and users of directories who are potential purchasers of the merchandise or services advertised. As an example, attention is drawn to page 19, a right-hand page, on which commences a very valuable item, "Artificial Silk Customs Duties"; this rightly continues on page 21, also a right-hand page, but the article "American Artificial Silk Specifications," again a valuable and interesting item, begins on page 23, a right-hand page, and continues on page 24, when one instinctively looks for it on page 25. One other criticism must be made, and that concerns page 27, on which is given a list of "consultants, professors, teachers &c." We feel unable to congratulate those whose names are worthy of inclusion on such a page upon their association with others whose claims to such prominence are less obvious. Moreover, such a list should be accurate, and it would seem courteous to include names by consent only—at least one name is included without, on its owner's own testimony, such consent. But it is willingly added that the undertaking is a good one, that the general arrangement and classification of the information so laboriously collected is excellent, and if these criticisms are the spur to subsequent further improvement they may be well worth while too. —H.L.R.

Bankers' Publications.

Banks continue to extend the range of facilities available to clients, and this tendency has resulted in increased publication of information. The Westminster Bank, Ltd., 41 Lothbury, London, E.C.2, issues post-free, on request, a batch of interesting pamphlets and leaflets, including "The Financial Machinery of the Import and Export Trade," "Foreign Travel," "Terms and Conditions of Appointment as Executor, Trustee &c.," and a statement covering the functions of the Shipping Department of the Bank. These are attractively produced, and are distinctly valuable as epitomes of fact in connection with the subjects with which each deals.

Modern Practice in Textile Wet Finishing.—i. Dyeing Artificial Fabrics; ii., Dyeing Wool Fabrics. By H. C. Riggs, Textile Department, Rodney Hunt Machine Co., Orange, Mass., U.S.A. (Prices—**i.,** 75 cents; **ii.,** 1 dollar 50 cents.)

These two attractively-produced trade manuals reflect considerable credit on the firm which issues them, as they bear evidence of much careful thought in their compilation. The booklet which deals with Artificial Silk Dyeing first considers "Methods for Identification," and the actual tests suggested, together with the "careful observation" urged by the author, should suffice for this essential preliminary to the actual process for dyeing. Notes on dyeing machines, preparation for dyeing, dyeing, and drying and finishing are then given, followed by tables showing properties of dyestuffs and general methods of application to artificial silks. The manual is obviously capable of extension, but the author's note that "only those properties and methods which have been thoroughly proved are given," indicates the policy adopted, and is certainly commendable. The second pamphlet, that which deals with Wool Dyeing, is, as befits a wider proved knowledge of the subject, considerably larger, but handles the subject on similar lines. The tables of common causes of faulty piece dyeing and of cloudy piece dyeing are well worth inclusion. The firm is to be congratulated upon its enterprise. —H.L.R.

The "Express" Metric Quotation Reckoner. By J. G. Inglis. Published by Gall and Inglis, London and Edinburgh (96 pages, 2s. 6d. nett).

Unfortunately until the universal adoption of the metric system of measurement is achieved, calculations more or less troublesome will have to be made from British units to metric units. This volume, which is No. 22 of the "Express" series of ready reckoners issued by this well-known firm, supplies in a handy and easily ascertained manner a key to the calculations required. Section 1 consists of tables for the conversion of prices per pound or ounce into prices per hundred grams. Section 2 deals with prices per ton and hundredweight converted into prices per tonne and per 100 kilos. Section 3 deals with prices per gallon in a similar manner, relating them to prices per litre. Prices per lineal yard are converted into prices per metre in Section 4, while in Section 5 the same measurements are converted into square yards and square metres. Ounces per lineal yard are converted into ounces per square yard and grams per square metre in Section 6, and the final section summarises the conversion tables. There is no doubt that this small reckoner has definite value to textile people.

—H.L.R.

The Institute acknowledges with thanks the receipt of calendars for 1927 from the following firms—P. & J. Arnold (London); J. Albinson (Oldham); H. Bronnert (Manchester); Burn Bros. (Manchester); "Chemical Trade Journal" (Manchester); Chorley & Pickersgill (Leeds); Chorlton & Knowles (Manchester); Cloister Press (Manchester); B. Dellagana (Manchester); Hoffmann Manufacturing Co. (Manchester); Kalamazoo (Manchester); R. Alan Murray (Manchester); and W. Stansfield (Manchester).

GENERAL ITEMS AND REPORTS

Manchester Ship Canal and the Cotton Trade

An audience of about 200, consisting of students of the College and others interested in the formation of a Textile Society in Wigan, assembled in the College Hall on Wednesday, 27th October, to listen to an interesting address by Mr. F. W. Way, of the Manchester Ship Canal Company.

Mr. Way astonished the audience by his description of the magnitude of the undertaking which few who have not had the opportunity of sailing up the canal and of visiting the Manchester Docks realise. The lecture was illustrated by a large number of lantern slides which showed the canal at various points both in course of construction and as it exists to-day. In addition, the audience was delighted with many views, both ordinary and aerial, of the various bridges, locks, wharfs, and docks associated with the canal. The Lecturer, in his account of the formation of the canal and of its relationship to the industries of Lancashire and of a much wider industrial area served by the canal, related the following interesting facts. The idea of a Ship Canal was put forward as far back as 1882 by Mr. Daniel Adamson, engineer and pioneer, at a meeting of about 70 representatives of industry and enterprise, held at his house, "The Towers," Didsbury, the present home of the Cotton Industry Research Association. The enterprise was a bold one, but the undaunted pioneers realised the economic necessity for the scheme, and after much expensive litigation eventually a Bill was passed by Parliament on the 6th August 1885. The Act prescribed that at least two-thirds of the capital required for the construction of the canal had to be raised before the venture could be undertaken, which meant a sum of nearly 7½ million pounds. After almost superhuman efforts, the sum was eventually obtained 24 hours only within the time limit allowed by the Act. No time was lost in arranging the necessary contract. The first sod was cut in November 1887, and on the 1st January 1894, the Ship Canal was opened for traffic to Manchester. To-day Manchester is the fourth greatest Port in the United Kingdom, and regular steamship services run between Manchester and the principal ports overseas. Grain, timber, oil, spirit, and fruit are all imported *via* the Ship Canal on a scale surpassed by few other ports, and, in addition, large and valuable supplies of cotton, wool, cattle, frozen meat, tea, sugar, provisions, ores, nitrates, manufactured iron, starch, farina, leather, paper, glucose, wood pulp, copper, and tobacco. During the recent unfortunate coal dispute the unprecedented spectacle of coal being imported into Lancashire by the Ship Canal has been witnessed. Among the exports are textile goods and machinery in large quantities, also iron and steel, chemicals, paper-making materials, coal, salt, and pitch. The rise in importance of the Port of Manchester, which has been extraordinary, is due largely to its uniquely favoured geographical position, standing as it does in the heart of the most important industrial area of the country. Within 75 miles of Manchester there is a population of over 14 million people, which exceeds that of the similar area around London by nearly one million. Last year the total traffic over the canal was just short of six million tons, the highest in any one year since the opening. In 20 years the importation of cotton to Manchester *via* the canal has increased tenfold, reaching last season the high figure of 684,656 bales. Over 50 per cent. of the Egyptian cotton for consumption in the United Kingdom now comes to Manchester, and, while the percentage of American is much less, it is growing in dimensions each year.

The Lecturer, in comparing the costs of shipment *via* Manchester and Liverpool for various districts, pointed out that for the Wigan district the difference in favour of Manchester was but small, but however small the saving, it is in the aggregate worthy of consideration, and he appealed to his audience to remember Manchester. Turning to the constructional side, Mr. Way mentioned that in the construction of the gigantic undertaking two floating dredgers were engaged, also 98 steam navvies of various types, 192 portable and other engines, 212 steam pumps, 194 steam cranes, 59 pile engines, also 183 locomotives and 6,300 wagons travelling over a route of 236 miles of railway. Nearly 17,000 individuals were employed, 70 million bricks were used in the construction in addition to huge quantities of masonry and concrete, while during the period of construction 120,000 tons of coal and 100,000 tons of cement were required per annum. No less than 76 million tons of earth in all were excavated. The authorised capital of the company is £20,000,000, and although it was not until the year 1915 that the company was able to pay a dividend, last year the dividend paid was £5 per cent.

Mr. F. J. Harlow, M.B.E., B.Sc., Principal of the College, who has accepted office on the invitation of the Formation Committee as first President, occupied the chair in the unavoidable absence through indisposition of Mr. John Heaton, J.P. In his remarks, Mr. Harlow explained that the object of the Society was not only to provide a means of broadening the education of the textile students of the College, but to bring together for educational purposes operatives, overlookers, managers, and others who for various reasons were not able to avail themselves of the facilities of the classes. He was glad to say the textile instruction given by the College and the formation of the Society had the strong support of the leaders of the local textile industry, and he thought the lecture they had listened to that evening would show how valuable to those engaged in the textile industry the formation of the Society would be. A splendid programme of lectures and of visits to works had been arranged, and he hoped every one present that evening would do their best to induce those engaged in the industry, whether male or female, to join the Society. The membership subscription to other than students of the College was 2s. 6d., and he was quite sure the privilege alone of visiting the Manchester Docks, which at the kind invitation of the lecturer would be arranged in the new year, was well worth the annual subscription. Those desirous of membership should forward their subscriptions to the Secretary, Mr. T. F. Walsh, at 159 Scot Lane, Newtown, Wigan, or at the Mining and Technical College, where the Secretary would be pleased to see intending members on Monday, Tuesday, or Friday evenings.

Weaving of Fine Worsted Cloths

Mr. George Shackleton gave an address on "Problems of Fine Cloth Weaving" before the Bradford Textile Society on 22nd November, Mr. Arthur Hitt (President of the Society) in the chair.

Mr. Shackleton, dealing mainly with botany cloths, said that though the ordinary tappet loom was rarely made with a capacity of more than eight shafts, which prevented its use for certain fabrics, yet it was the best shedding mechanism yet made, because a tappet could be constructed to give any proportion of dwell to rise and fall. Whether tappets or dobbies were used, the timing and setting should be such as to reduce to a minimum the strain and friction on the warp threads. For fine cloths wire healds could not be equalled. As few shafts as possible should be used. The correct shed was the smallest that would open clearly, and through which the shuttle would easily pass. The false reed was of much assistance in this connection, and should be used for all fine sets. The position of the warp lines required careful consideration. Evenness of wefting was essential. The finer cloths that were replacing the repp were even more subject to barriness caused by slight thick-and-thin places, and the most minute and constant attention was necessary to ensure the even slipping of the beam and the proper action of the take-up motion. Fine weft yarns were difficult to weave without curls. If the yarn could be allowed to stand a month or more in a slightly damp atmosphere, it would set and be better for weaving. The present state of trade did not allow so long a time to elapse between spinning and weaving. The sprinkling of the yarn with water was helpful, but the yarn should be allowed to stand at least a week, in order to moisten the yarn underneath the top layers. All yarns were more or less uneven in thickness, leading to greater liability to breakage, unevenness, and knots. The human factor was important. A great many faults could be avoided by foresight on the part of the overlooker. Piece work developed speed in performing such mechanical actions as threading shuttles, changing shuttles, tying warp threads, and putting these through the mails and reed; and when it was remembered that on an average looms stood for about half their working time whilst one or other of these actions was performed, the importance of quick movement would be realised. One weaver could produce 50 per cent. more than another, and would produce better pieces.

Mr. G. F. Ashley said that on the Continent a vacuum chamber was employed for the conditioning of yarn. The skeps were put in, the air extracted, and dry steam admitted for two minutes. This penetrated the yarn, and after withdrawal from the chamber the yarn was allowed to cool. It was ready for weaving within six hours, and there were no curls or kinks and less liability to shrinkage.

Mr. Ward Parkinson said that fine yarns should be double-combed for the making of fine cloths, which would give a cleaner yarn and save burling and mending costs, which were altogether too high at present.

The Bleaching and Finishing of White Wool Goods

Before the Bradford Textile Society on Monday, 6th December, Mr. John Schofield (Huddersfield) gave a lecture on "The Bleaching and Finishing of White Wool Goods."

Mr. Schofield said the difficulties of the sulphur bleach were mainly overcome by the moving stove, in which the pieces were passed forward through an atmosphere of sulphuric acid gas. In more recent forms of this system, the sulphur dioxide fumes were produced in a separate burner and pumped into the bleaching chamber. The bisulphite method required two soakings, (*a*) by a solution of bisulphite of soda, and (*b*) acidification, usually by sulphuric acid. This was not generally used at present as a regular bleach, and certainly offered no special advantages in quality, price, or output. The liquid system of sulphur bleaching, in which the material was bleached in the ordinary rope or dolly scouring machine after the scouring process, using a solution of sulphuric acid, had been adopted by himself before the war, and had been in continuous work in several bleaching plants since that date. It had the great advantage of using the mechanical squeeze of the dolly rollers on the bleaching liquor. In recent years there had been a great extension in the bleaching of wool goods by peroxide, and it was now probable that the majority of wool pieces received a peroxide bleach. Most practical bleachers favoured the use of direct hydrogen peroxide solutions rather than sodium peroxide; and the newer high concentrations, 100 volumes or over, found increasing application. There were many methods of working the peroxide bleach on piece goods. The jigger was perhaps the most convenient, but a wide mangle, fitted with a trough and batching rollers, was useful for large outputs of similar qualities. Vat treatments were less effective, because they lacked the mechanical squeezing and replacement in the fibre if exhausted by fresh liquor.

The processes subsequent to bleaching followed closely the lines of ordinary worsted finishing, but there was at all stages the stern necessity of absolute cleanliness in working. The use of aluminium in the bleach works had proved extremely beneficial. The water supply should be exceptionally pure. The actual finishing operations, however, were generally few and not specially laborious. In pre-war times the actual cost of wages per finished piece was approximately 6s.; it was now probably about 13s. The actual cost of material for the liquid sulphur bleach in the early war period was not more than 2d. per 60-yard piece; but the peroxide bleaching of to-day might easily be ten times that figure. The finishing charges for goods, which were from 20s. to 30s. per piece before the war, were now from £2 to £3. The "white trade" was very largely a British industry, and also largely a Bradford industry.

Mr. W. A. Elliott (who presided) said that in examining cream goods in the finished state he had been struck by the prevalence of black or coloured hairs, the fault of which apparently went back to the wool grower.

Mr. Clifford Thompson, referring to the use of aluminium rollers, said in practice he had found that as time went on dust was formed by rubbing, and this dust found its way on to the pieces and caused stains.

Mr. Thomas Halstead said a serious problem in regard to sulphur-finished goods was the objectionable smell, which seemed to cling to the material for all time. Vegetable matter in wool was a bigger problem than ever.

THE JOURNAL OF THE
TEXTILE INSTITUTE
TRANSACTIONS

1—AN EXAMINATION OF THE PROCESS OF SIZING COTTON YARNS ON AN EXPERIMENTAL TAPE FRAME

FREDERICK DENNY FARROW, M.Sc., and ERIC HARDING JONES
(The British Cotton Industry Research Association)

INTRODUCTION AND SUMMARY

The ordinary tape frame used for sizing cotton warps deals rapidly with large quantities of yarn, and does its best work when allowed to run with a minimum of interruption. It cannot readily be used for experimental work, and in consequence there are few quantitative records of the behaviour of yarn when sized under differing conditions. In order to facilitate investigations into the mechanism of sizing, and for other purposes, a small machine has been constructed capable of sizing about twenty ends of yarn, and the present paper gives an account of the behaviour of various kinds of yarn when sized under controlled conditions on this machine.

The laboratory tape-frame (see page T5) is not a scale model, but is virtually a longitudinal section of an industrial machine, the yarn being treated under conditions closely resembling those employed in technical practice. In one respect it fails to reproduce every-day conditions in that with increasing strength of size a relatively low concentration is sufficient to retard or even to stop the rotation of the floating roller. A similar effect is encountered in mill practice with very viscous sizing mixtures, and the discrepancy between the laboratory and the mill machines is explained by the much lower ratio of driving surface to bearing friction for the sizing roller of the laboratory apparatus.

The following summary of the work deals in order with the influence of twist, counts, and character of lint on the compactness and behaviour during sizing of single cotton yarns; and with the effect of the physical conditions under which size is applied, on the nature of the process.

i.—Twist, Diameter, Specific Volume, and Sizing Capacity

When any one mixture of cotton is spun to the same counts with various degrees of twist, the diameter of the yarn is less the higher the twist. It is impossible to ensure that in such comparative spinning the counts shall be exactly equal, and the diameter naturally depends to some extent on counts. In comparing the compactness of yarns it is therefore found to be preferable to eliminate the effect of differences of count, by calculating from the diameter and the weight of the yarn, how much space is occupied by unit weight of cotton. This number, the specific volume, is the inverse of compactness and will be used in this paper as a measure of that property. The specific volume of a yarn decreases as the twist increases, slowly at first, but more rapidly as higher values of the twist are reached. The capacity for taking up size is influenced in an exactly similar manner by twist, so that in a specific example where the numbers of turns per inch of two 16's yarns were 12·4 and 15·9, the respective amounts of size taken up were in the ratio of 122 to 100. The influence of twist on sizing is therefore not sufficient to cause slight accidental departures from a normal twist to have any considerable effect on the mean amount of size taken up by a warp.

ii.—The Sizing of Yarns of Different Counts

With a series of similar yarns ranging from 8's to 36's the amount of size taken up is greater the finer the counts. Other kinds of yarn up to 80's follow the same rule so long as the comparison is confined to one mixing of cotton. This behaviour is not in accordance with the expectation of experienced tape sizers, but it has occurred quite consistently throughout these experiments and there is no reason to doubt that it would be observed in mill practice if a similar comparison between fine and coarse yarns of the same type of cotton were made. It must be remembered, however, that fine warps are commonly prepared from a finer grade of cotton than are coarse, and it will be shown that the finer staple cottons are less receptive of size than others. Moreover, the mill judgment of sizing capacity is based on the strength of mixture required to produce adequate sizing, and since it is generally found necessary to use more size on fine warps than on coarse, it seems probable that the general opinion is based rather on a customary employment of a strong mixture for fine yarns, than on any exact knowledge of the relative sizing capacity of different counts.

The fact that fine yarns size more heavily than coarse must be attributed to the part which the surface of the yarn plays in sizing. It is not possible to define the surface area or surface condition of any yarn with sufficient exactness to permit of a precise relationship being developed between extent of surface and amount of size taken up, but it is obvious that the surface area of unit weight of equally dense yarns increases from coarse to fine counts, and it will be shown later that when size is first applied to yarn, it is present as a cylinder closely adjacent to the mean surface. The fact that the extent of the yarn surface determines how much size is taken up, does not mean that the size necessarily remains confined to the surface, and in practice it is generally found to have invaded the whole of the yarn before being immobilised by drying.

iii.—The Sizing Capacity of Yarn Spun from Cottons of Different Growths

If different samples of cotton which are distinguishable by fineness of lint (measured as hair weight per centimetre) are spun to equal counts with the same twist, the finer hairs yield a more compact yarn, which sizes less heavily than does one from coarse cotton. Thus in the earlier experiments of this series a 36's Sakel yarn was found consistently to take up only 70 per cent. of the amount of size taken up by an equally dense American yarn of the same counts. Over a wider range of samples extending from an Indian cotton of hair weight 266 units to Egyptian of hair weight 157, the sizing capacity varied in a nearly linear fashion from 123 to 70 (Texas being taken as 100).

iv.—The Effect of Changing the Concentration of the Size

It is of course well known that concentrated paste is a more effective sizing material than is a dilute mixture. This is now shown to arise not only from the obviously superior weighting capacity of the former, but also from the fact that so long as one kind of starch and mode of preparation is considered, a concentrated paste is taken up in larger volume than one more dilute.

v.—The Viscosity of Size

The viscosity of a liquid is a measure of the force required to maintain it in steady motion, high viscosity being manifested by a slow rate of flow through narrow tubes. It is well known that the viscosity of size is greater, that is, it flows less readily, the more concentrated it is. The amount of sizing paste picked up by yarn is dependent primarily, not on the concentration, but on the viscosity of the size. Thus a 36's Egyptian yarn was found in different experiments to carry the amounts of size shown in Table I.

Table I.

No.	Starch	Concentration	Amount of Size (Paste) on Yarn (per cent.)	Apparent Viscosity.	Dry Size on Yarn (per cent.)
190	Maize	4·2	67	0·15	2·6
192	Maize	6·1	134	0·46	8·2
195	Farina	5·2	178	1·41	9·2

The table shows that farina pastes are more freely taken up by yarn than are maize sizes, a fact which can only be attributed to the higher viscosity of farina compared with maize pastes of equal concentration. In this example the highly viscous farina size is taken up in such large quantity that in spite of its lower concentration it weights the yarn more heavily than the more concentrated maize size. When, however, one type of starch alone is employed, and size is prepared and used in a standard manner, concentration serves as a rough measure of viscosity, and the loading of the yarn with paste follows the order of concentration, as is noted in the previous section.

vi.—The Appearance of Sections of Sized Yarn

If sections of sized cotton yarn are stained with iodine and viewed with suitable illumination under the microscope, it is sometimes possible to see that the size has only advanced a limited distance into the yarn, leaving an unwetted core of cotton free from size. This unsized area is generally small and irregularly distributed in yarn which has been dried by passage round hot cylinders, but yarn which is collected, without drying, immediately it leaves the sizing rollers, often carries its size in a well-defined cylindrical zone upon its surface. In sections of such material the average area which is free from size is readily measurable and is characteristic of the method of sizing and of the yarn. It appears that size originally laid down on the surface, migrates inwards when the yarn is dried over hot cylinders in the usual way, but when it is collected wet the yarn rapidly cools and the size on it becomes too viscous to move far from its original situation. The fact that size is generally laid down in the first place on the surface of the yarn explains why fine yarns are more heavily sized than coarse.

The rapidly cooled and air-dried yarns yield sections in which the margin of the starch zone is more definite than in others, and for this reason material collected wet has been used in examining the influence of mechanical conditions on the penetration of size into yarn.

vii.—Speed of the Machine

From 5% to 10% more size is taken up when the speed of the machine is increased from a delivery rate of 55 yards to 75 yards a minute. A further acceleration to 100 yards a minute has very little additional effect on the weight of size taken up, but the penetration of size into the yarn is decreased continuously as the machine is run faster.

viii.—The Nature of the Surface and the Pressure of the Sizing Roller

If yarn is immersed in size, withdrawn without having been subjected to any pressure, and allowed to drain, it retains a heavy coating of starch which does not enter the yarn to any appreciable extent (Plate II., G and H). One passage through the squeezing rollers is sufficient to remove a large proportion of this coating, the major part being returned to the size box over the surface of the copper roller, and some penetrating a certain distance into the yarn (Plate II., E and F). Two stages of immersion and squeezing following each other in rapid succession have little more effect on the total amount of size carried, but cause increased penetration.

The fabric used to cover the upper sizing roller has an important influence on the sizing, a coarse flannel surface allowing the size to be taken up most freely, followed in order by fine flannel, by the latter covered by a cotton fent, and finally by coarse flannel similarly covered. If the roller is loaded so as to double its pressure the amount of size applied is reduced while the penetration increases, while three times the normal pressure has little more effect on sizing than twice, though the penetration is continuously increased.

ix.—The Mechanism of Sizing

The foregoing observations enable a conception to be formed of the method of interaction of size and yarn during the short passage of the latter through the size box and under the squeezing roller. The yarn entering the size box drags with it a sheath of size which is the more voluminous the higher the viscosity of the paste. On meeting the squeezing roller much of the paste so carried is forced off the yarn, the amount displaced being less, and the sizing in consequence heavier, the more viscous the size, the softer the covering of the roller, the less the pressure, or the less the time available—as determined by the speed of the machine—for this flow to occur. Immediate repetition of the sizing and squeezing has no great effect on the quantity of size on the yarn, since a sheath similar to the original one is reformed at the second entry of the yarn into the size, and has to be dispersed afresh.

Penetration into the yarn is determined by physical conditions which control flow, being increased by heavy pressure, by repetition of squeezing, or by prolonged pressure such as is experienced when the machine runs slowly, these conclusions being similar to those arrived at in the earlier work on the wetting of yarn by starch pastes[4].

Presumably the viscosity of the size affects penetration, but it has not been possible to obtain conclusive evidence on this point and the subject is still under investigation. With constant sizing conditions the amount of size taken up by a yarn is dependent on the nature and extent of its surface; but the final distribution is controlled to some extent by the method of drying, so that normally a sample of yarn from a dried warp bears little evidence of surface sizing.

EXPERIMENTAL

The Laboratory Tape Frame

The machine consists essentially of a size box, a pair of sizing rollers, and two drying cylinders all slung in a heavy iron frame which supports, in addition, the necessary gearing interposed between a line shaft and the rollers. The sow-box is of tinned iron and is heated by means of a double jacket in which water is kept boiling by live steam. Provision is also made for heating the size by a jet of steam led from a carefully trapped supply. The dimensions and shape of the box are shown in Fig. 1.

The sizing rollers are six inches in diameter in accordance with industrial practice. The lower or copper roller (6″ long) is driven, while the upper roller (7″ long) is of iron and is supported with its axis vertically above that of the lower on two ball bearings which are free to rise and fall. The copper roller runs half immersed and carries a continuous supply of size up to the sizing roller at any of the speeds used in these experiments. The cylindrical faces of the drying cylinders are of heavy tinned sheet iron and their construction enables them to be used with steam at an excess pressure of 20 lb. per square inch when required. The axis of one of the cylinders has been tilted so that yarn passing round it is deviated to one side to an extent dependent on the tilt, entering on its next journey round the other cylinder at a definite and controllable distance from its previous course. This arrangement enables a ribbon of yarn to be carried in perfect order six or seven times round these one-foot cylinders, and so to be dried as efficiently as it is by the usual single traverse of a pair of cylinders several feet in diameter. One of the cylinders is rotated by means of a chain from the countershaft, the other being driven by a webbing band running round the pair.* In order to ensure that yarn shall be delivered by the sizing rollers at the correct speed, the drive to these is by a rope from an adjustable pulley on the countershaft, while variations of the speed of the machine as a whole are suitably provided for.

During an experiment the ends of yarn to be sized are led individually from suitably-placed ring bobbins or knitting cones (see Fig. 1) to a comb immersed in the size and from this to the copper roller, and after being squeezed, proceed as a ribbon round the drying cylinders. They are finally collected separately on a swift which is driven by light friction from a pulley on one of the shafts.

Preparation and Use of Size

The size beck is a 40-gallon cask filled with an open boiling pipe fed with steam at 15 lb. pressure, running round its base, and is efficiently stirred by a central vertical shaft to which are bolted in corkscrew fashion stout oak dashers.

The starch used in the experiments under review was usually maize, which will stand a great deal of boiling, being rather less liable than other starches to fall off in viscosity when stored. A small quantity of tallow was generally used with a view to preventing the sticking of size to the drying cylinders, though the addition was not always effective. The method of

* The machine has lately been converted so that both cylinders are driven by a common chain.

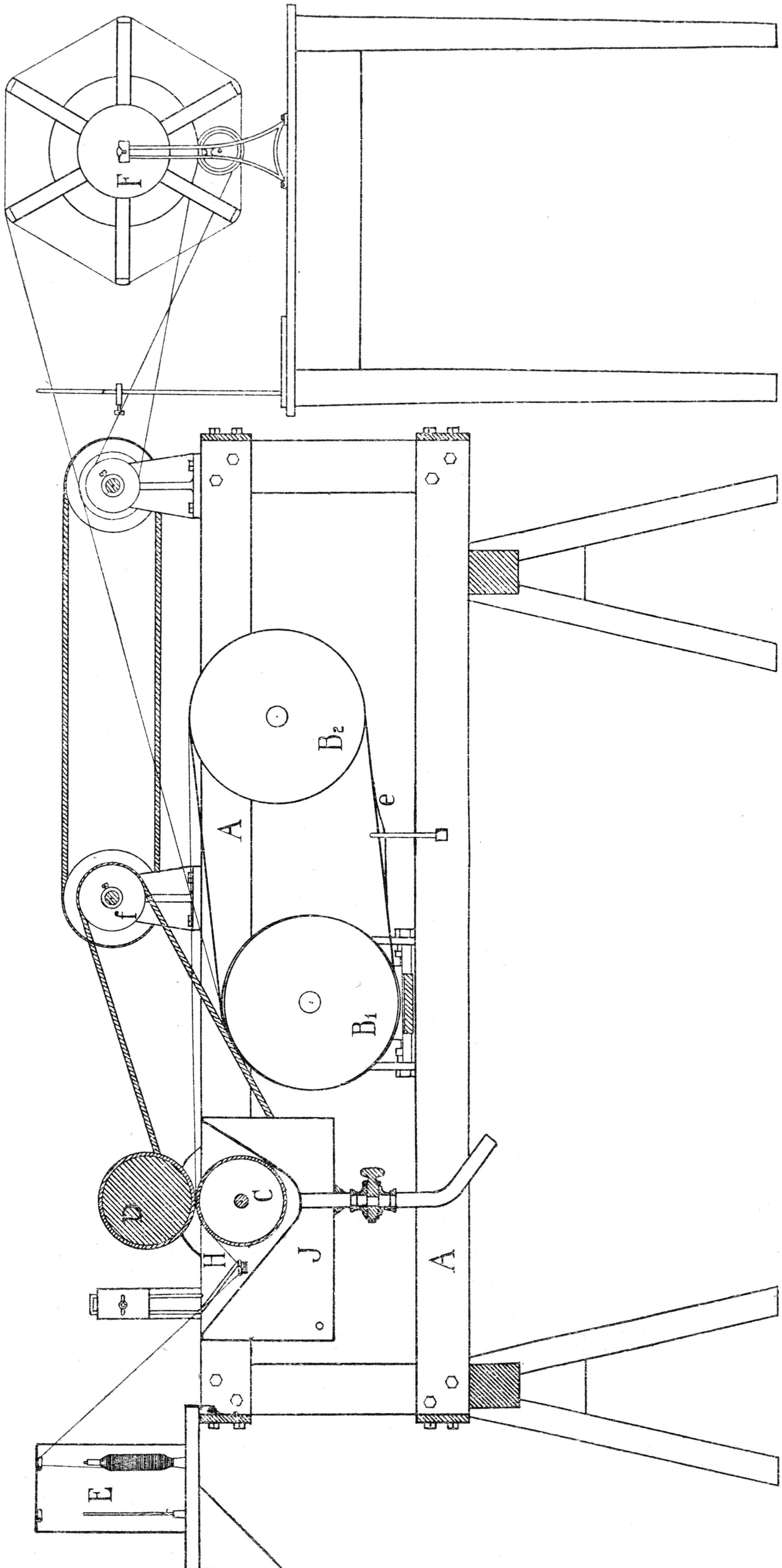


Fig. 1—Experimental Tape Frame. (*a*) Elevation

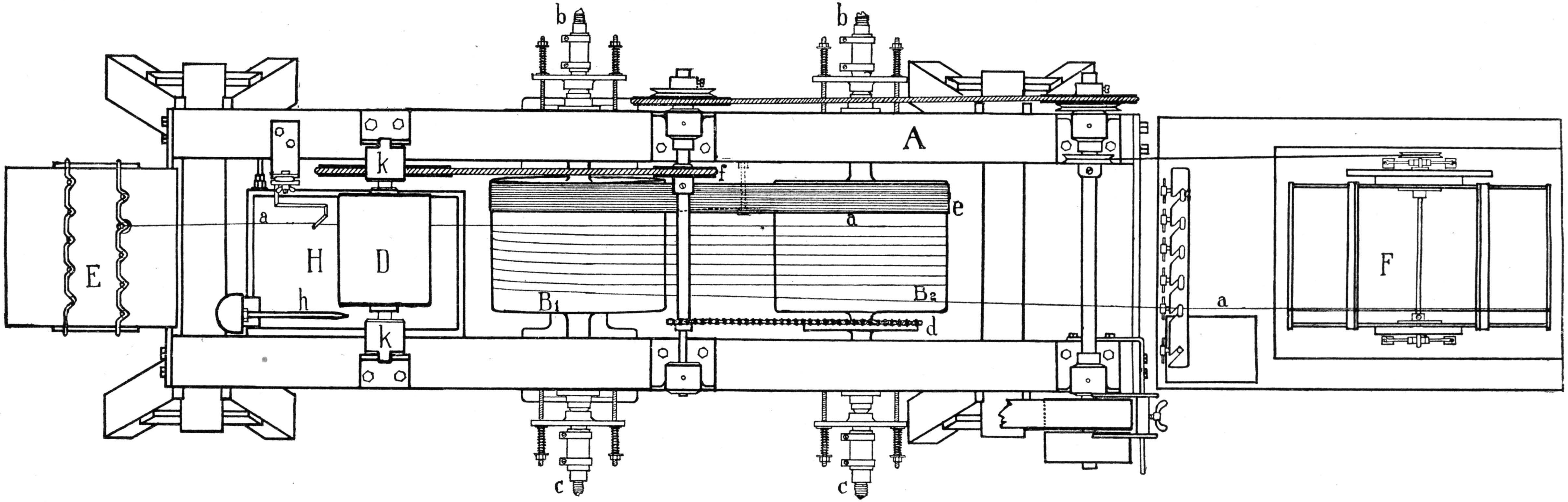


FIG. 1—EXPERIMENTAL TAPE FRAME. (*b*) PLAN.

A—Frame. B1—Tilted drying cylinder. B2—Horizontal drying cylinder. C—Copper roller. D—Floating squeezing roller. E—Yarn rack. F—Collecting swift. H—Size box. J—Water jacket. a.a.—Path of yarn. b.b.—Steam inlet to drying cylinders. c.c.—Steam outlet from drying cylinders. d—Chain drive. e—Webbing band. f—Adjustable pulley. h—Live steam supply to sow box. k.k.—Ball bearing housings.

preparation was to throw the starch into cold water and disperse it by rapidly moving the dashers by hand before any steam was admitted. The violent hand stirring was maintained during the early stages of heating until the temperature had risen sufficiently to produce some swelling of the starch, and in this way perfectly smooth size free from lumps was regularly prepared. The size was usually boiled for four hours before use, and during this time it was mechanically stirred, the dashers rotating fifteen times a minute.

During sizing, the mixture was allowed to flow continuously from the beck to the sow box, the excess being drawn off from the latter by a valve underneath it. The motion of the sizing rollers caused very efficient stirring in the size box, and this was usually assisted by the action of the steam jet employed for heating the size. Before any yarn was collected the machine was allowed to run for about 15 minutes with size in the box in order to heat the sizing rollers and to permit the covering of the squeezing roller to become soft and permeated with size. The roller covering in the earlier experiments usually consisted of a number of layers of sizing flannel covered by a cotton fent, but later seamless flannel of two grades was employed, and the sizing roller was duplicated so that a rapid and accurate comparison could be made of the effect of changing the roller covering.

In spite of the use of tallow in the size, it was found impossible to avoid a small amount of fouling of the first drying cylinder by paste sticking to it. It is believed that this behaviour is inseparable from the use of a machine which causes yarn while still wet to be pulled away from the surface of the cylinder. On a large machine the size on the side of the yarn in contact with the first cylinder is probably dry by the time it leaves this surface for the other, and, whatever its relationship to the yarn, it will come clearly away from the polished metal, as starch films are found to do in the laboratory.[6] On the small machine, with its step by step drying, it is impossible in the first stage to get rid of sufficient water to enable a clean separation to be made, and the wet yarn breaks away from a thin film of liquid adhering to the cylinder.

In comparing the sizing capacities of different yarns the various specimens were preferably arranged together, run through the size box side by side, and dried and collected simultaneously, thus ensuring that all had had identical treatment. Sometimes this was impossible, and small homogeneous batches consisting of a few ends of the different sorts were sized in rapid succession, care being always taken to see that differences in sizing were not produced merely by changes in the size arising through lapse of time.

Expression of Results

The samples of sized yarn were analysed for total dry size, and portions of size removed from the box from time to time were evaporated and their content of dry solids ascertained. From the data so obtained for the composition of the sized yarn and of the size, there could be calculated the more interesting figure for the percentage of liquid size which was taken up by the raw yarn. For example, a 20's American yarn was sized with a mixture containing 6% of solids. By analysis it was found that the amount of solid matter put on the dry yarn was 6·72%. It is clear that the yarn carried from the size box $6{\cdot}72 \div 6$ times its own weight, or 112%, of paste, and it is the corresponding quantity which is used in the tables in which the results of the experiments are recorded.

The Effect of Twist on Sizing

The first batch of yarn used for this work consisted of eight specimens of 16's yarn, four from American cotton and four Indian, spun to different twists. It was desired to find some physical property of the material which might be related to sizing capacity, and the diameters were therefore measured in the manner already described.[4] The counts differed slightly, and as this variation would obviously affect the diameter the number chosen for expressing the compactness was the apparent specific volume, or the space in cubic centimetres occupied by one gram of yarn. The calculation is as follows—

Length of unit weight=counts (N).

Weight of unit length$=1/N$.

Volume of unit length$=\pi r^2=\pi D^2/4$ (D=diameter).

whence the specific volume V (the volume of unit weight)$=\pi D^2/4 \div 1/N = N\pi D^2/4$. If the counts are expressed in the usual way, and the diameters measured in centimetres, the specific volume is given as cubic centimetres occupied by a gram of yarn, by the formula

$$V=133\ ND^2.$$

Details of the physical properties of these eight yarns are given in Table II., which shows the ascertained counts, the twist, and the spinning constant K derived from these by the ordinary rule (K = turns per inch $\div\sqrt{\text{counts}}$). The specific volume is calculated in the manner just described, while the succeeding columns record the percentage weight of sizing paste taken up in a set of experiments in which the eight yarns were sized as nearly as possible under the same conditions. In these tests a certain amount of empirical interpolation to the same time of sizing has been done in order to enable comparative figures to be given, and the results of each test have been brought to a common basis by taking the sizing capacity of one yarn as 100, and reducing the other values in proportion, the means of the reduced percentages being given in the final column. The mean values are plotted against the spinning constants in Fig. 2, in which the specific volumes are shown also, separate curves being drawn for the American and the Indian

Table II.

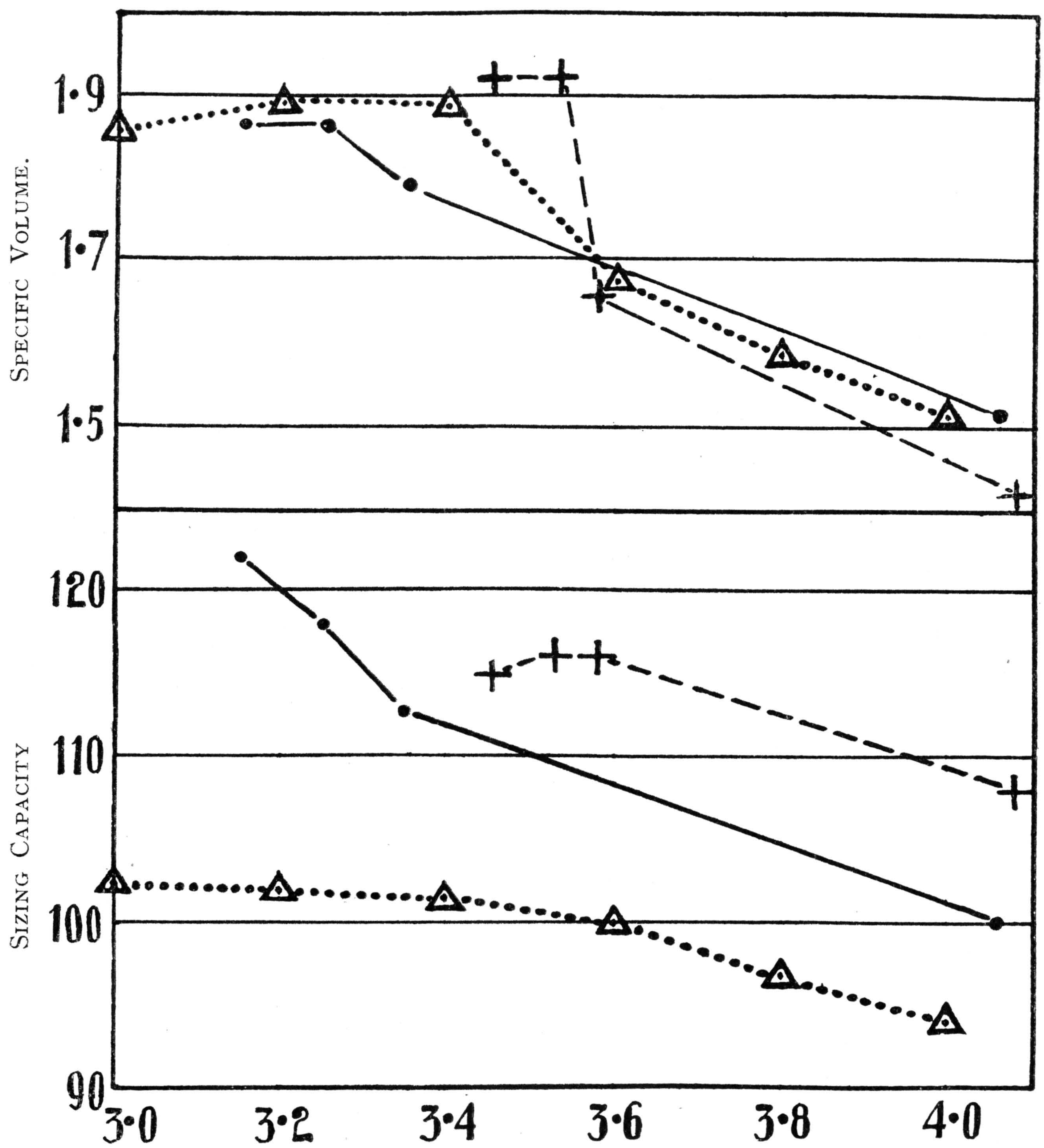
Twist of Yarn and Absorption of Size

Cotton	Counts	Turns per inch	K	Specific Volume	Percentage of Sizing Paste taken up						Mean *
American...	15·5	12·4	3·15	1·87	242	162	—	—	—	—	122
,, ...	16·5	13·2	3·25	1·87	247	150	180	206	—	153	118
,, ...	16·2	13·5	3·35	1·79	222	135	188	227	—	136	113
,, ...	15·3	15·9	4·06	1·51	201	130	172	192	157	111	100
Indian ...	15·5	13·6	3·45	1·92	221	162	—	—	—	128	115
,, ...	15·7	14·0	3·53	1·92	222	165	—	—	157	138	116
,, ...	15·7	14·2	3·58	1·67	226	172	178	212	161	146	116
,, ...	15·5	16·0	4·06	1·42	230	145	—	—	149	125	108
Concentration of Size % ...					7·2	6·7	9·5	5·1	5·0	4·0	
Experiment No.					127	137	141B	141D	141E	142	

* Mean in terms of the fourth American yarn as a standard.

yarns. It is clear that if this were not done the graphs would give a very confused picture of the relationship between twist and either compactness or sizing capacity.

Treated separately it appears that both for American and Indian yarns the specific volume is insensitive to twist of low value, but decreases to a marked degree as higher twists are employed. The sizing of the Indian yarn is not affected to any great extent by the rather small range of twist examined, but with the four American yarns a continuous reduction in the amount of size taken up is recorded when the spinning constant is increased from about 3·2 to 4·0.



•American 16's. +Indian 16's ΔEgyptian 20's.

Fig. 2

A second test was made on some specially spun Egyptian yarn where the spinning constant was varied by equal stages from 3 to 4. The sizing and other measurements are given in Table III. and curves representing the mean behaviour in Fig. 2.

Table III.

Twist of Yarn and Absorption of Size (Egyptian Yarn)

Turns per inch	*K*	Specific Volume	Percentage of Sizing Paste taken up					
13·4	3·0	1·86	160	—	—	182	—	105
14·3	3·2	1·89	157	162	—	182	—	104
15·2	3·4	1·89	155	159	163	182	180	103
16·1	3·6	1·68	153	156	160	172	172	100
17·0	3·8	1·58	141	148	160	—	170	97
17·9	4·0	1·51	137	152	142	—	170	94
Concentration of Size %			5·6	6·5	3·7	3·9	3·9	—
Experiment No.			164	165	166A	166B	166C	Mean †

† Expressed as a percentage of the amount of size on the fourth specimen.

The sizing curve is less steep than with the coarser yarns, while the volume curve has the same characteristic change of slope as is found with the other cottons. The correspondence in shape between the sizing and the volume curves is very good, and it is evident that specific volume measures some property which is closely connected with the sizing capacity of the yarn. A third example of similar change of sizing capacity with twist is given by some measurements made for another purpose on 40's yarn of two sorts (Table IV.) the actual quantities of size taken up being shown.

Table IV.

Penetration of Size into Yarns of Different Twist

No. 218—Farina size, boiled 20 hours, thin, 7% concentration.	Pressure	Percentage of Size (Paste)					Fraction of Section free from Size				
		40's Sakel turns			40's Tanguis		40's Sakel			40's Tanguis	
		16	20	24	20	25	16	20	24	20	25
Roller covered with 3 layers of flannel, no fent.	1	158	143	131	158	139	·03	·11	·16	·04	·21
	2	150	137	133	147	141	·01	·02	·07	·01	·01
	3	140	127	122	138	130	·00	·00	·00	·00	00

Sizing Yarn of Different Counts

The first experiments on this question were done on six American yarns spun from the same mixing, ranging from 8's to 36's, and on one very regular Egyptian yarn also nominally 36's. The specific volume of these was measured as already described and the figures are given in Table V. Taking the American yarns only it is seen that there is a general drift of volume downwards as the spinning constant increases, but the relationship is irregular and it is impossible to come to any conclusion with regard to the different effect of twist on the compactness of fine and of coarse yarns. The set must be accepted for sizing as it stands, being taken as typical of a range of yarns of different counts spun from the same mixing. A striking feature of the table is that the Egyptian yarn though spun with a much lower twist is of about the same density as the American 36's.

These seven yarns were sized together in a large number of experiments conducted in different ways, and apart from minor irregularities, fine yarns in the American series are more heavily sized than coarse. Table V. gives the results of typical systematic experiments, while Table VI. shows comparisons between yarns of different counts sized together in the course of work on other points.

Table V.

Yarns of Differing Counts Sized Together

Experiment No.			120	121	122	123	125	141	191	192	203	Mean*
Counts	*K*	Specific Volume	Percentage of Sizing Paste taken up									
8·28	4·1	1·93	136	111	106	141	148	121	136	158	62	134
11·48	4·3	1·73	147	113	118	136	153	123	145	176	—	144
18·4	4·2	1·60	150	119	128	—	154	127	153	186	73	150
23·6	4·7	1·41	151	123	125	—	163	144	178	199	—	160
28·2	4·35	1·84	176	146	144	170	195	160	164	208	86	175
37·0	4·85	1·65	170	—	134	208	204	164	196	199	—	178
34·3E	3·5	1·55	—	—	—	141	151	—	130	167	53	—
Concentration ...			7·1	5·0	4·8	9·4	7·0	4·9	6·1	8·0	Nil†	

E. Egyptian Yarn. The others are American.

* Mean omitting 121, 123, and 203. † In experiment 203 salt solution was used and the yarn analysed for chloride.

Table VI.

Amounts of Size taken up by Yarn of Differing Counts

No.	Counts of Yarn	Parts of Size	No.	Counts of Yarn	Parts of Size
108	8, 36	95, 118	123	8A, 36A, 36E	141, 208, 149
108	12, 36	86, 92	129	8, 24	139, 160
108	18, 36	75, 79	130	8, 24	117, 128
108	24, 36	78, 73	135	24A, 36E	180, 148
108	28, 36	98, 78	142	36E, 80E	158, 183
109	8, 36	85, 112	142	36E, 60E, 78S.I. 160 S.I.	175, 220, 216, 194
110	36, 60, 80	112, 150, 160	182	36E, 28A	123, 175
111	36, 60, 80	79, 101, 108	184	36E, 28A	126, 173
112	36A, 36E	146, 112			

A=American, E=Egyptian, S.I.=Sea Island.
Unless identified, yarns in the same experiment are from the same type of cotton.

In both tables heavier sizing of fine yarns is the rule so long as one grade of cotton only is considered, but if one of the cottons is finer than the others the amount of size it takes up is low. In the American series the 28's comes very close in sizing capacity to the 36's and it is to be noted that it is spun with a lower twist constant than the other, has an abnormally large diameter and in consequence a high specific volume.

While specific volume is a good general criterion of the compactness of yarns whatever their counts, it is incapable of explaining differences of sizing due to change of fineness. The heavier sizing of fine yarns appears to arise from the greater amount of surface which is developed by unit weight of cotton when it is more highly attenuated.

The specific surface in square centimetres per gram is calculated for the set of American yarns in Table VII., the 36's apparently possessing about twice the surface displayed by the 8's.

Table VII.

Counts Hanks per lb.	N cm. per gram.	W grams (or cc.) of Size per gram of Yarn	W/N cc. Size per cm.	D Diameter	Specific Surface $=\pi DN$
8·3	1380	1·34	$9{\cdot}73\times10^{-4}$	0·042	182
11·5	1915	1·44	$7{\cdot}56\times10^{-4}$	0·034	205
18·4	3070	1·50	$4{\cdot}89\times10^{-4}$	0·026	253
23·6	3938	1·60	$4{\cdot}08\times10^{-4}$	0·021	262
28·2	4705	1·75	$3{\cdot}72\times10^{-4}$	0·022	327
37·0	6070	1·78	$2{\cdot}88\times10^{-4}$	0·018	345

The relative sizing capacities of the two yarns bear a lower ratio to each other than do their surface areas, and a further analysis of the factors which determine their behaviour is desirable.

Let the weight of size on unit length of yarn be W, which will also be assumed to express the volume of paste in cubic centimetres, and the diameter D $(=2r)$. Suppose that in sizing a set of yarns similarly spun from the same cotton but of different counts, the paste penetrates to a distance d below the surface, and finds there a fraction a of the space unoccupied by cotton. Then

$$W=\pi\, a[r^2-(r-d)^2]+\pi[(r+t)^2-r^2],$$

where t is the thickness of the layer of size external to the yarn.

$$\text{i.e., } W=2\pi r(ad+t)+\pi(t^2-ad^2). \qquad (1)$$

If a, d, and t are assumed to be constant for the series of yarns, then W is a linear function of r. To test this the mean figures from Table V. have been used to calculate W for the American yarns, and the resulting values plotted against the radii in Fig. 3. The graph is a good straight line, the equation for which is

$$W=0{\cdot}0568r-2{\cdot}2\times10^{-4}$$

Comparing with equation (1) we get—

$$2\pi\,(ad+t)=0{\cdot}0568$$

$$\text{and } \pi(t^2-ad^2)=-2{\cdot}2\times10^{-4}$$

from which, neglecting negative values of d the following relationship between t, d, and a is found.

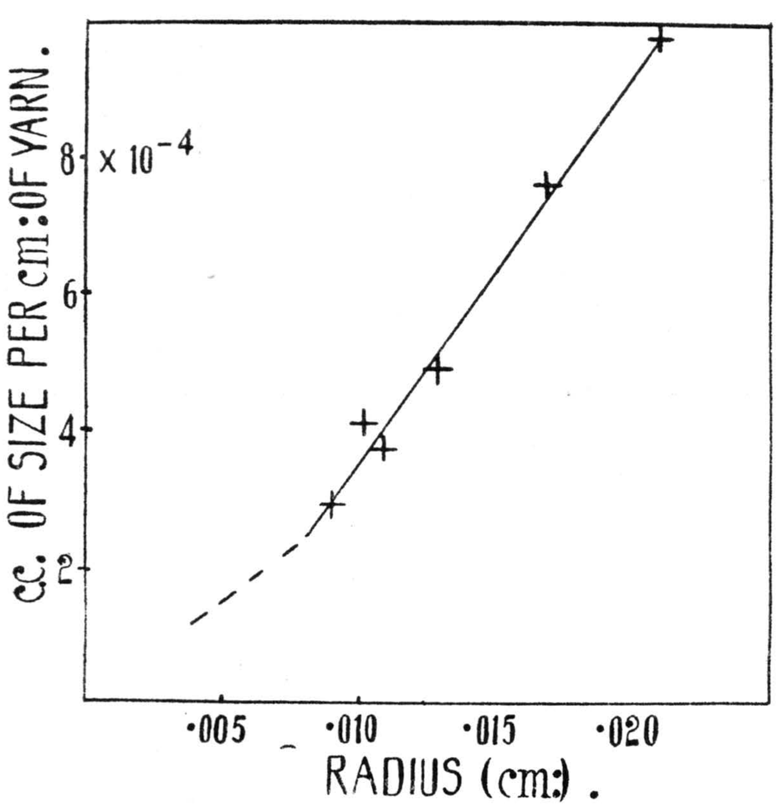


FIG. 3

Table VIII.

a	1	0·8	0·6	0·5	0·4
d (cm. $\times 10^{-2}$)	·84	·94	1·12	1·26	1·44
t (cm. $\times 10^{-2}$)	·06	·15	·23	·27	·32

On the assumptions made in deducing equation (1) it is impossible for the graph to continue as a straight line down to very small values of r, since once the penetration is equivalent to the radius of the yarn the rd and d^2 terms behave physically as r^2 and the graph turns towards the origin. From the position of the plotted points it appears that this condition is not reached in the finest of the yarns, and in consequence d cannot exceed $0{\cdot}9\times10^{-2}$ cm. This implies that a, the coefficient of porosity, lies between 0·8 and unity, an improbable value since in the 36's yarn, for example, the space apparently occupied by a gram of yarn is 1·65 cc., of which 0·63 is filled by cotton cellulose[2] giving a maximum value of the coefficient of porosity as 0·61. The explanation of the discrepancy is probably that the measurement of diameter assigns the surface of the yarn to an ill-defined region within which the porosity is decreasing, the packing of the cotton becoming denser, for an appreciable distance. The scope for calculations of this type is at present limited, since neither the assumptions on which they are based, nor the data employed are very exact, but it is believed that they give none the less a qualitative account of the manner in which the amount of size carried by a yarn is determined by its surface, and indicate directions in which sizing can be affected by the physical conditions under which it is conducted.

The Relation of Lint Characteristics to the Sizing Capacity of Yarn

A noticeable feature of Tables V. and VI. is the regularity with which the 36's Egyptian yarn is less heavily sized than the finer American yarns. The Egyptian lint is also apparently more readily compressed by twist than the American, since the yarns are equally compact, though they have been spun with factors of 3·5 and 4·85 respectively. This question was further examined by sizing together in a series of very regular experiments yarns of about 36's counts spun from cottons ranging from Sakel to a coarse staple Indian. The physical properties of the unsized yarns and the weights of unit lengths of the hairs of each variety, were measured in the usual way, and these data, and the sizing results, are given in Tables IX., X., and XI.

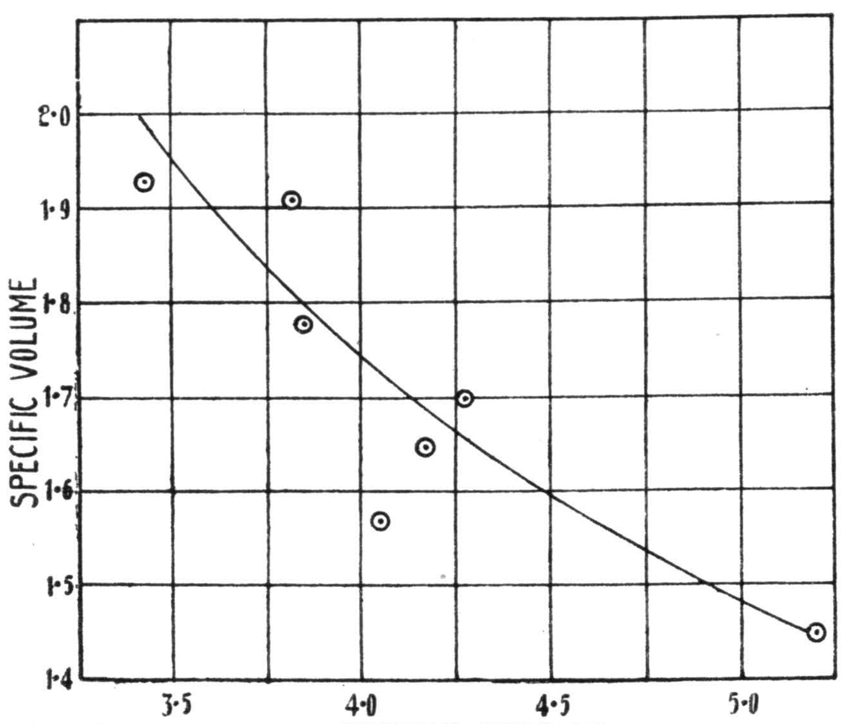


FIG. 4

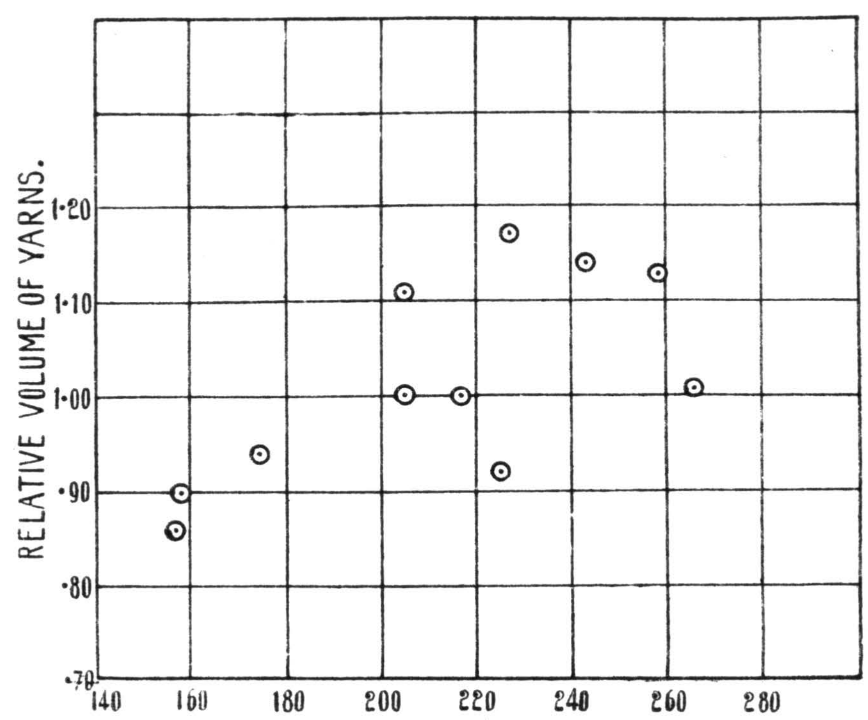


FIG. 5

The cottons available may be divided into a normal set, nominally Texas, with hair weights ranging from 205 to 234 units, and a more divergent remainder of "extreme" cottons whose hair weights exceed or are less than these values. The variables which have to be dealt with are hair properties, and counts, twist, diameter, and sizing capacity of yarns. The small variation of counts may be neglected if allowance is made for its effect on diameter by calculating specific volume, and the question can be treated as two independent problems dealing in the first place with twist, hair-weight, and specific volume, and secondly with twist, hair-weight and sizing capacity.

For the former question the Texas yarns are treated as being of constant hair weight and a graph plotted showing how their specific volume is related to the twist. The curve which is drawn by inspection (Fig. 4) for this relationship is used as a basis for comparing the specific volumes of the "extreme" cottons with those of equally twisted Texas yarns, and a series of ratios showing the specific volume of any yarn in terms of Texas as unity is obtained (Table X., column 7), the graph of these (Fig. 5) showing that in a general way the coarse staple cottons are less readily compressed than the fine.

Table IX. Spinning Constant, Specific Volume and Weight of Size for Texas Yarns

No.	Counts	Hair Wt. Milligrams $\times 10^{-5}$	Spinning Constant	Specific Volume	% Size
Y81	38's	229	3·43	1·93	183
71	36's	217	3·82	1·91	177
70	38's	234	3·85	1·78	163
72	34's	217	4·05	1·57	147
73	38's	217	4·17	1·65	148
80	38's	221	4·27	1·70	144
75	36's	205	5·20	1·44	133

Table X.

Relative Compactness of Yarns Spun from Cottons of Different Hair Weights

1 No.	2 Counts	3 Hair wt. Mgms. × 10^{-5}	4 K Spinning Constant	5 Specific Volume	6 Sp. Vol. of Texas Yarn of equal K	7 Relative Compactness Ratio Col. 5÷Col. 6
Y0	36's	157	3·58	1·64	1·92	·86
82	36's	158	3·89	1·60	1·78	·90
83	36's	175	3·86	1·68	1·80	·94
76	36's	205	3·80	2·03	1·82	1·11
77	36's	225	3·96	1·62	1·76	·92
18	36's	227	4·80	1·79	1·53	1·17
79	36's	243	4·79	1·74	1·53	1·14
67	34's	259	5·15	1·64	1·45	1·13
46	34's	266	4·76	1·55	1·54	1·01

The coefficient of correlation between hair weight and relative compactness $= +0{\cdot}71$.

By a more exact treatment by the method of partial correlation using the data of Tables IX. and X. together, the coefficient of correlation between hair weight and specific volume is given as $+0{\cdot}57$.

Table XI.

Relative Sizing Capacity of Yarns Spun from Cottons of Different Hair Weights

1 No.	2 Counts	3 Hair Wt. Mgms. × 10^{-5}	4 K Spinning Constant	5 % Size Carried	6 % Size Carried by Texas Yarn of equal K	7 Relative Sizing Capacity Ratio Col. 5÷Col. 6
Y0	36's	157	3·58	125	178	·70
82	36's	158	3·89	113	158	·71
83	36's	175	3·86	124	160	·78
76	36's	205	3·80	159	163	·98
77	36's	225	3·96	143	155	·93
18	36's	227	4·80	151	136	1·11
79	36's	243	4·79	142	136	1·04
67	34's	259	5·15	141	133	1·06
46	34's	266	4·76	167	136	1·23

The coefficient of correlation between hair weight and relative sizing capacity $= +0{\cdot}93$.

More exact treatment, in which no arbitary assumptions are made, changes the above coefficient of correlation to $+0{\cdot}85$.

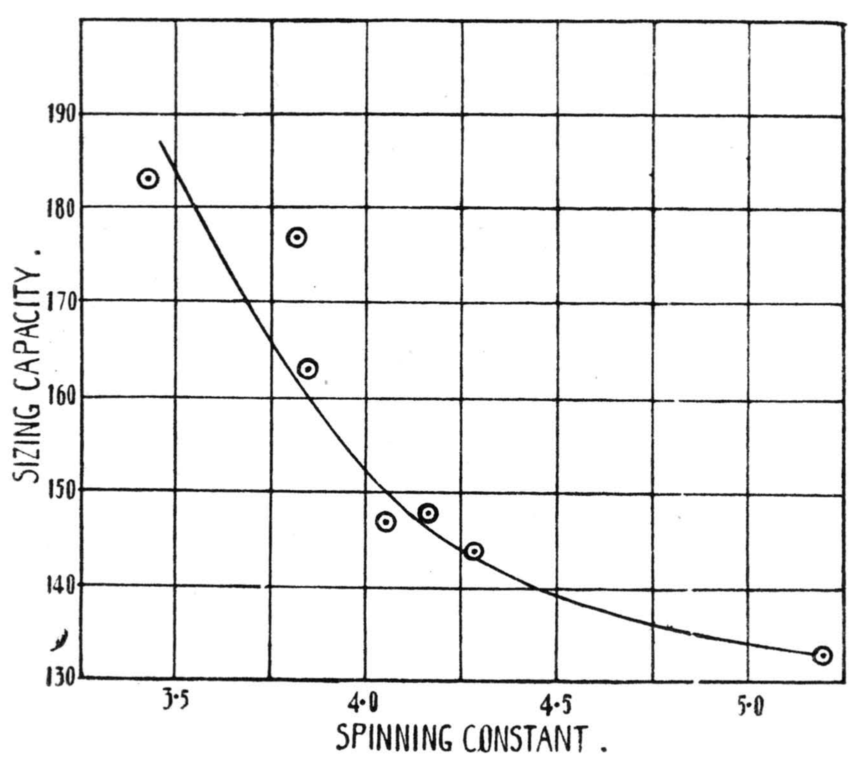


FIG. 6

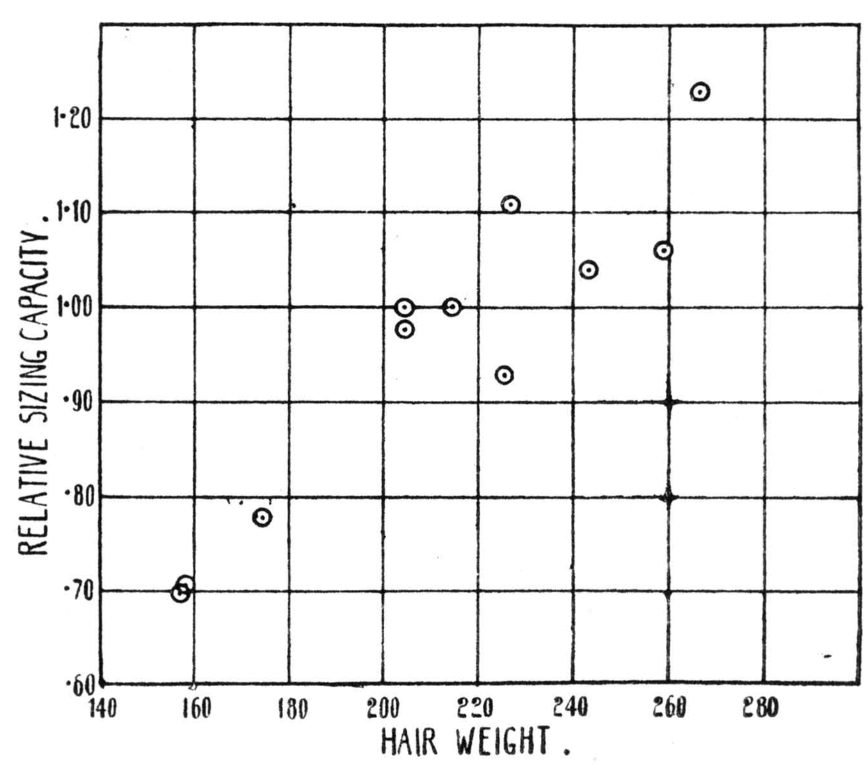


FIG. 7

The sizing figures have been treated in an exactly similar way using the "normal" curve of Fig. 6, and expressing the relative sizing capacities as ratios of the sizing capacities of Texas yarn of equal twists (Table XI., Fig. 7). Since the specific volumes depend on hair weight, and since sizing capacity has been shown to run parallel with specific volume (Fig. 2), it is to be expected that sizing capacity should increase with increase of hair weight. Actually the much higher correlation of Table XI. than that of Table X. suggests that there is a specific connection between fineness of lint and sizing superimposed on that arising indirectly through the compressibility of the yarn. The available data are insufficient to enable a decision to be arrived at on this point, but it may be recalled that the last two yarns of Table V. were equally compact, had much the same specific surface and yet differed widely in sizing capacity in a direction suggesting that the finer Egyptian cotton more effectively obstructed the size than did the American.

Concentration of Size and Weight of Size on Yarn

The standard 36's Egyptian yarn was sized in a series of tests in which the concentration of the size was observed and at the same time the viscosity of a sample of size taken from the sow box during the experiment was measured at 90° C. in a viscometer of the replaceable capillary type.[3] Of the experiments quoted, Nos. 190 to 196 were a homogeneous set, the physical conditions having been kept as constant as possible, whilst the sizes used ranged from very dilute, to pastes as concentrated as the machine could deal with. The results of these tests are given in Table XII., and Figures 8 to 10 express the data graphically.

Table XII.

No.	Starch	Concentration of Size %	Weight on Dry Yarn %	Size Picked up (Paste) %	Apparent Viscosity	Remarks
104	Maize	2·8	2·3	81	0·04	—
105	,,	5·2	5·7	111	0·29	—
107	Farina	5·8	10·0	172	1·10	—
108	Maize	3·6	3·2	87	0·14	—
109	,,	5·0	4·7	93	0·33	—
111	,,	5·7	6·4	112	0·27	—
112	,,	5·7	7·2	127	0·48	—
120	,,	7·1	8·9	125	1·49	—
121	,,	4·6	4·6	102	0·36	—
122	,,	4·6	4·2	93	0·25	—
123	,,	8·8	13·1	149	8·1	Roller Stopped
125	,,	6·8	10·3	150	1·00	—
129	,,	7·0	9·2	132	1·32	—
130	,,	5·6	5·6	100	0·32	—
190	,,	4·2	2·6	67	0·15	—
191	,,	6·1	8·2	134	0·46	—
192	,,	8·0	13·4	167	1·10	—
193	,,	2·2	1·2	53	0·02	—
194	,,	9·7	10·1	104	3·46	Roller Stopped
195	Farina	5·2	9·2	178	1·41	—
196	,,	8·1	11·2	138	1·48	Roller Stopped

These are best examined in the first place from the point of view of the viscosity of the sizes. Fig. 10 shows that the amount of paste on the yarn increases with the viscosity, passes through a maximum and then decreases in an irregular way. The decrease of sizing at high viscosity is definitely connected for the points marked "S," with the fact that the upper sizing roller was slowed down or stopped by the most concentrated sizes, and it is not unreasonable to suppose that the two other points which lie off the curve were similarly affected, since no great attention was paid to the speed of the roller in the earlier work.

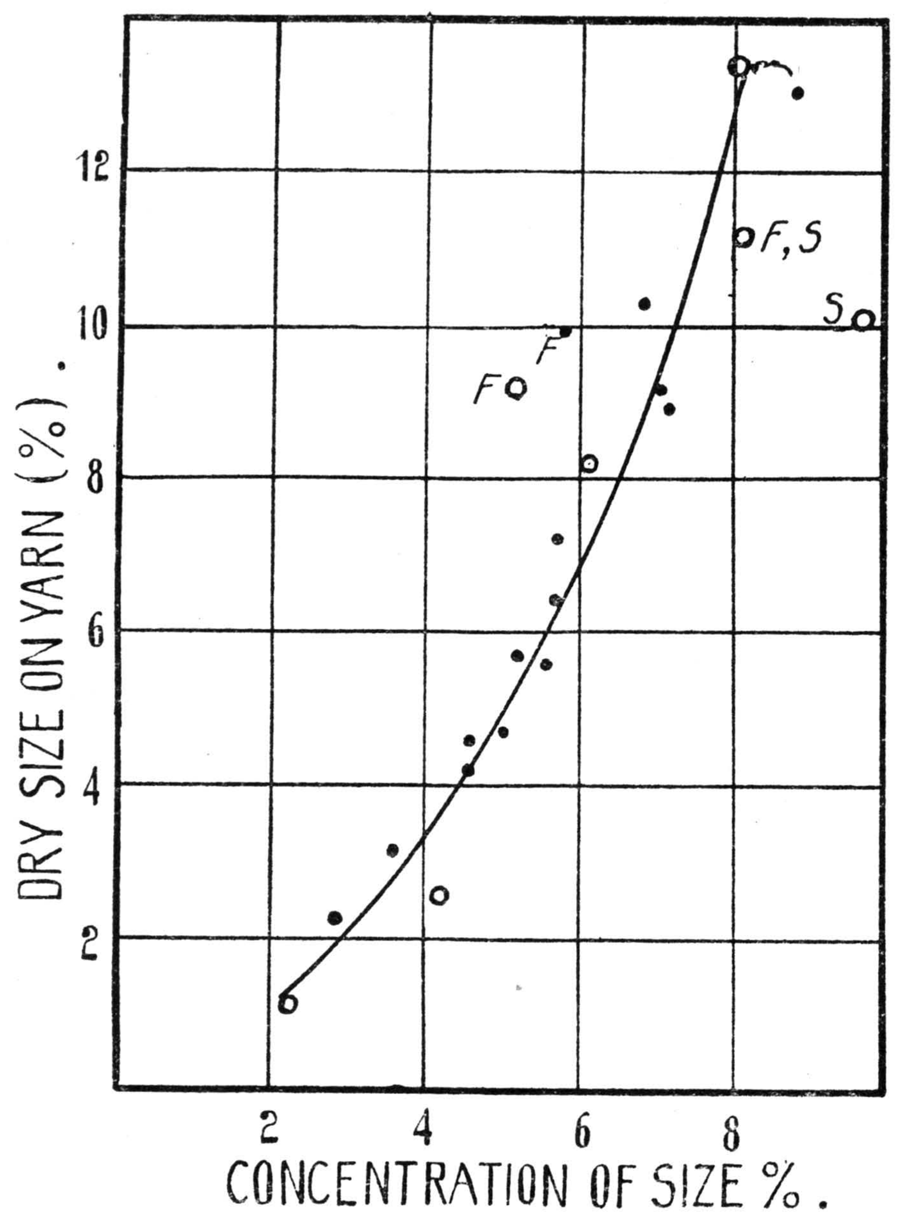


FIG. 8

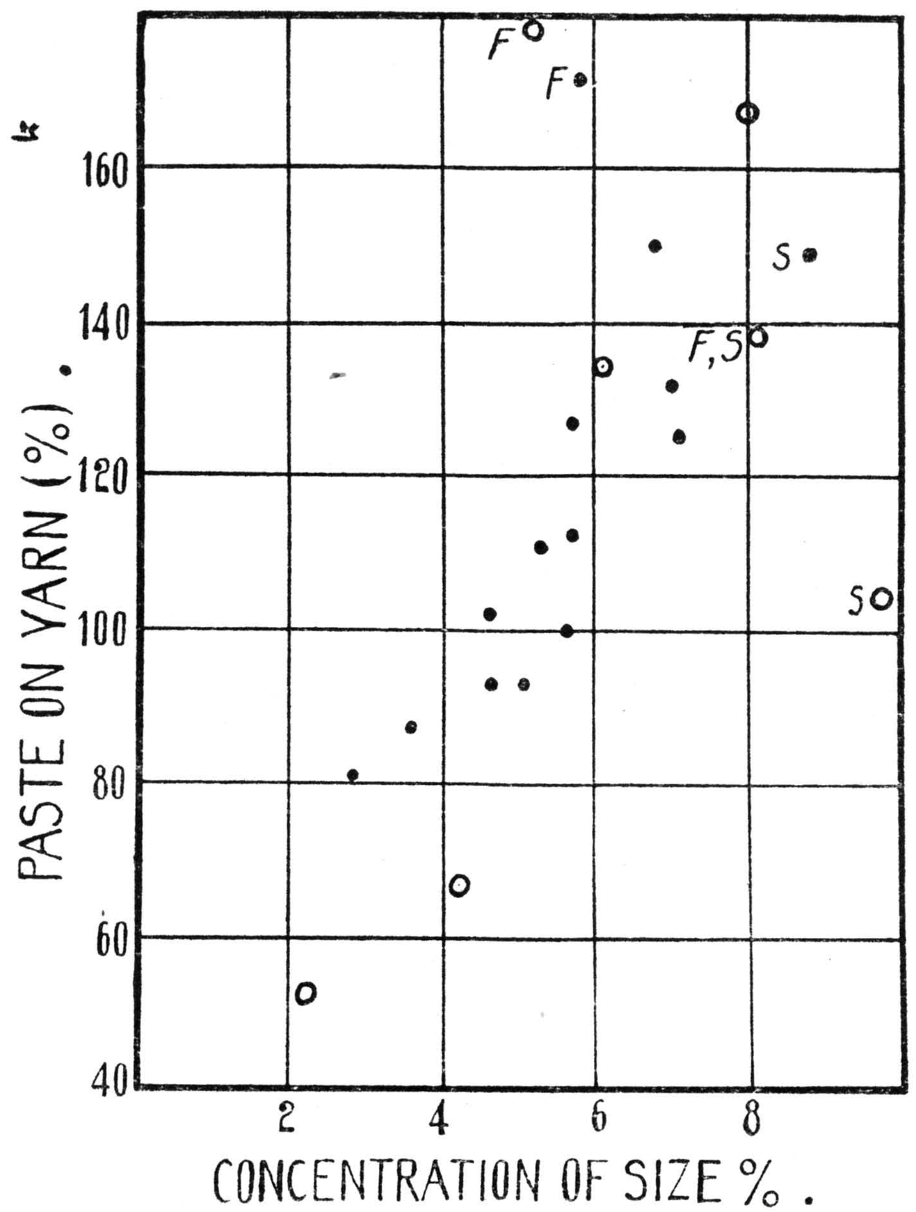


FIG. 9

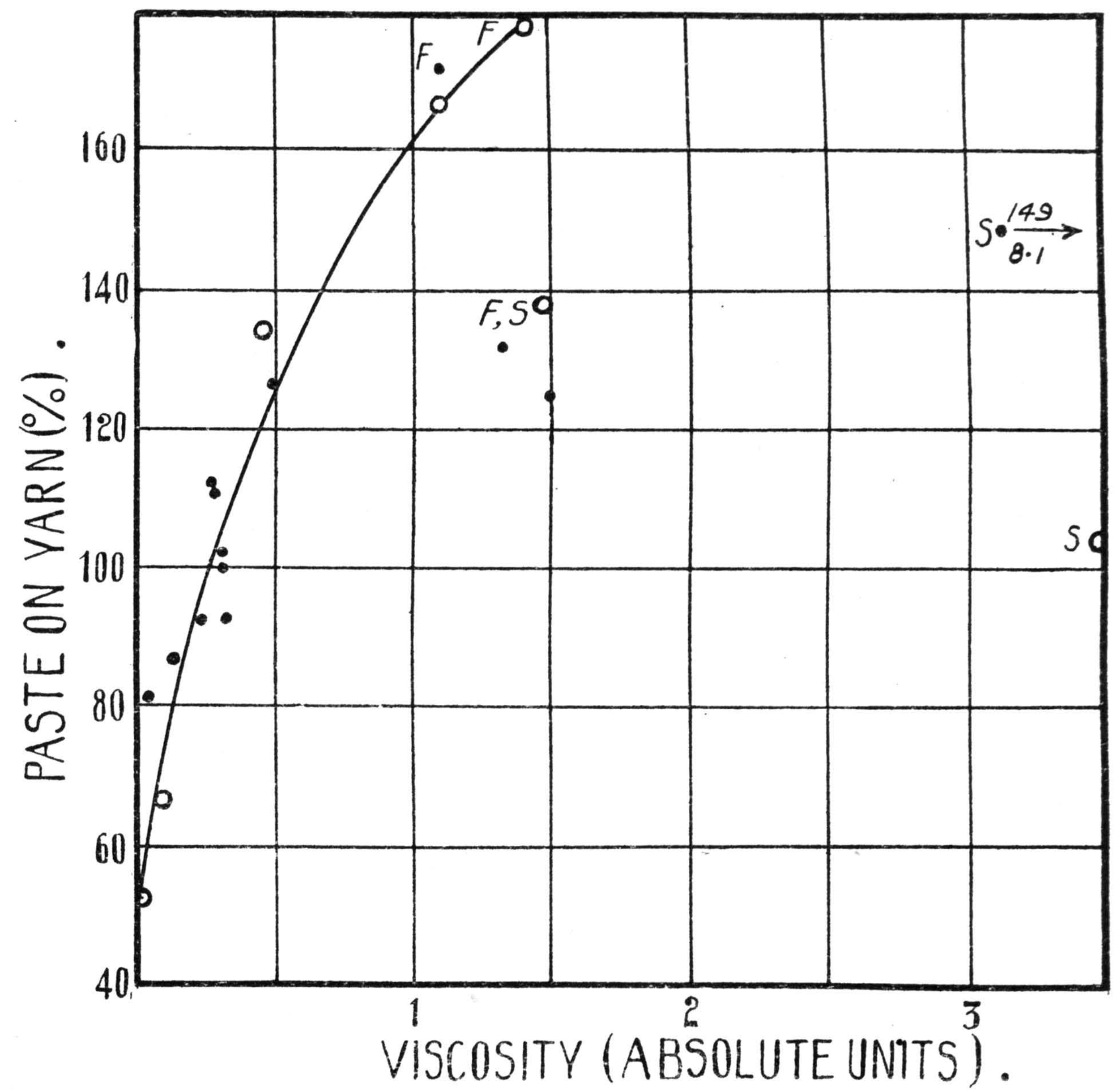


FIG. 10

Experiments 190 to 196, ◎   Farina Pastes—F.   Roller Stopped—S.

On the rising curve the connection between viscosity and sizing appears to be the same whether farina or maize starch was used, but the farina points lie at the high viscosity end of the curve only, since it is a characteristic of farina that for equal concentration pastes made from it are more viscous than those from maize. Owing to the fact that relatively low concentrations of farina give pastes of high viscosity, which are in consequence picked up freely, it follows that yarn takes up a greater amount of farina size than it does of an equally concentrated preparation of maize. For this reason the points for farina, marked "F" in Fig. 9, which fell normally on the viscosity graph now lie high off the curve connecting the sizing power of maize pastes with their concentration.

The weighting capacity of any paste is obviously the product of the amount of size which is taken by the yarn, into its concentration, and in consequence the graph of dry solids on yarn against concentration (Fig. 8) is smoother than the corresponding graph for paste on yarn. Whatever the functional relationship between the latter quantity and concentration, the amount of dry weight on the yarn depends on concentration to a higher degree, and the variation of weighting with change of concentration is necessarily more pronounced the higher the concentration. Evidence of this is to be seen in Fig. 8, where the graph for maize starch is convex to the concentration axis.

The Appearance of Sections of Sized Yarn

In the preparation of sections of sized yarn the embedding material used was gelatin which was subsequently hardened in alcoholic formaldehyde.[1] The finished sections were stained with iodine in dilute alcoholic solution, the starch being coloured a deep blue, while the cotton remained white. They were mounted in terpineol and were usually viewed with the aid of a Watson 2/3 Holoscopic objective, a No. 7 Holoscopic eyepiece, and a Holoscopic immersion condenser used dry at full aperture. With this arrangement, it is possible, if the condenser is in focus, to see that in some sections the size has only penetrated to a limited extent into the yarn, leaving the centre of the section unsized (Plate II., E.), and consequently unstained. If the condenser is thrown out of focus the sharp margin of the size becomes less clearly defined owing to the appearance of shadows among the unstained cotton hairs in the centre of the section. In order to get the best results, with the stained starch sharply defined in an otherwise featureless field, it is necessary for the illuminant to be critically focussed, and for the cone of light to have an aperture considerably wider than that corresponding to the N.A. of the objective. Under such conditions, unstained ends of cotton yarn appear as faint white patches in the yellowish gelatin. Some unsized threads were always included in the bundle of yarn prepared for sectioning in order to provide a criterion by which the significance of faint markings in the interior of the sized sections might be judged. A trace of one of these "blank" ends is visible in the bottom right-hand corner of B (Plate I.).

The existence of surface sizing was noted at an early stage of this investigation, but for a long time its occurrence was capricious and no generalisation could be made as to the conditions under which it arose. Later it was found that sharply-defined surface sizing could almost always be detected in yarn which had not been dried by heat but had merely passed direct from the sizing rollers to the collecting swift, drying slowly at room temperature. It appears that in drying on the cylinders the margin of the size becomes broken up and further irregular advance to the centre of the yarn occurs. This is illustrated by photographs A and B of Plate I., the former showing yarn which has been collected wet, with fairly well displayed unsized patches, the latter being irregular both internally and externally owing to the redistribution of size during passage of the yarn round the drying cylinders.

The appearance of yarn which has been collected wet is typically shown in E and F of Plate II., which contain respectively sections of twenty-two ends of 36's Egyptian, and eleven ends of 12's American. The black bands surrounding white patches represent a zone of cotton hairs embedded in starch stained with iodine. The white interior is very faintly marked with the outline of the cotton hairs which have never been wetted by size, and consequently are unstained. By observing a number of fields such as these and estimating the area of each yarn diameter which remains white, it is possible to give an average figure for the fraction of the yarn section which is free from size. This procedure was adopted with all preparations where the unstained region appeared sufficiently well marked to allow a quantitative estimate to be made, and its use may be illustrated by the following special observations. It is noticeable in the tables that follow that the 36's Egyptian yarn is less well penetrated by size than its American partner. Gassed yarn is similarly characterised when compared with ungassed (Table XIII.) and is also less heavily sized than the latter. The effect of increasing twist is as might be expected to reduce the penetration (Table IV.) while in accordance with the rule connecting hair weight and sizing, the Tanguis yarn picks up more than Sakel of equal twist.

Table XIII.

Comparison of the Sizing Capacity of Gassed and Ungassed Yarn

No.	Size	Concentration	Roller Pressure	Roller Cover	Yarn	Percentage of Size (Paste)		Fraction of Section free from Size	
						Untreated	Gassed	Untreated	Gassed
226	Maize	7·0	1	3 layers coarse flannel	36's E	121	102	·07	·12
			3	2 layers coarse flannel	36's E	111	96	·01	·02
			1	3 layers coarse flannel with fent	36'sE	110	90	·19	·28
			3		36'sE	84	72	·03	·05
250	Maize	6·4	1	1 layer coarse flannel	33's (gassed 36's)	187	158	·14	·18
			1	Same, with fent		188	151	·07	·13

Sized yarn obtained from the mills rarely gives evidence of having been imperfectly wetted, but the presence of size throughout the yarn may be to some extent due to its migration while the warp was being dried. A section of typical yarn sized on an industrial tape frame is shown in Plate I., C, while D is an example of a heavily-sized warp in which there is definite evidence of imperfect penetration of size throughout the yarn.

The Effect of Mechanical Conditions on Sizing

The conditions considered were speed, weighting, and nature of the surface of the sizing roller. Speed was controlled by the gearing of the machine; the roller was loaded by hanging weights so as to bear equally on the vertically sliding housings of its ball bearings; while the roller surfaces compared consisted of two grades of seamless flannel shrunk on to duplicate rollers which could be interchanged as required. When a cotton fent was used over the flannel it could be restricted to one half of the roller leaving the other side free, and so permitting separate threads of the same sort of yarn to be sized and collected simultaneously, though subjected to the action of different roller surfaces.

With a view to obtaining a clear picture of the primary sizing uncomplicated by migration during drying, the sized yarn was collected wet and analysed and examined after drying at room temperature. The results as given in Tables XIV. to XVI. are self-explanatory, and in the following remarks an attempt will be made to show their relation to the theory of sizing which has been outlined in the introduction to this paper.

Table XIV. The Effect on Sizing of a Second Passage of the Squeezing Roller

No.	Size	Concentration	Roller Cover	Pressure	Percentage of Size (Paste)				Fraction of Section free from Size			
					12's American		36's Egyptian		12's American		36's Egyptian	
220	Maize	7·5%	3 layers flannel (No fent)	1	—	—	134	89	—	—	·23	·08
				2	—	—	107	85	—	—	·06	·01
				3	—	—	93	83	—	—	·01	·00
			Same, with fent	1	122	124	115	110	·23	·08	·23	·14
				2	110	110	102	99	·04	·01	·06	·01
				3	106	110	91	80	·03	·00	·04	·00
Times squeezed					once	twice	once	twice	once	twice	once	twice

The Function of the Sizing Roller

It has been shown[5] that when wires are enamelled by passage through a bath of molten material they carry a sheath of wax whose thickness is determined by the radius of the wire, the rate at which it moves, and the properties of the liquid. It is reasonable to suppose that cotton yarn will behave in somewhat the same way, and in G, H, of Plate II., sections are shown of two yarns which have been run through the size box at the normal speed and then hung up to dry without being squeezed. In the dried material a layer of starch of considerable thickness is to be seen, showing that the volume of liquid size which the yarn could support was very great compared with its own bulk. One passage through the squeezing roller at normal pressure disperses the greater proportion of this liquid (compare F and G of Plate II.), the dispersion being the more complete the lower the viscosity of the liquid. If the yarn is squeezed, and then sized again, the second squeezing has little effect in reducing the amount of size on the 12's American yarn (Table XIV.), and there is no reason why it should, since on re-entering the size the yarn may be presumed to renew its coating, which has to be dispersed afresh at the second passage of the roller. The Egyptian yarn, however, is less heavily sized after a double squeeze, and no explanation can be offered for this behaviour.

Table XV.
The Effect of the Surface and Pressure of the Roller on Sizing

No.	Size	Concentration %	Roller Cover	Percentage of Size (Paste) Pressure—1	2	3	1	2	3	Fraction of Section free from Size 1	2	3	1	2	3
				12's American			36's Egyptian			12's American			36's Egyptian		
210	Maize	5·8	3 layers coarse flannel	132	125	130	130	120	111	·09	·02	·00	·15	·10	·00
			Same, with fent	139	127	124	102	90	112	·09	·05	·00	·15	·12	·01
219	Maize	7·0	Flannel only	126	117	115	103	110	107	·15	·03	·01	·35	·08	·05
			Same, with fent	120	104	97	119	109	91	·21	·13	·11	·31	·14	·07
220	Maize	7·5	Flannel only	—	—	—	134	107	93	—	—	—	·23	·06	·01
			Same, with fent	122	110	106	115	102	91	·23	·04	·03	·23	·06	·04
	Dextrin	14·0	Flannel only	87	88	87	65	80	86	·25	·03	·01	·54	·12	·06
			Same with fent	71	76	67	64	65	63	·08	·01	·00	·34	·07	·04
				20's American			36's Egyptian			20's American			36's Egyptian		
248	Maize	6·1	1 layer coarse flannel	182	174	135	151	138	115	·03	·02	·00	·13	·04	·02
			Same, with fent	112	110	87	86	98	72	·02	·01	·00	·14	·04	·03
			1 layer thin flannel	161	139	130	138	122	104	·00	·00	·00	·08	·01	·01
			Same, with fent	141	122	105	116	113	94	·03	·01	·00	·13	·01	·01

Table XVI.
The Effect of Speed on Sizing

Size	Concentration %	Roller Pressure	Roller Cover	Percentage of Size (Paste) 20's American			36's Egyptian			Fraction of Section free from Size 20's American			36's Egyptian		
Maize	6·2	1	1 layer coarse flannel	183	201	208	145	155	148	·05	·03	·21	·20	·26	·31
		1	Same, with fent	137	143	140	147	123	122	·06	·06	·10	·11	·19	·21
		2	Without fent	135	155	148	90	105	113	·01	·01	·03	·04	·06	·09
		2	With fent	110	118	117	81	89	91	·00	·01	·01	·00	·02	·04
Speed of Machine ...				Low	Middle	High	Low	Middle	High	Low	Middle	High	Low	Middle	High

Consideration of the sizing roller as an agent for dispersing a viscous sheath from the yarn is well supported by the experiments on roller weighting (see particularly Table XV.) in which the general effect of heavier pressure is to reduce the amount of size on the yarn. There is some evidence that for each value of the viscosity of the size there is a minimum below which further increase of pressure is ineffective. The difference between the amounts of size shown in the columns headed "pressure 2" and "pressure 3" of the table is usually small, while for the very mobile dextrin size the minimum is apparently reached at the lowest value of the pressure.

Speed.—When the machine is accelerated the yarn is subject to the action of the squeezing rollers for a shorter time. Regarded as a means of dispersing a viscous fluid the roller may be expected, therefore, to be less effective at high than at low speed. The change from low to middle speed does increase the amount of size on the yarn though a further acceleration has very little additional effect. It is possible that at the highest speed an appreciable amount of slipping of the upper roller takes place, and it has already been shown that this leads to loss of sizing capacity.

Roller Cover.—The order of decreasing weighting of yarn as the material which covers the sizing roller is changed is coarse flannel, fine flannel, fine flannel with fent, coarse flannel with fent. It is easy to understand that fine flannel makes more effective contact with the yarn than coarse and so has more effect in moving the size coating the yarn, and the same applies to covering either flannel with cotton. It is not so easy to see why the application of a cotton covering should reverse the order of the flannels, though an explanation could be constructed on the basis of the coarse flannel being more yielding than the fine and so bringing the cotton into more intimate contact with the yarn.

Mechanical Conditions and Penetration

Penetration of size into yarn appears to occur as a viscous flow influenced by the same factors and in the same direction as is the dispersion of the external sheath of size. Thus penetration is favoured, the area free from size becoming less, when the yarn is twice sized, when the machine runs slowly, or when heavy pressure is applied. It is curiously unresponsive to changes in the roller cover which have so marked an effect on the total amount of size taken up, and this fact suggests that the account now put forward of the mechanism of sizing is in need of some amplification.

The Bearing of these Experiments on Technical Practice

It may be of interest to conclude with a recapitulation of the aspects of this work which appear to have some relation to the management of sizing on an industrial scale. If, for instance, it is known that on a certain machine a normally spun American 36's twist yarn takes up 180% of a maize paste containing 8% of solids—the weight of the yarn when dried increasing by 14·4%, it may be concluded that a Sakel yarn similarly treated will only take up 126% of paste, or roughly 11% of solids. Similar considerations apply to the question of the amount of water to be evaporated from sized yarn. If dextrin can be taken to be a mechanically efficient sizing agent, 10% of solid matter can be applied to the yarn, as 70% of a 14% paste (see Experiment 224, Table XV.) from which roughly 55% of water has to be evaporated. A 7·5% maize size, on the other hand, puts 9% of solids on the yarn as 120 parts of paste, and from this 110% of water must be driven. This is no doubt an extreme example of the possibility of economy of heating steam depending on the use of concentrated size of low viscosity, but it is certain that the use of freshly-boiled farina involves the evaporation of an appreciable amount of otherwise useless water, which serves merely as a vehicle for the adhesive, in excess of that required when other, less viscous, starches are employed.

That the deposition of size on warps is controlled by the same factors in industry as in the laboratory is shown by the observations recorded in Table XVII. dealing with the course of sizing in two mills. The analytical figures refer to yarn taken from each beam as it was doffed and to size taken from the sow box immediately before the beam was filled, the amount of paste being derived in the usual way. In both mills the concentration of the size undergoes changes which are reflected in the amount of paste taken up, and therefore necessarily in the amount of dry solids on the warp, and it is known that changes of this magnitude are sufficient to affect to an appreciable extent the weaving properties, feel and weight of the finished cloth. The volume of size taken up by the yarns in these two tests are of the same order as those found in the laboratory, and these, and other records made on technical plants, show that in this respect at least the laboratory apparatus is carrying out its work is a similar manner to the industrial machine.

Table XVII.

Pure sizing (sago only)				Heavy sizing (starch salts and china clay)			
Order of Beam	Concentration per cent.	Weight on Warp per cent.		Order of Beam	Concentration per cent.	Weight on Warp per cent.	
		Dry Solid	Paste			Dry Solid	Paste
1	14·4	21·3	148	1	23·7	42·7	181
2	15·0	22·8	152	2	24·7	47·3	190
3	14·45	21·4	148	3	24·6	46·7	190
4	14·3	20·4	143	4	25·2	47·2	187
5	14·2	20·2	142	5	27·0	55·5	205
6	14·15	19·8	141	6	27·1	54·2	200
7	14·1	19·4	138				
8	14·45	20·1	139				
9	14·3	19·4	136				

The sections of sized yarn used in this work were cut, and where necessary photographed, by Mr. E. Bradbury.

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DESCRIPTION OF PLATES I. AND II.

A—18's American yarn containing 10% of maize starch. The yarn was collected wet and appreciable areas are free from size. (Experimental sizing.)

B—Yarn similar to A but dried on the cylinders. The yarn is less regular in appearance than A and the unsized region has diminished. (Experimental sizing.)

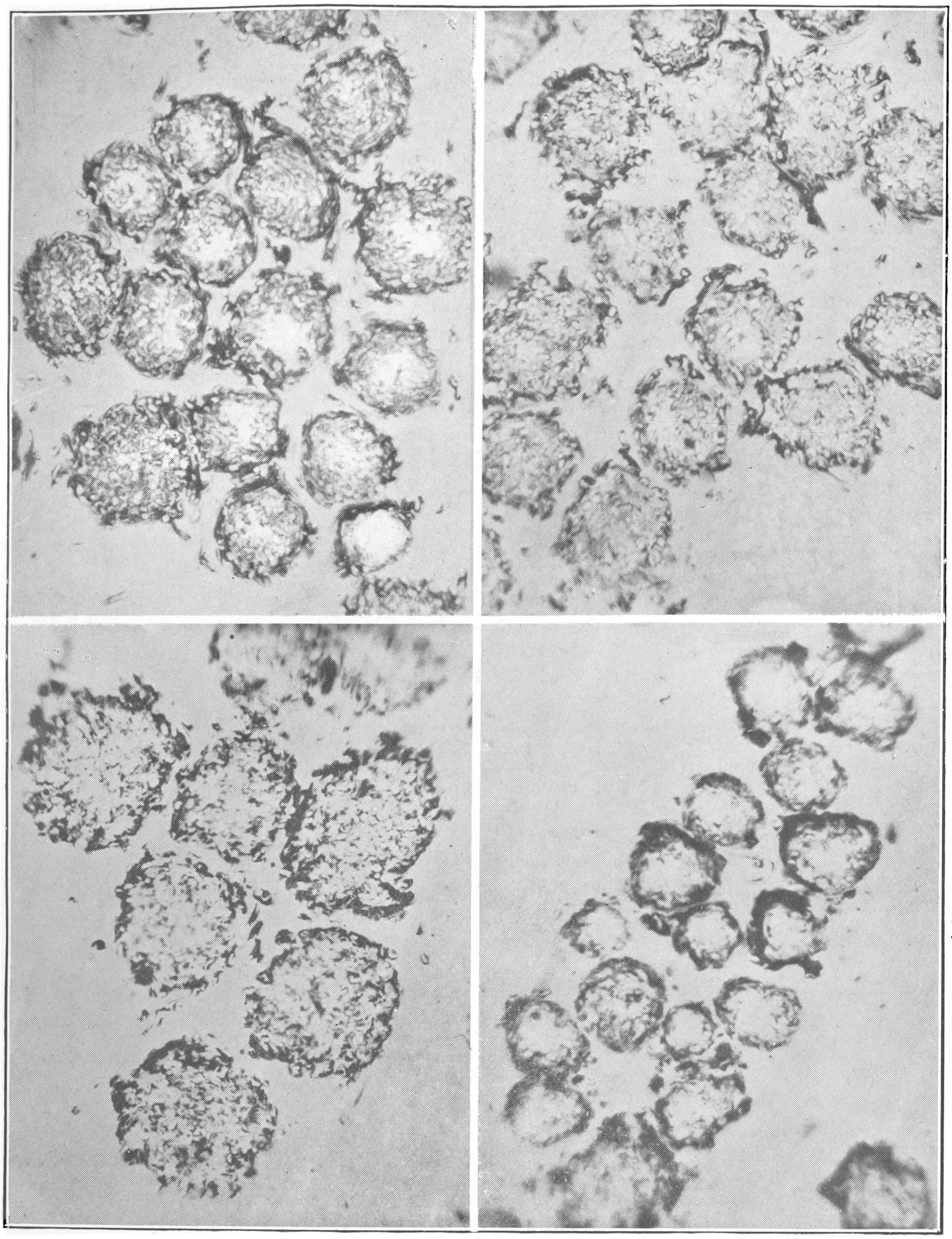
C.—12½'s American yarn with 12% of maize size. Dried by hot air. (Industrial sizing.)

D—46's American ring twist with 72% of size, cylinder dried. There are well defined areas free from size in the sections. (Industrial sizing.)

E—36's Egyptian yarn with 8% of maize size. The yarn was collected wet and allowed to dry in the air. (Experimental sizing.)

F—12's American yarn sized in a similar manner to E. The normal weight of the sizing roller was used on these specimens.

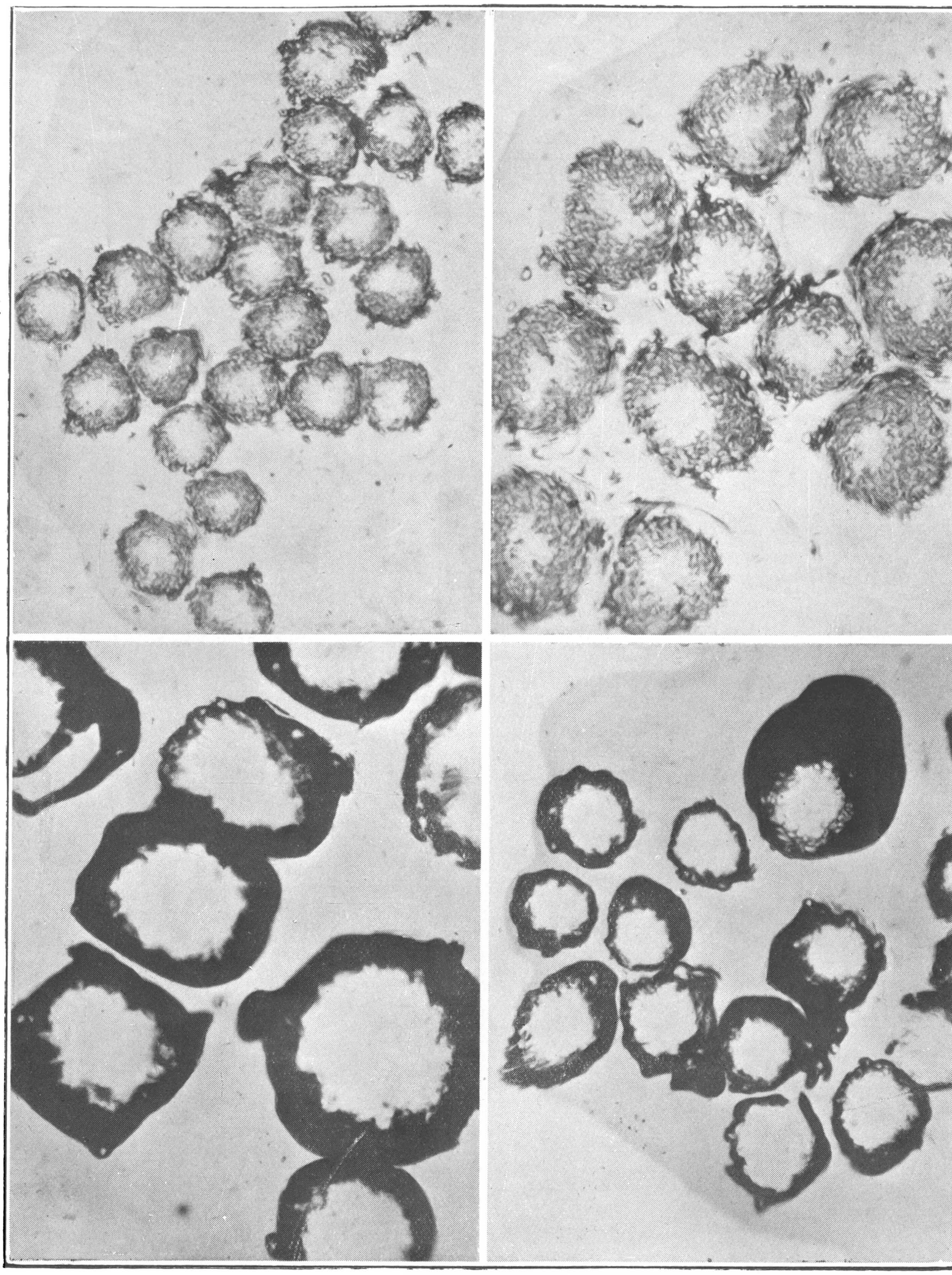
G, H—12's American and 36's Egyptian yarns sized but not squeezed. The black rings show the thickness of the deposit of solid size. The layer of paste must have been considerably thicker.



A B C D

PLATE I.

E F



G H

Plate II.

2—THE UNIFORMITY OF HEAVY SIZING IN MILL PRACTICE

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INTRODUCTION AND SUMMARY

When cotton warps are heavily sized it is frequently important that the weights of individual pieces of the finished cloth shall lie within fairly narrow limits. An opportunity was given for investigating the sizing of a number of warps of a sort of cloth which was known on occasion to depart rather widely from the desired standard of weight, and the results of the observations are recorded below as general conclusions in a preliminary summary, and in more detail as a series of graphs with descriptive matter.

Conclusions

The final result of this work is to show that there are certain causes which lead to dilution—or the reverse—of size in the sow box of the tape frame; that from diluted size an inadequate amount of paste, and therefore of solid matter, is taken up by the warp; and that the deficiency of size on the warp corresponds with the amount by which the weight of the cloth falls short of the standard.

On the tape frames on which these observations were made live steam condenses in the sow box in quantity sufficient to supply by its latent heat the amount of heat lost by radiation and conduction, or used in raising the temperature of the moving yarn. The supply of steam thus gives rise to a steady flow of water into the box, and when the size from the beck also flows steadily in, to replace that taken up by the yarn, the mixture in the sow box is maintained at a concentration which is a definite fraction of that of the supply.

If the machine stops, size is no longer used up and the supply from the beck is interrupted, but the loss of heat from the box is sufficient to ensure that water still condenses in appreciable quantity, and the size in consequence becomes more dilute.

If the automatic valve is defective and the supply of size from the beck is interrupted when the machine is running, dilution of the mixture again occurs, the level in the sow box falling as size is used up. When the sow box is refilled, by hand operation of the valve, the inflow of fresh paste temporarily over-balances the steady supply of water, and the mixture in use becomes more concentrated.

Other causes which have been observed to produce irregularity in the concentration of the size in the sow box are inequality of concentration of successive mixings in the supply beck, deliberate dilution by the addition of water, and on one occasion evaporation when the steam supply was accidentally shut off for a time. It should be noted that evaporation is not in general a cause of any change of concentration in the sow box, since it is usually balanced by the condensation of an equivalent amount of steam.

The concentration of the size very largely determines the weighting of the warp, in the first place because the percentage of paste taken up by the yarn increases as the concentration rises, and secondly because unit weight of a more concentrated size has necessarily more weighting power than the same amount of a more dilute mixture. Thus the quantity of dry size left on the yarn increases more rapidly than the concentration; in a typical instance a rise of size concentration from 24·1% to 27·2% resulted in the increase of amount of size on yarn from 42·7% to 56%.

It has been thought desirable to exclude the possibility that the change of piece weight might be caused indirectly by some change in the weaving properties of the warps due to irregular sizing. By systematic analysis of samples of cloth it has been shown that the amount of size in the cloth corresponds from piece to piece with the weights of the woven pieces, and that both these quantities show fluctuations parallel to those which take place in the concentration of the size. It is found that a difference of weight in the piece of as much as 10% may arise from relatively small changes of concentration of size in the tape frame. The causes of the difficulty are clear, but the remedies, while obvious, are not necessarily easy to apply, and cannot be usefully discussed from the practical point of view at the present moment.

EXPERIMENTAL DETAILS

Preparation and Supply of Size.—The size was mixed cold in a mixing beck, and successive mixings were transferred to a storage beck as this became empty. There it was heated to boiling on admission, kept hot by means of live steam, and pumped to the automatic float valve regulating the level of size in the sow box. Live steam, blown from a small nozzle through a pipe laid horizontally across the bottom of the sow box, served both to heat and to stir the size.

Sizing and Drying of Yarn.—On the two tape frames used the yarn did not enter the size, but was passed between a pair of squeezing rollers, of which the lower was partly immersed, and was then cylinder dried at 8 to 10 pounds per square inch steam pressure.

Methods of Investigation.—Observations were made of the temperature and concentration of the size from the supply pipe and in the sow box, the incidence of stops, the depth of size in the sow box, the amount of size on samples of yarn obtained at the doffing of each beam, and on each piece of cloth taken from the looms, and the weights of the pieces of cloth and of the sized beams. The amounts of size on the cloth samples were estimated conveniently by igniting them and weighing the ash, which consisted chiefly of china clay and represented about half of the total weight of dry size. The amount of dry size represented by a given weight of ash was determined by drying and then ashing a sample of the size.

All the factors examined are plotted against time of sizing in Figs. 11 and 12, whilst those most significant in causing irregularity of cloth piece weight are shown in pairs in Figs. 1 to 10.

EXPERIMENTAL RESULTS

Causes of Variations in Size Concentration

Irregular Supply of Size (Fig. 1).—When the float valve controlling the level of size in the sow box fails to function, and is in consequence manipulated by hand, the changes in size level afford some measure of the irregularity of supply. Though the operation of other factors precludes exact similarity of the curves, in general a rise in level of size, caused by too rapid supply of the more concentrated size from the beck, is accompanied by a rise of concentration in the sow box.

Irregular Running of Machine (Fig. 2).—When the machine stops and size is no longer taken up by the yarn, the float valve shuts off the supply of size from the beck. Steam, however, continues to condense in the sow box, and hence the size is diluted during stoppages.

Varying Concentration of Supply (Fig. 3).—The concentration of the size in the sow box would be expected to follow closely changes in the concentration of the supply from the beck, and this effect is realised in practice.

The Effect of Size Concentration on Weighting

Weighting of the Warp (Figs. 4, 5, 6, and 7).—The amount of dry size on the samples of warp taken from the slasher at the end of each beam, divided by the concentration of the size at the moment of sizing, gives a measure of the amount of sizing paste taken up by the yarn. Figures 4, 5, and 6 show that this quantity increases considerably as the concentration of the size increases. The most probable explanation of this is that the more concentrated paste has a higher viscosity, and is thus less completely dispersed by the squeezing rollers. (Preceding paper.) It follows that the amount of dry size left on the yarn increases more rapidly than the concentration increases, and Fig. 7 illustrates this. This effect has already been observed for light sizing.

Weighting of the Cloth (Figs. 8, 9, and 10).—The amount of size remaining on the woven pieces, as determined by the analysis of short samples from the end of each piece, gives a possibility of following the irregularities of sizing more closely, since twenty cuts were available from each beam. Fig. 8 shows that the concentration of the size with which the particular warps were sized largely determines the weighting of the cloth, whilst Fig. 9 shows how the weights of the pieces of cloth depend on the amount of size present. In Figs. 11 and 12 the individual values of size on cloth are plotted against the time of sizing of the warps, the scattering of the points being probably due to local irregularities of sizing, since only a few inches from the end of each piece were available for analysis. From the known construction of the cloth, and the amount of size found on it, a value may be calculated for the weight of a piece. This has been done in Table I. for the five beams

Table I.

Prog. No.	Mean Concentration of Size %	Mean % Size on Cotton (Cloth)	Weight per Cut of Weft + Unsized Warp Lb.	Mean Weight of Size per Cut Lb.	Mean Cut Weight, Calcd. Lb.	Mean Cut Weight, Observed Lb.	Difference
7	22·9	24·8	8·50	2·11	10·61	10·44	0·17
8	24·4	27·9	8·50	2·37	10·87	10·60	0·27
9	24·6	26·5	8·50	2·26	10·76	10·69	0·07
10	26·6	31·7	8·50	2·70	11·20	11·11	0·09
11	27·0	33·9	8·50	2·88	11·38	11·19	0·19

No.	Concentration of Size %	% Size on Warp Sample	Weight per Cut of Unsized Weft Lb.	Weight per Cut of Sized Warp Lb.	Weight of 1st Cut, Calcd. Lb.	Weight of 1st Cut, Observed Lb.	Difference
7	23·6	42·8	2·83	8·10	10·93	10·50	0·43
8	24·8	47·4	2·83	8·36	11·19	10·82	0·37
9	25·0	47·4	2·83	8·36	11·19	10·88	0·31
10	27·2	55·2	2·83	8·80	11·63	11·25	0·38
11	27·2	54·2	2·83	8·75	11·58	11·25	0·33

whose sizing is recorded in Fig. 11, the effect of local irregularities in the distribution of size being reduced by averaging the weights and size contents of all the pieces of any one beam. For the same beams the weights of the first pieces have been calculated from the percentage of size found on the samples of warp taken when each beam was doffed, and figures so found are compared with the actual weight of the pieces in the second half of the table.

The fluctuations in the amounts of size are sufficient by either method of calculation to account for the variations of cloth piece weight, but the observed piece weights are invariably lower than those calculated from the composition of the cloth and the amount of size. In the first set of figures this may be due to inexact counts or change of moisture regain, but the larger discrepancy observed where the weight is calculated from the size found in the warp before weaving probably arises from loss of size in the loom.

Finally, Fig. 10 compares the weights of the pieces of cloth with the concentration of the size applied to the warps, and shows the close relation which exists between these quantities.

General

The temperature of the size in the sow box (Figs. 11 and 12) normally remains between 90° and 98° C., but shows a definite rise when the machine stops. The size is at a lower temperature when the machine is running, because heat has then to be supplied to the cold yarn and to keep hot the extra surface of size exposed on the moving rollers. On one occasion the temperature of the size fell to 71° C. (Fig. 12, 1.15 p.m.)—owing to the stopping of the steam supply for a time—but the amounts of size found on the corresponding cloths and the weights of the pieces did not differ much from the normal. It thus appears that moderate fluctuations of size temperature have but little effect on weighting.

By comparing the curves on the larger graphs (Figs. 11 and 12), it is possible to make some estimate of the effect of several factors varying simultaneously. Thus in Fig. 11 the minor irregularities of concentration generally correspond with the fluctuations of size level, which measures the regularity of supply, but when the machine stops or when water is added the resulting tendency to dilution affects the slope of the concentration curve. Apart from these more or less temporary effects, the size in the sow box in this instance becomes steadily more concentrated, on account of the increasing concentration of the size supplied from the beck.

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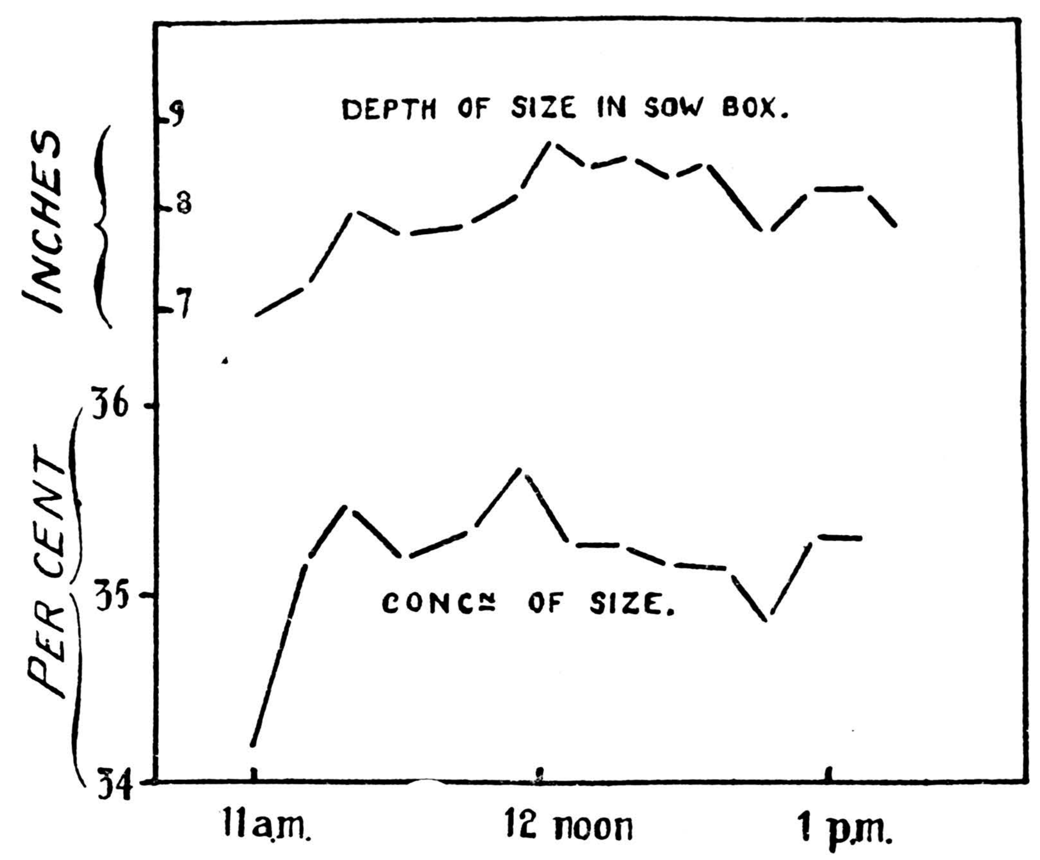


Fig. 1

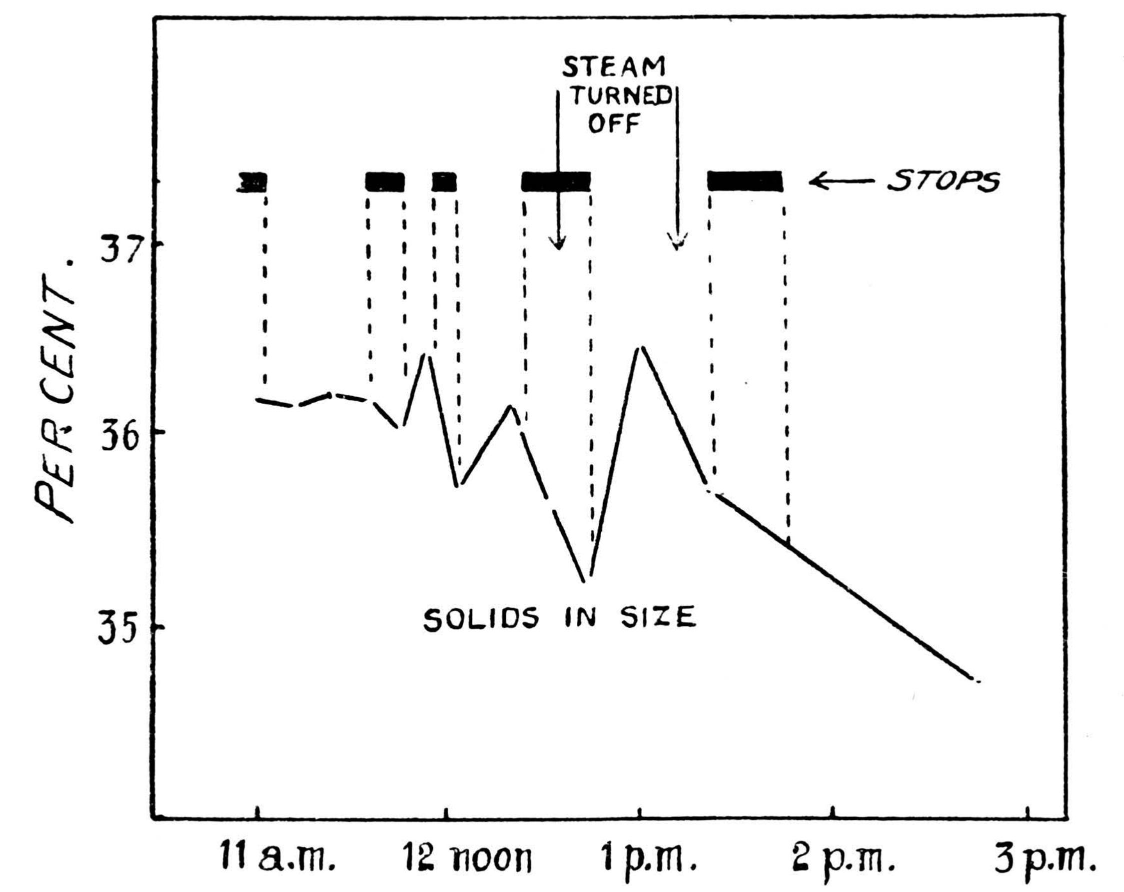


Fig. 2

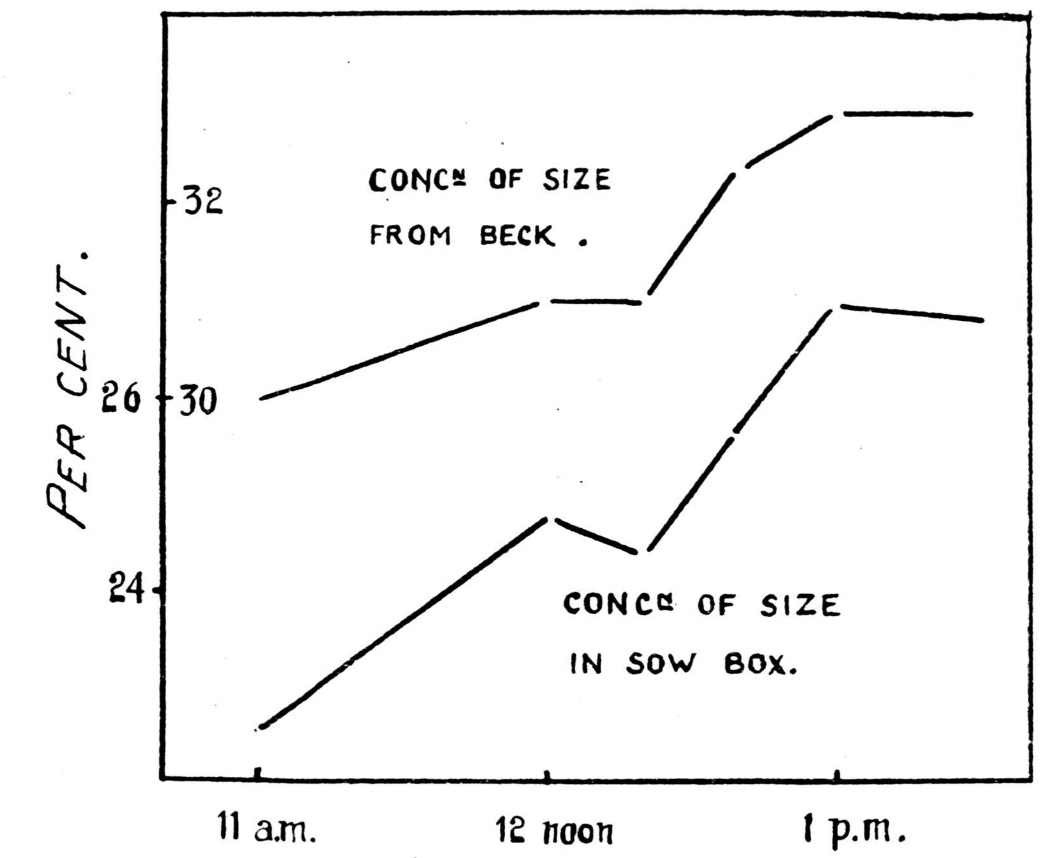


Fig. 3

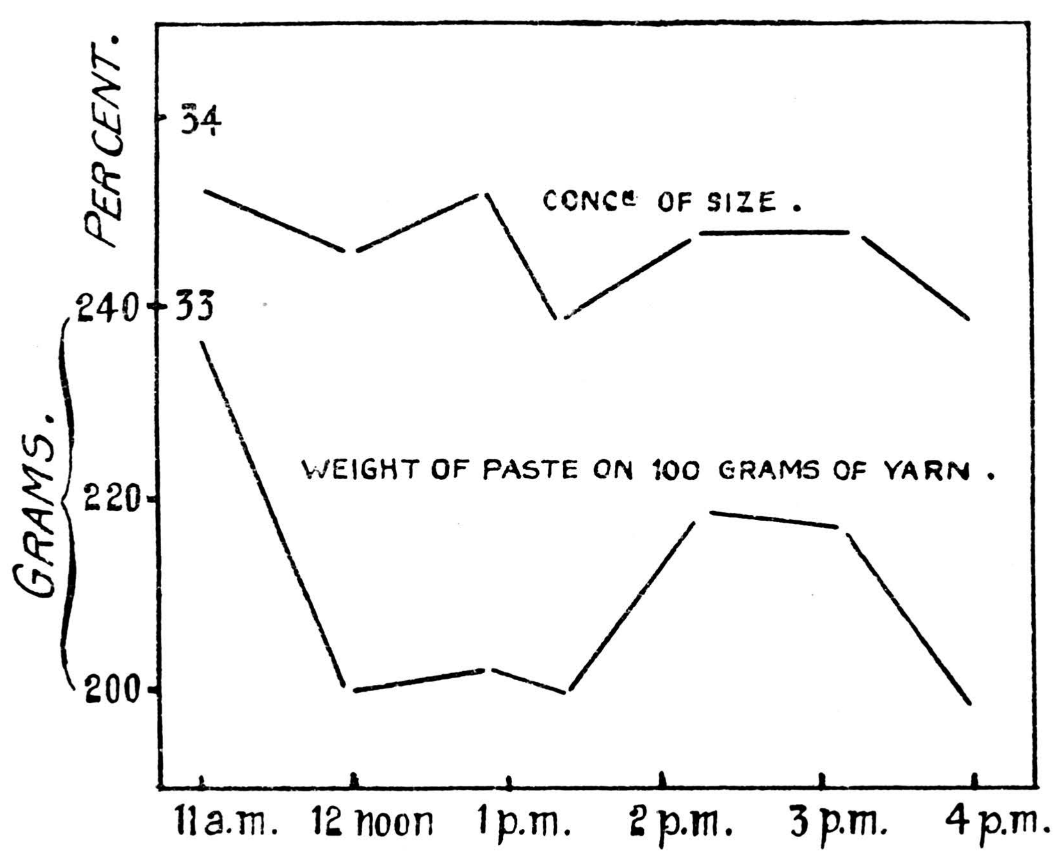


Fig. 4

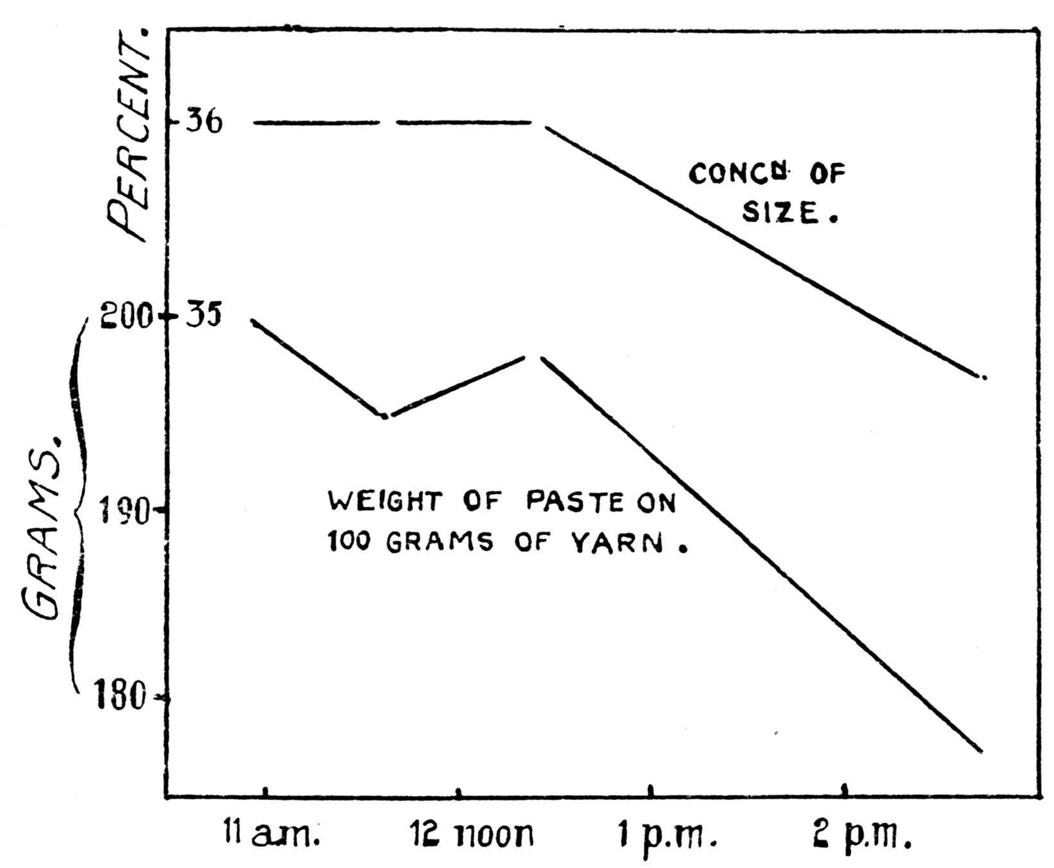


Fig. 5

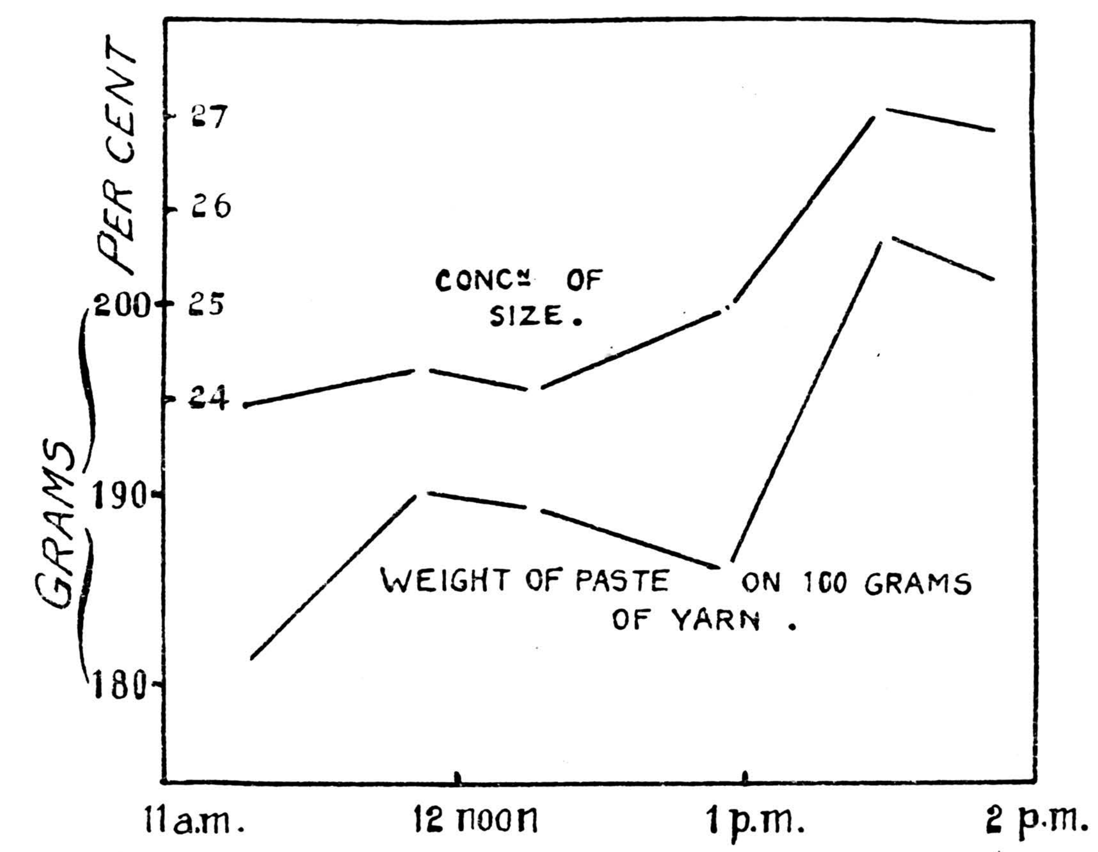


Fig. 6

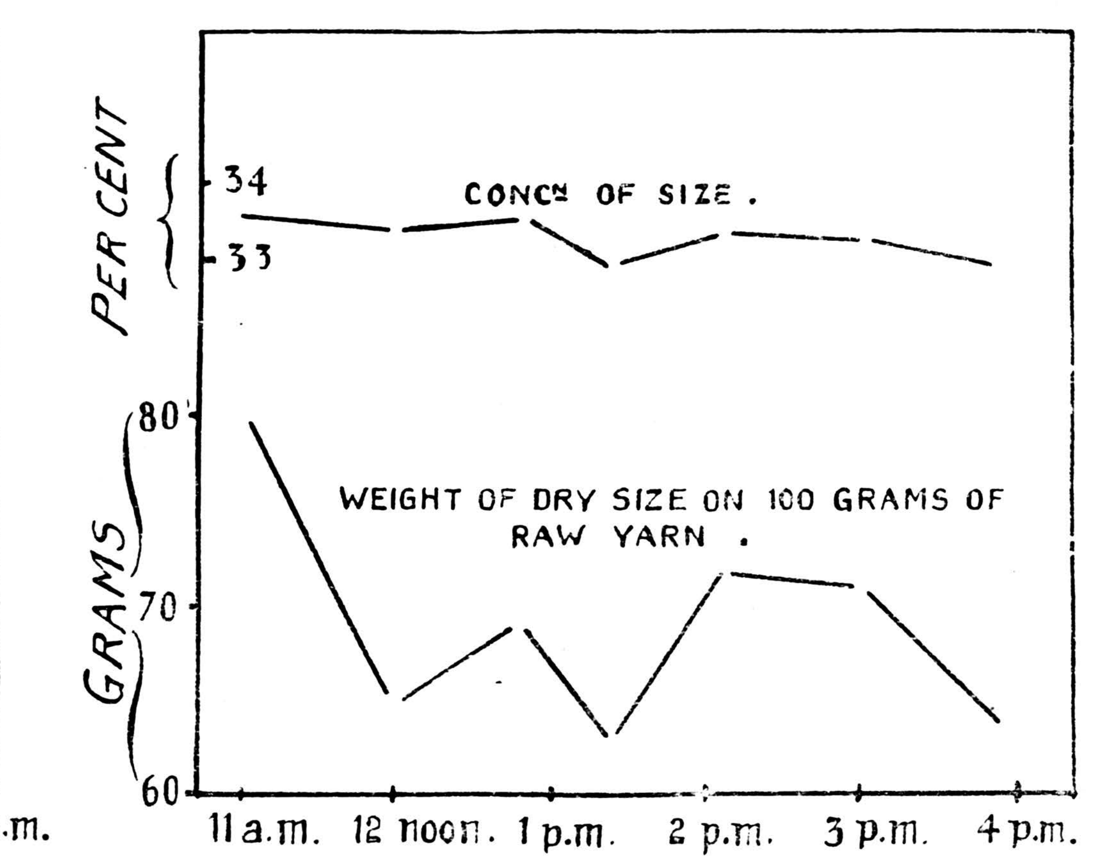


Fig. 7

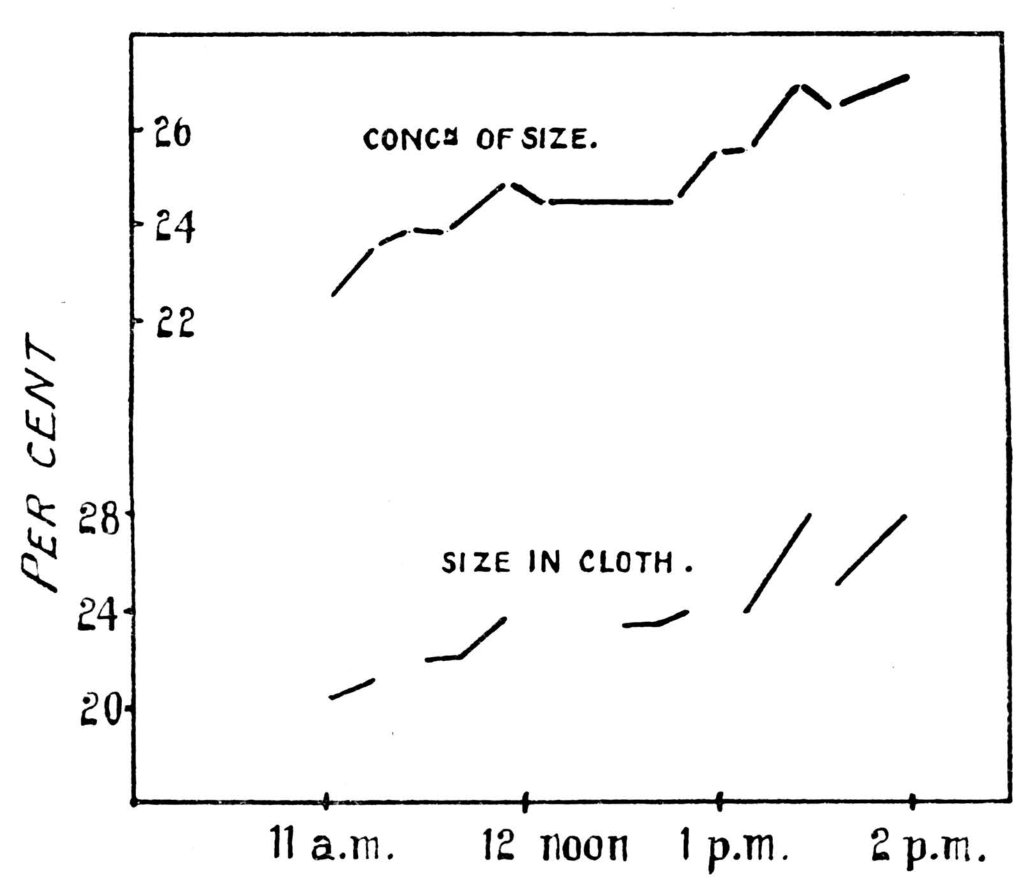


Fig. 8

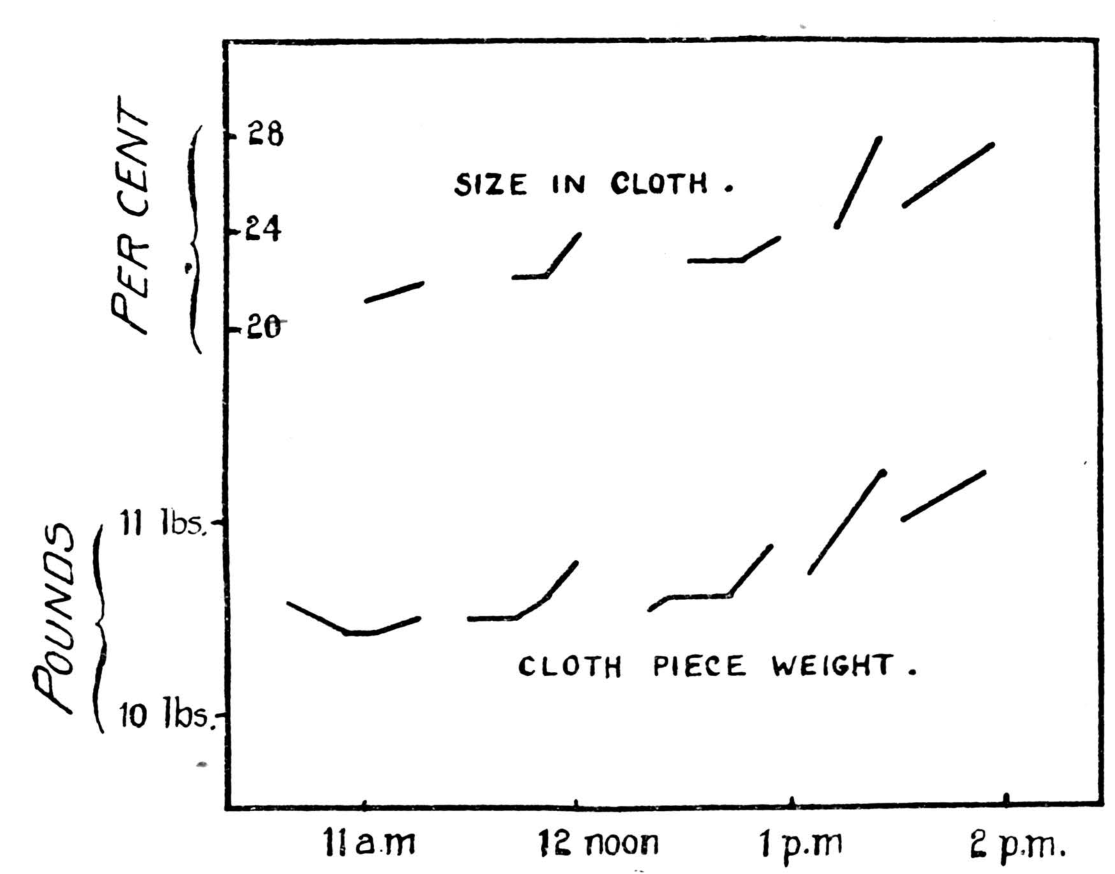


Fig. 9

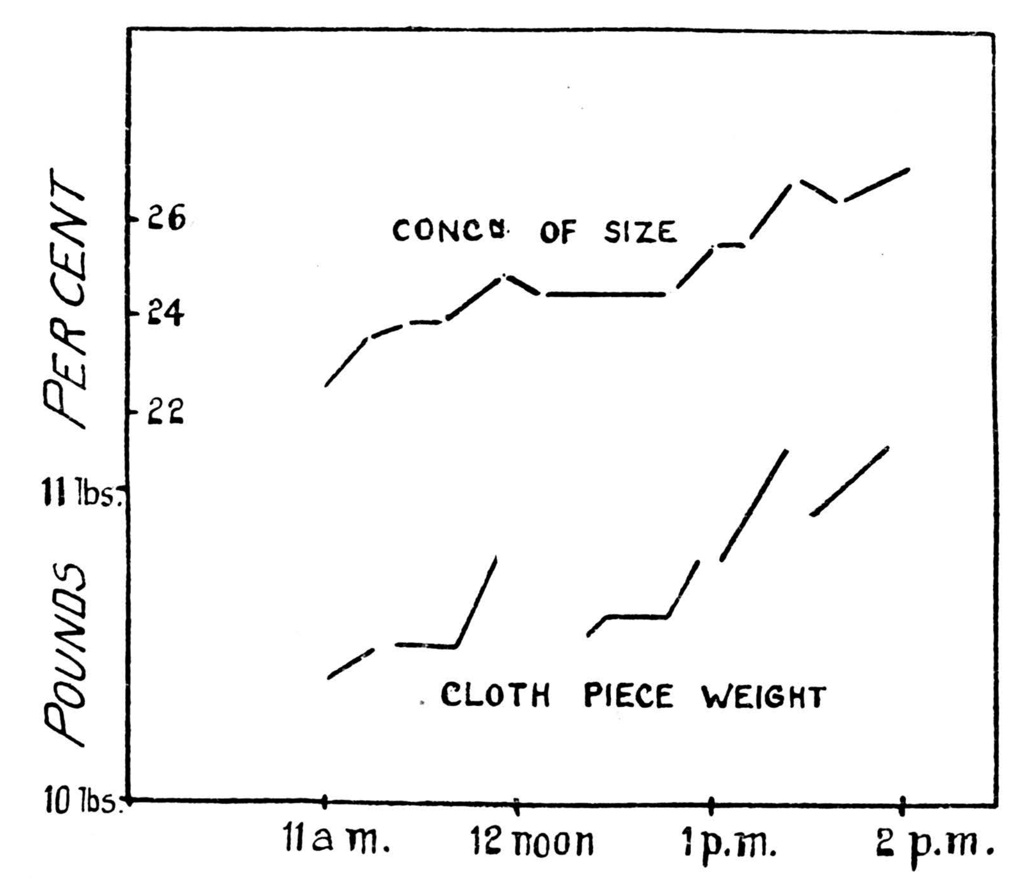
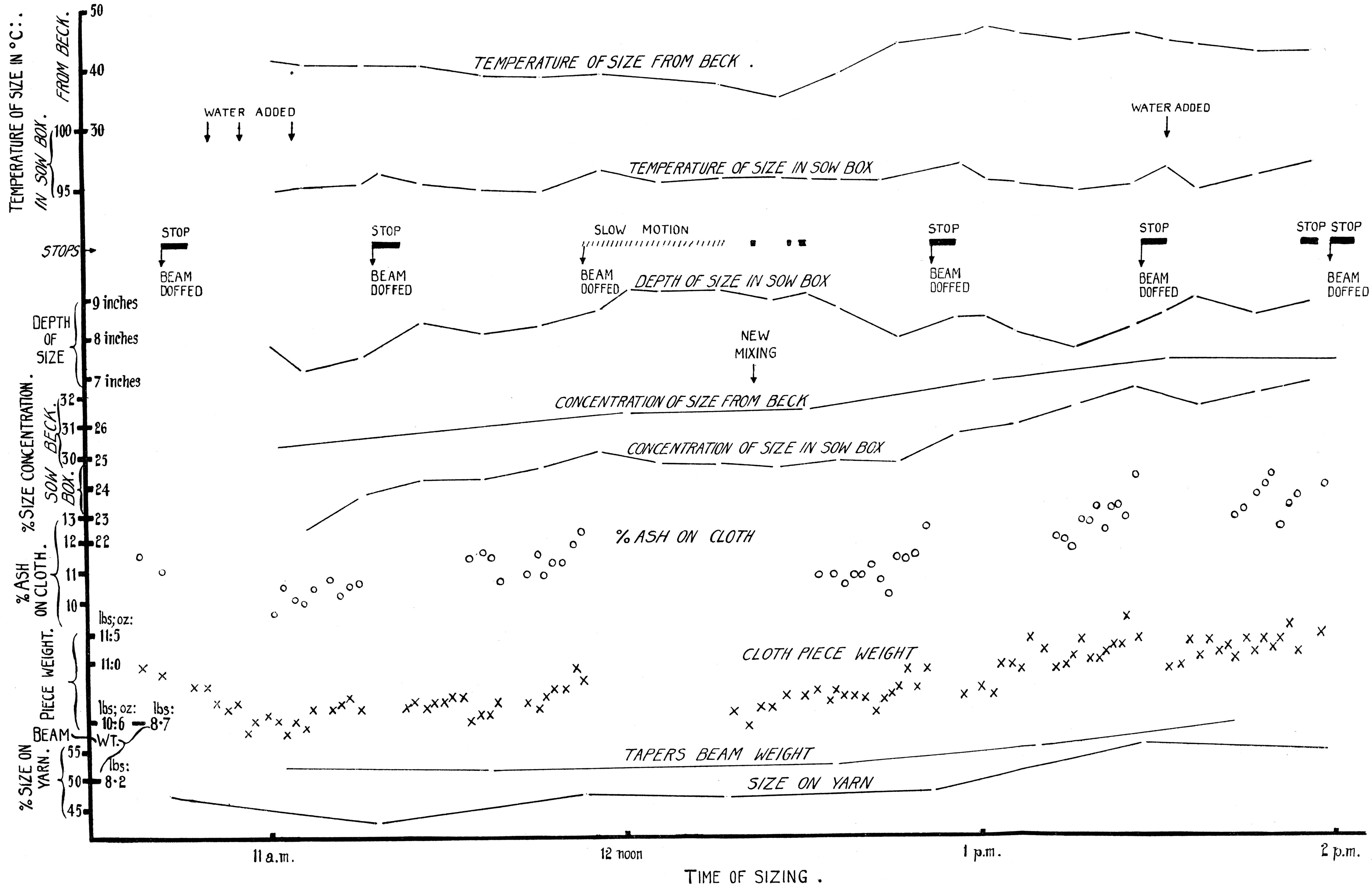


Fig. 10



TEMPERATURE OF SIZE IN °C:.
FROM BECK.
IN SOW BOX.
50
40
30
100
95
TEMPERATURE OF SIZE FROM BECK.
WATER ADDED
WATER ADDED
TEMPERATURE OF SIZE IN SOW BOX
STOPS
STOP
STOP
SLOW MOTION
STOP
STOP
STOP STOP
BEAM DOFFED
BEAM DOFFED
BEAM DOFFED
BEAM DOFFED
BEAM DOFFED
BEAM DOFFED
DEPTH OF SIZE IN SOW BOX
DEPTH OF SIZE
9 inches
8 inches
7 inches
NEW MIXING
% SIZE CONCENTRATION.
BECK.
SOW BOX.
32
31
30
26
25
24
23
22
CONCENTRATION OF SIZE FROM BECK
CONCENTRATION OF SIZE IN SOW BOX
% ASH ON CLOTH.
13
12
11
10
% ASH ON CLOTH
PIECE WEIGHT.
lbs; oz:
11:5
11:0
lbs; oz:
10:6
lbs:
8·7
CLOTH PIECE WEIGHT
BEAM WT.
lbs:
8·2
% SIZE ON YARN.
55
50
45
TAPERS BEAM WEIGHT
SIZE ON YARN
11 a.m.
12 noon
1 p.m.
2 p.m.
TIME OF SIZING.

FIG. 11

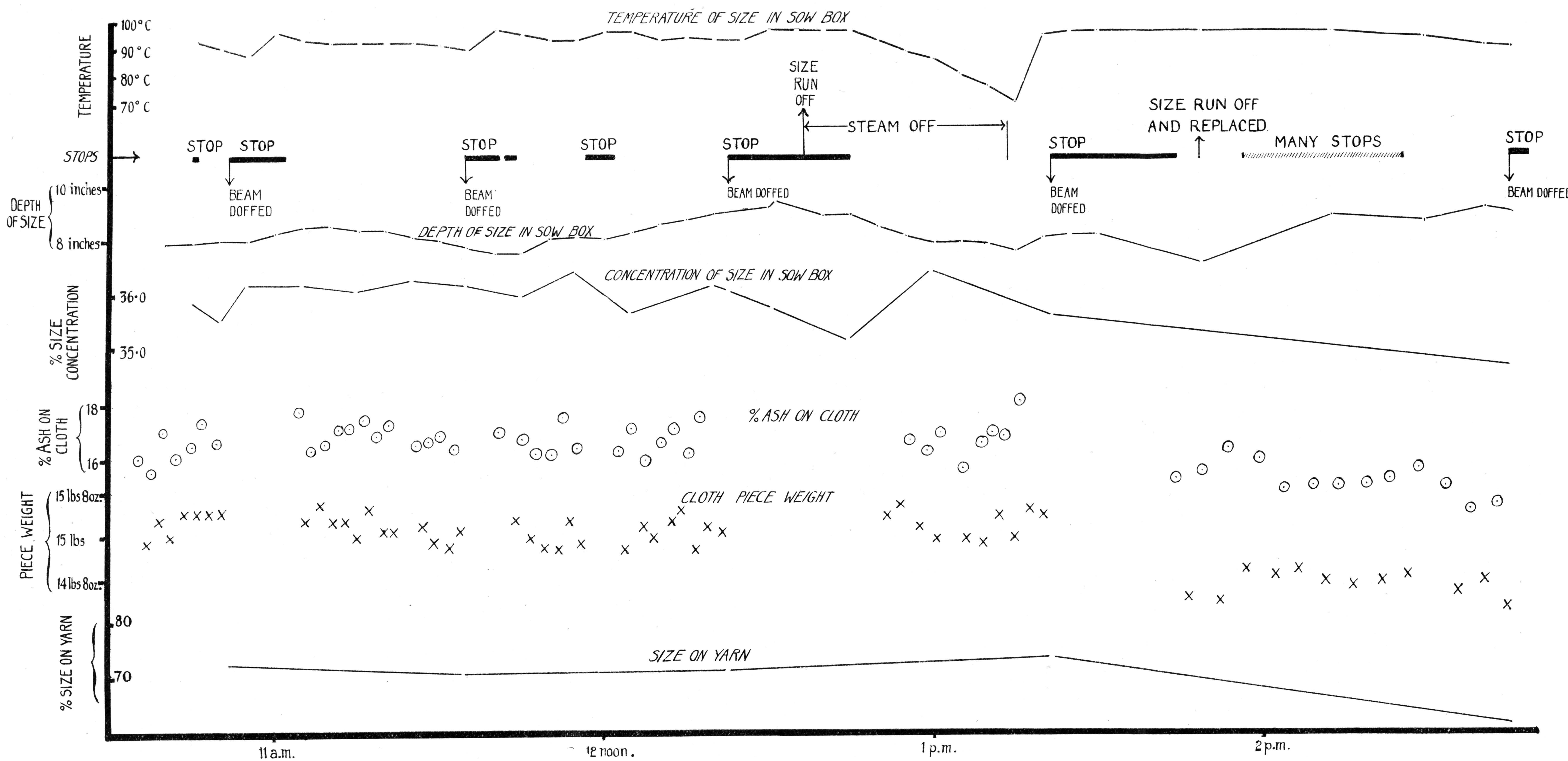

TEMPERATURE OF SIZE IN SOW BOX
TEMPERATURE
100° C
90° C
80° C
70° C
SIZE RUN OFF
STEAM OFF
SIZE RUN OFF AND REPLACED
STOPS
STOP
BEAM DOFFED
MANY STOPS
DEPTH OF SIZE
10 inches
8 inches
DEPTH OF SIZE IN SOW BOX
CONCENTRATION OF SIZE IN SOW BOX
% SIZE CONCENTRATION
36·0
35·0
% ASH ON CLOTH
18
16
CLOTH PIECE WEIGHT
PIECE WEIGHT
15 lbs 8oz.
15 lbs
14 lbs 8oz.
% SIZE ON YARN
80
70
SIZE ON YARN
11 a.m.
12 noon.
1 p.m.
2 p.m.
TIME OF SIZING

Fig. 12

3—THE STEEPING PROCESS

THE CONSTITUENTS OF COTTON SOLUBLE IN WATER OR DILUTE MINERAL ACIDS AND THE EFFECT OF THEIR REMOVAL ON SUBSEQUENT SCOURING

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INTRODUCTION AND SUMMARY

The principal object of any steeping process is to promote thorough and even wetting of the material prior to entering the kier, and thus ensure conditions favourable to uniform scouring. Whether or not this has been achieved may be ascertained by determining how completely such constituents of the cotton itself as are soluble in water or in dilute acids have been removed, the thorough washing required to ensure even and thorough penetration necessarily involving the elimination of the soluble constituents of the cotton. The second purpose is to promote the removal, or at least the softening, of the size, the desirability of removal being regulated to some extent by the nature of the subsequent scouring operations and the purpose for which the cloth is intended.

As a preliminary to the study of the efficiency of technical steeping, it is therefore essential to determine the amount and nature of the material removed from cottons of different origin by treatment with water or with dilute mineral acids, to devise analytical methods to show how efficient the removal has been, and to find in what way the removal affects subsequent scouring.

No attempt has been made, therefore, to identify actual constituents, attention being confined to the amount of material in cottons of different origin which dissolves in water or in dilute mineral acids; to its analysis in terms of reducing, nitrogenous, and mineral constituents; and to an examination of the effect of its removal on subsequent scouring, so far as this can be ascertained from laboratory experiments. In a later communication, the application of the results in the control of technical steeping operations will be described. Further, the effects of dilute sulphuric acid on grey and scoured yarns have been compared, in order to ascertain the applicability of the copper number determination as a measure of tendering during a grey sour; whilst a number of typical enzyme preparations used in the desizing of cotton goods have been examined to determine whether they have any effect on the constituents of the cotton itself.

Loss in Weight on Steeping—The weight lost by different cottons on thorough treatment with cold dilute mineral acids varies from 1½% to more than 4%. American, South American, and Egyptian cottons usually lose between 2% and 3% in weight, whilst Sea Island cottons exhibit lower, and many native Indian cottons higher, losses. With water the losses are generally slightly lower than when acids are employed. In both cases they increase slowly as the temperature of treatment is raised.

Elimination of Mineral Constituents—After treatment with dilute mineral acids, the residual mineral matter is of the order associated with bleached yarns and cloths, and invariably lower than 0·1%. Hydrochloric and sulphuric acids show no significant difference, but when acetic acid is employed the elimination is rather less thorough. Water is less effective than acids, and there usually remains from 0·15% to 0·25%, the ash alkalinity being correspondingly high.

Elimination of Nitrogenous Material—Treatment with cold water causes an exceedingly variable reduction in the nitrogen content, a number of typical cottons losing from 8% to 31% of that initially present. With dilute acids the fall is equally variable but tends to be rather greater, the same series of cottons losing from 16% to 35% of the initial nitrogen content. With rise in temperature, there is a gradual increase in the amount eliminated.

Change in Reducing Power—So far as the removal of reducing substances is concerned, the effects of water and of dilute mineral acids appear to be identical, the copper numbers of the grey yarns falling usually to a figure between 0·3 and 0·5. Though a high number in the untreated yarn is generally associated with a high steeping loss, there is no correlation between the fall in the copper number and either the total or the non-nitrogenous organic material removed during the steep.

Effect on the Fat and Wax—Within the limits set by possible tendering of the cotton, treatment with mineral acids causes no observable hydrolysis of the fat and wax, and its effect appears to be confined to the liberation of a proportion of the small amount of fatty acids initially present in the form of insoluble soaps.

Analytical Control of the Steep—The results described above indicate three possible methods of testing the completeness of removal of the soluble constituents of cotton during steeping, and therefore, indirectly, the mechanical efficiency of the process. They are (1) the reduction in ash content and ash alkalinity; (2) the reduction in copper number; and (3) the reduction in nitrogen content. They have, of course, certain limitations, and can be applied with certainty only when controls are carried out on corresponding grey material which has been thoroughly extracted in the laboratory. The following conclusions may, however, safely be drawn—

(1) Save when the grey material contains china clay or other insoluble inorganic substances, thorough treatment with water or with enzyme preparations on a large scale should reduce the ash content to approximately 0·25%, and the ash alkalinity to a correspondingly low figure, whilst still lower values should characterise a successful acid steep.

(2) The copper number of a cloth after an efficient steep will generally vary between 0·3 and 0·5. Figures in excess of this may be due to more than one cause. First, there is the possibility of incomplete elimination of the reducing substances initially present in the cotton, whilst, secondly, there may be left on the cloth a small amount of partly degraded starch. Both of these are consistent with one cause—incomplete washing—and the copper number will fall to the value characteristic of the thoroughly steeped cloth on further treatment with warm water. There is, however, a third and more serious cause—tendering by acids during the grey sour. In this respect the behaviour of raw cotton is very similar indeed to that of

corresponding scoured material, the change in copper number being practically identical for the same treatment and additive to that of the thoroughly washed grey yarn. When a high copper number is due to acid attack, therefore, it will still be high after washing the cotton with warm water.

(3) The relatively small changes observed in nitrogen content as a result of steeping operations, and the exact method of measurement necessary, render this test of doubtful value in routine control; here its value is confined principally to cases where hydrolysis of nitrogenous constituents is claimed or suspected.

The Relative Tendering of Grey and Scoured Yarns by Acids—The effects described hitherto have been produced by acids under conditions which preclude appreciable attack on cellulose. As it was desired, if possible, to utilise the measurement of copper number to determine whether tendering had occurred during a grey sour, it became necessary to compare the action of dilute acids on grey and scoured material. In view of the numerous possible causes of divergent behaviour, the results allow of unexpectedly simple interpretation, for the formation of reducing substances takes place at approximately the same rate from both, whilst the copper numbers arising from the action of the acid on the grey yarns are additive to the initial values of the thoroughly washed material. Such slight differences as there are suggest that grey yarns are attacked a little more slowly than bleached, probably because of the protective action of fatty and other substances, but the behaviour of the two is sufficiently close for the conclusions to be drawn that limiting conditions for the acid treatment of grey material may be deduced safely from the results already published on the acid attack of bleached cotton, and that copper number measurements provide a valid estimate of the tendering which may have occurred during a grey sour.

The Effect of the Steep on Subsequent Scouring—The removal from cotton of the constituents which are soluble in water prior to the scour yields an appreciably better final result, the elimination of fat and wax being more complete, the Methylene Blue absorption significantly lower, and, perhaps most important, the "white" superior. The acid steep leads to similar results, the final wax contents and Methylene Blue absorptions being, if anything, a little lower, whilst the "white" of the scoured material is definitely superior to that attained by the inclusion of the water steep. This is perhaps the most marked effect of acid treatment. It is in no way associated with tendering, for when the copper number of the grey material is raised significantly, the white finally attained is inferior to that produced when the acid treatment has caused no tendering. Slight tendering appears to facilitate the elimination of the constituents of cotton which cause the absorption of Methylene Blue, but as the tendering becomes more marked this effect is masked by the formation, by the action of the alkali on the hydrocellulose, of products which absorb Methylene Blue; this effect will be dealt with more fully in later work on hydrocellulose.

It may be concluded, therefore, that treatment with acids is superior to treatment with water prior to the scour, even though the amount of material eliminated by the two does not differ very greatly, and that it is desirable that the conditions of acid treatment should not produce a copper number of more than 0·2 due to the formation of hydrocellulose, not only on account of the loss in weight and in strength on subsequent scouring, but also because of the adverse effect on the white finally attained.

The Effects of Typical Enzyme Preparations—Experiments with a number of typical enzyme preparations used in the desizing of cotton goods have shown that their action on cotton itself is almost identical with that of water under similar conditions. The steeping losses are practically identical, and the elimination of waxy, nitrogenous, and reducing substances is in no case more thorough than when water alone is employed, whilst scouring trials subsequent to the steep indicate that no appreciable degradation of the Methylene Blue absorbing constituents has taken place.

Table I.

Steeping Losses

Sample	Loss in Weight (per cent.) on extraction with— *N*/10 HCl (20° C.)	Water (20° C.)
American—		
149, Texan	2·4	2·2
16, Texan	2·15	—
142, Upland	1·5	1·4
152R2, Upland	1·9	—
154, Salsbury	2·2	2·1
212, Memphis	2·4	2·4
75, Long-staple Upland, Webber 82	2·6	2·4
South American—		
150, Tanguis	2·8	2·7
W.C. 41, Tanguis	1·9	—
153, Peruvian Mitafifi	2·6	2·5
152, Long-staple Brazilian	2·9	2·75
W.C. 49, Peruvian Mitafifi	1·7	—
W.C. 53, Peruvian smooth (fine)	2·7	—
W.C. 61, Pernam	2·3	2·1
W.C. 64, Ceara	2·4	—
Egyptian—		
148, Sakel	3·1	3·0
157, Sakel, Government type 30	2·25	—
156, Sakel	2·5	2·5
158, Uppers, Government type 4	2·1	—
133, Uppers	2·6	2·3
155, Pillion	2·0	—
140, White Abassi	2·6	2·6
73, Brown Egyptian (Mitafifi type)	2·5	—
151, Pima (grown in Arizona)	3·75	3·4
Sea Island—		
92	1·5	1·45
159	1·5	—
14	1·7	1·6
Indian—		
W.C. 13, Broach	4·2	4·0
141, Broach	3·3	3·05
W.C. 1, Surtee	3·3	—
201, Surat, 1027 A.L.F.	4·1	3·9
192, Gadag, No. 1	3·65	3·6
198, Cambodia	2·15	2·1
194, Sircar, 14	3·3	3·05
W.C. 3, Oomra, No. 1, fine M.G.	2·45	2·3
160, Oomra	2·45	—
W.C. 9, Bengal, fine M.G.	2·7	—

Table II.

Effect of Temperature on Steeping

Sample and Treatment	Loss in Weight (per cent.) on steeping at 20° C.	40° C.	60° C.	90° C.
142, American Upland, *N*/10 HCl	1·5	1·65	1·95	—
142, American Upland, water	1·4	1·6	1·7	2·3
149, Texan, *N*/10 HCl	2·4	2·6	3·05	—
141, Broach, water	3·1	3·5	3·7	3·8

EXPERIMENTAL

Loss in Weight on Steeping

Hanks of yarn of known weight and predetermined moisture content were wetted out by hand as thoroughly as possible in the liquid (water or $N/10$ hydrochloric acid), and then transferred to round-bottomed flasks, covered with the liquid, and the flasks evacuated and shaken frequently to remove air bubbles. After a few minutes the pressure was released and the process repeated until no more air could be removed, when the wetting was considered to be complete. The yarn was then left in contact with the liquid overnight at 20° C., and finally washed very thoroughly with water and dried first at room temperature and finally at 110° C. until constant in weight, the steeping loss being calculated on the bone-dry weight of the grey material. The results (Table I.) show that the losses in weight of American cottons on steeping with acid vary from 1·5% to 2·6%, the mean for seven samples examined being 2·2%. South American varieties lose from 1·7% to 2·9%, with a mean value for eight samples of 2·4%, whilst typical Egyptian growths lose 2·0% to 3·7%, the mean for nine samples being 2·6%. Sea Island varieties lose rather less, three samples showing a variation of 1·5% to 1·7%, whilst Indian cottons are, in general, characterised by higher losses, the variation over a range of ten samples being 2·2% to 4·2%, with a mean of 3·2%. Corresponding experiments with water indicate that the losses incurred on thorough treatment with cold water are only slightly lower than those caused by the dilute acids.

As the temperature of treatment is raised there is, as might be expected, a gradual increase in the losses observed (Table II.).

Effect of Steeping on the Ash Content and Ash Alkalinity

In a series of nine cottons (Table III.), the ash content after treatment with acid varied between 0·02% and 0·06%, the ash alkalinity running roughly parallel and varying from 0·16% to 0·56%. Treatment with water proved to be less effective, the ash contents of the same cottons varying from 0·15% to 0·25%, and the ash alkalinities from 4 to 6. Thorough treatment with mineral acids, therefore, removed an average of 97% and corresponding treatment with water an average of 84% of the mineral matter initially present. Experiments on a single American cotton (Table IV.), with hydrochloric, sulphuric, and acetic acids, indicated rather less thorough elimination of mineral constituents when acetic acid was employed.

Table III.
Effect of Steeping on the Ash Content and Ash Alkalinity

Cotton	Raw		After Acid steep		After Water steep	
	Ash %	Ash alkalinity	Ash %	Ash alkalinity	Ash %	Ash alkalinity
149, Texan	1·14	16·47	0·02	0·22	0·15	4·46
— Texan	1·15	16·20	0·035	0·18	0·19	4·63
— Texan	1·11	15·80	0·03	0·16	0·16	4·55
142, Upland	1·08	14·46	0·035	0·26	0·19	4·50
154, Salsbury	1·26	18·19	0·04	0·22	0·16	4·14
157, Sakel, ex-super ...	1·20	18·62	0·06	0·26	0·25	5·41
156, Sakel	1·23	18·73	0·06	0·56	0·20	5·09
W.C. 13, Broach	1·58	21·54	0·05	0·54	0·26	5·95
W.C. 3, Oomra	1·07	15·45	0·05	0·25	0·19	4·14

Table IV.

Comparative Effects of Water and Different Acids

Sample	Loss in Weight (per cent.)	Ash content	Ash alkalinity
154, Salsbury cotton—		%	
Grey	—	1·26	18·19
Steeped in $N/10$ HCl at 20° C.	2·3	0·04	0·22
„ $N/10$ H_2SO_4 at 20° C.	2·3	0·04	0·33
„ $N/10$ acetic acid at 20° C.	2·3	0·09	1·77
„ in water at 20° C.	2·15	0·16	4·14

Elimination of Nitrogenous Constituents

The removal of nitrogenous constituents during steeping is exceedingly variable. Eight samples (Table V.) lost from 7% to 31% of the nitrogen initially present on steeping with water, and from 16% to 35% with dilute hydrochloric acid. With rise in temperature there is a gradual though slight increase in the amount eliminated.

Table V.

Effect of Steeping on the Nitrogen Content

Sample and Temperature of treatment	Nitrogen (per cent.) in			Proportion of Nitrogen (per cent.) removed in	
	Grey	Acid steeped	Water steeped	Acid steep	Water steep
154, Salsbury ... ... 20° C.	0·161	0·127	0·145	20·8	7·9
142, Upland ... ... 20° C.	0·172	0·131	0·142	24·1	17·7
„ „ ... ... 40° C.	„	—	0·112	—	35·0
„ „ ... ... 60° C.	„	0·107	0·108	37·7	37·6
„ „ ... ... 90° C.	„	—	0·108	—	37·6
149, Texas ... ... 20° C.	0·180	0·122	0·124	32·1	31·3
„ „ ... ... 60° C.	„	0·113	0·119	37·4	34·0
156, Sakel ... ... 20° C.	0·250	0·201	0·216	19·4	13·4
157 „ Govt. type 30 20° C.	0·230	0·189	0·198	17·6	13·7
148 „ ... ... 20° C.	0·227	—	0·192	—	15·0
151, Pima ... ... 20° C.	0·432	—	0·382	—	11·0
141, Broach ... ... 20° C.	0·234	—	0·192	—	28·0
„ „ ... ... 40° C.	„	—	0·162	—	30·8
„ „ ... ... 60° C.	„	—	0·148	—	36·7
„ „ ... ... 90° C.	„	—	0·140	—	40·2
W.C. 13, Broach ... 20° C.	0·267	0·172	0·183	35·5	31·4
W.C. 3, Oomra ... 20° C.	0·147	0·103	0·103	30·2	30·2
W.C. 41, Tanguis ... 20° C.	0·142	0·119	—	15·8	—

Removal of Reducing Substances

The removal of reducing substances initially present in the cotton is effected equally as well by water as by dilute acids, the initial copper number of the grey yarns usually falling to a figure between 0·3 and 0·5 as a result of the treatment (Table VI.), only one of the samples—Pima—behaving abnormally. Though a high copper number is usually associated with a high steeping loss, there is no correlation between the copper number and the steeping loss, or between the fall in copper number and either the total or the non-nitrogenous organic material removed during the steep (Table VII.).

Table VI.

Effect of Steeping on the Copper Number

Cotton	Copper Number: Raw	After Acid steep (20° C.)	After Water steep (20° C.)
149, Texas	1·15	0·35	0·34
154, Salsbury	1·39	0·30	0·28
212, Memphis	0·74	0·29	0·27
148, Sakel	1·13	0·54	0·53
133, Uppers	1·08	0·50	0·49
140, White Abassi	0·75	0·37	0·31
151, Pima	1·76	1·05	1·04
94, Sea Island	0·53	0·36	0·35
W.C. 13, Broach	2·97	0·47	0·44
141, Broach	2·03	0·44	0·42
W.C. 1, Surtee	2·28	0·46	0·46
201, Surat, 1027 A.L.F.	2·34	0·35	0·35
192, Gadag No. 1	2·34	0·40	0·40
198, Cambodia	0·79	0·35	0·35
194, Sircar 14	1·05	0·48	0·43
W.C. 41, Tanguis	0·77	0·38	0·36
150, Tanguis	0·70	0·36	0·32
153, Peruvian Mitafifi	0·96	0·56	0·52
152, Brazilian, long staple	1·43	0·43	0·41

Table VII.

Sample	Total Organic Matter removed during the steep %	Non-nitrogenous Organic Matter removed during the steep %	Fall in Copper Number during the steep
149, Texas	1·28	0·9	0·8
154, Salsbury	0·98	0·76	1·09
150, Tanguis	1·7	1·6	0·38
148, Sakel	2·0	1·8	0·8
151, Pima	2·1	1·8	0·72
141, Broach	1·9	1·3	1·6
W.C. 13, Broach	2·7	2·1	2·5

Effect of Steeping on the Fat and Wax

In studying the effects of steeping on the fat and wax present in grey yarns, the conditions of treatment with acids have been limited to such as would produce a copper number of 0·2 due to the formation of hydrocellulose, for reasons given elsewhere (p. T41). There appeared to be three points of interest: first, whether appreciable hydrolysis occurred; secondly, whether the elimination of the water-soluble constituents of the cotton rendered more open to attack any fatty material otherwise protected by their presence; and thirdly, whether, as both Higgins[4] and Knecht[5] have suggested, there were present initially in the cotton insoluble soaps from which the acids were liberated by the action of mineral acids.

With respect to the first point, treatment with dilute acids effects no appreciable hydrolysis. Typical figures are given in Table VIII. The differences between the amounts realised from the cottons by direct extraction and by extraction after souring are very small, so to examine the second and third points measurements of rates of extraction before and after steeping were undertaken, the initial treatment of the grey yarn with carbon tetrachloride or chloroform being continued until the rate of extraction became exceedingly slow, at which point the material was treated thoroughly with water or cold dilute acid, dried without heating, and the extraction continued (Tables IX. and X.). The rate of extraction increases after the cotton has been thoroughly washed with water. This is presumably due to two causes (*a*) the removal of soluble constituents of the cotton which may have precluded extraction to a slight extent, and (*b*) facilitation of the extraction of the small amount of fat and wax which remains by the complete renewal of the solvent in contact with the cotton; the second of these appears to be the more important. As the effect of treatment with acids is greater, it is reasonable to assume that some liberation of fatty acids present initially as soaps takes place. The effect is repeated (Table IX.) owing to the complete replacement of solvent already mentioned, and to the persistency of retention of a small ash alkalinity by cotton (Table III.), which is due, no doubt, in part to the difficulty of decomposing insoluble soaps of fatty acids without fairly drastic treatment.

The evidence adduced by Higgins[4] for the presence of insoluble soaps rested solely on the presence of magnesium in the acid washings. The comparative effects of water and dilute acids show that the additional extracts can be due only in part to this cause. Further evidence may, however, be obtained by comparing the acid values of the extracts obtained before and after souring, for if acids have been liberated the acid values of the subsidiary extracts should be much higher than those of the initial extracts. The following figures are typical—

Sample	Acid Value of Extract obtained— Before Souring	After Souring
107R, American Upland	29	77
142, 36's American	27	97
219, 2/50's Sakel	30	76

The fact that the extracts do not consist wholly of acidic material is most readily shown by the isolation of a sufficient amount of the subsidiary extract for more complete micro-analysis. The extract from sample 142, for example, proved to have the following properties—Acid value, 97; saponification value, 141; ester value, 44; unsaponifiable matter, 16%. The extract was resinous rather than waxy in appearance, and gave a pronounced sterol reaction with acetic anhydride, chloroform, and sulphuric acid.

The figures quoted by Higgins[4] and by Knecht[5] for the amounts of these subsidiary extracts are markedly different, for whilst the former obtained from 5% to 10% of the weight of the initial extract, the latter obtained from 25% to 61% for a series of five representative cottons. The discrepancy is due most probably to incomplete extraction of the grey material, using the conditions employed by Knecht, as is shown by the extraction data published in an earlier communication,[2] whilst unsatisfactory methods of drying the extracts to constant weight probably account very largely for the consistently high figures obtained both for the initial and subsidiary extracts. In a number of cases examined, using routine methods of extraction as opposed to the rate of extraction measurements already cited, the subsidiary extracts obtained as a result of treatment with acids after thorough extraction with chloroform have varied between 9% and 18% of the initial extract, and therefore agree with the determinations quoted by Higgins rather than those cited by Knecht.

Briefly, therefore, within the limits set by possible tendering of the cotton, hydrolysis of the natural fat and wax will not occur as a result of acid steeping; treatment with water or with dilute mineral acids prior to the scour may render more open to attack a relatively small amount of wax; whilst treatment with acids will, in addition, liberate the acids from a proportion of the small amount of insoluble soaps initially present in the cotton.

Table VIII. Effect of Acid Steeping on the Amount and Properties of the Wax

Sample	Treatment	Carbon tetrachloride extract (per cent.)	Properties of Extract		
			Acid value	Saponification value	Ester value
142, Upland ...	Untreated ...	0·42	23	55	32
	Steeped in $N/10$ HCl at 50° C.	0·44	31	60	29
156, Sakel ...	Untreated ...	0·42	32	83	51
	Steeped in $N/10$ HCl at 40° C.	0·45	31	81·5	50·5
W.C. 3, Oomra*	Untreated ...	0·33	43	147	104
	Steeped in $N/10$ HCl at 40° C.	0·30	41	142	101

Table IX. Effect of Steeping on Extraction with Carbon Tetrachloride

American Yarn No. 142

Treatment	Time of Extraction hours	Successive Extracts	Total Extract	Rate of Extraction (mgr. per 100 grs. per hour)
Grey ...	6	0·463	0·463	77
	6	0·020	0·483	3·3
	6	0·009	0·492	1·5
Soured with $N/10$ HCl, 20° C.	1·5	0·029	—	19
	3	0·011	0·040	3·7
	4	0·008	0·048	2·0
Re-soured ...	1·5	0·013	—	8·7
	3	0·003	0·016	1
	4	0·006	0·022	1·5
Re-soured ...	1·5	0·0085	—	5·7
	3	0·0025	0·011	1
	4	0·004	0·015	1
Re-soured ...	1·5	0·010	—	6·7
	3	0·003	0·013	1
Grey ...	6	0·446	—	74
	6	0·018	0·464	3
	6	0·010	0·474	1·7
Steeped in water, 20° C. ...	1·5	0·013	—	8·7
	3	0·009	0·022	3
	4	0·003	0·025	1
Soured with $N/10$ HCl, 20° C.	1·5	0·019	—	13
	3	0·003	0·022	1
	4	0·006	0·028	1·5

Table X. Effect of Steeping on Extraction with Chloroform.

(American Yarn 142).

Treatment	Time of Extraction hours	Successive Extracts	Total Extract	Rate of Extraction (mgr. per 100 grs. per hour)
Grey ...	6	0·523	0·523	87
	6	0·026	0·549	4·3
	6	0·014	0·563	2·3
Soured with N/10 HCl at 20°C.	1·5	0·029	0·029	19
	3	0·013	0·042	4·3
	4	0·009	0·051	2·2
Grey ...	6	0·515	0·515	86
	6	0·048	0·563	8
	6	0·014	0·577	2·3
Steeped in water at 20° C. ...	1·5	0·013	0·013	8·7
	3	0·008	0·021	2·7
	4	0·005	0·026	1·2

The Relative Tendering of Grey and Scoured Yarns by Acids

Birtwell, Clibbens, and Geake[1] have shown that for technically scoured Egyptian cotton the relation between copper number and time of acid action is closely expressed by the equation—

$$N_{Cu} = K.T^{0\cdot6}$$

where N_{Cu} symbolises copper number and T the time of treatment, whilst K is a constant under definite conditions of acid treatment (concentration and temperature). It appeared improbable that the same relationship would hold in the case of raw cottons, owing to the numerous possible causes of divergent behaviour, for example (1) the presence of insoluble reducing substances which might be hydrolysed to soluble products or might consist of hydrocellulose, and thus modify the course of the subsequent action; (2) the presence of insoluble nitrogenous and other constituents which might introduce further complications by leading to the formation of insoluble reducing products; and (3) the presence of fat and wax which might exercise some protective action, and thus reduce the rate of tendering of the grey yarns relative to that of corresponding scoured samples.

As only the early stages of acid attack are of importance in connection with the grey sour, it was decided to compare the effect of treating thoroughly washed grey yarns and corresponding well-scoured samples with $N/2$ sulphuric acid at 40° C.; if marked divergences in behaviour were found, it would be obvious that copper number measurements were of doubtful value in determining the extent of acid attack of grey material; whilst a close similarity in the behaviour of the two would justify the assumption that the formation of insoluble reducing substances was due essentially to acid attack of the cellulose itself, in which case copper number determinations would provide an adequate measure of the extent to which yarns or cloths had been modified during the grey sour.

The experiments (Table XI.) which have been carried out with American (Texan), Egyptian (Sakel), and Indian (Broach) yarns—(*a*) thoroughly washed, and (*b*) well scoured by treatment with 1% sodium hydroxide for 12 hours at 20 lb. excess pressure—show that the equation deduced above holds exactly for the increase in the copper numbers of the grey yarns above the values for the thoroughly washed specimens, the copper numbers due to acid attack being in all three cases additive to these. This is shown by the constancy of the value of K (Table XII.). As the maximum increase in copper number measured during the experiments was 0·7, the results are a valuable comment on the reliance which may be placed on the measurement of even small copper numbers. The comparative experiments with scoured material have yielded results which necessitate the use of a higher exponent than that deduced by Birtwell, Clibbens, and Geake, and are expressed closely by the equation—

$$N_{Cu} = K.T^{0\cdot7}$$

The difference is probably due to variations in the scouring processes employed, as the material used in the present experiments had been very thoroughly scoured in the laboratory and had therefore a lower wax content and Methylene Blue absorption than that used in the earlier work.

Grey cotton is, therefore, a little more slowly attacked than scoured, in all probability because of the protective action of fatty and other constituents.

Table XI.

Relative Tendering of Grey and Scoured Yarns

Time of Treatment with $N/2$ Sulphuric Acid at 40° C.	Increase in Copper Number, Grey Yarns			Increase in Copper Number, Scoured Yarns		
	Texan 149	Sakel 219	Broach 141	Texan 149	Sakel 219	Broach 141
hours						
5	0·09	0·08	0·08	0·07	0·075	0·07
11·5	0·17	0·155	0·14	—	—	—
15	—	—	—	0·17	0·18	0·175
18	0·22	0·19	0·20	—	—	—
28	0·28	0·25	0·28	—	—	—
30	—	—	—	0·28	0·29	0·30
45	0·39	0·36	0·34	—	—	—
48	—	—	—	0·39	0·39	0·385
72	0·53	0·48	0·46	0·52	0·52	0·53
96	0·60	0·55	0·56	0·67	0·66	0·66

Effect of the Steep on Subsequent Scouring

(*a*) *Treatment with Water or with Dilute Acids in the Absence of Tendering*—In order to render the results as widely applicable as possible, the experiments have been carried out on an American (Texan), an Egyptian (Sakel), and an Indian (Broach) yarn.

Whatever the subsequent treatment with caustic alkali, thorough washing with water prior to the scour occasions a rather more efficient removal of the natural impurities of the cotton, as judged by the loss in weight on scouring, the residual wax content, and the absorption of Methylene Blue by the scoured material. Typical results are shown in Tables XIII. and XIV. There is, however, another and perhaps more important effect of the preliminary treatment, for it invariably causes an improvement in the white obtained after scouring. As the severity of the scouring process is increased, these differences become relatively less marked; this was to be expected, for it has been shown already[3] that greater severity of treatment, whether caused by increasing the concentration of the caustic alkali, or by increasing the temperature or time of treatment, results not only in lower wax contents and Methylene Blue absorptions, but also in a superior white, and therefore tends to minimise the effect of the pre-treatment.

As steeping with water or with dilute acids produces very similar results, it was anticipated that little significant difference would be found between samples steeped by the two processes and subsequently scoured. When the acid steep has been employed, however, the wax contents and Methylene Blue absorptions of the scoured samples tend to be lower, whilst the white attained is definitely superior. Lower final wax contents were perhaps to be expected in view of the decomposition of small amounts of insoluble soaps initially present in the cotton by the preliminary treatment with acid, whilst the effect on the Methylene Blue absorption is consistent with the results of later experiments (Table XV.) in which the yarns have been slightly tendered, which suggest that there are substances present in the cotton which are more easily eliminated by alkalis after a slight acid attack. The removal of soaps would, in view of their effect on Methylene Blue absorption from neutral solution, act in the same direction. The more efficient removal of colouring matter was more unexpected, however, and

Table XII.—Relative Tendering of Grey and Scoured Yarns by $N/2$ Sulphuric Acid at 40° C.

Sample	Time of Treatment T, days	0·48	0·625	0·75	1·17	1·25	1·87	2	3	4	Mean
149, Texan, acid-washed	Increase in copper number, N_{Cu} ...	0·17	—	0·22	0·28	—	0·39	—	0·53	0·60	
	Velocity constant, K	0·26	—	0·26	0·26	—	0·27	—	0·27	0·26	0·26
149, Texan, scoured and acid-washed	Increase in copper number, N_{Cu} ...	—	0·17	—	—	0·28	—	0·39	0·52	0·67	
	Velocity constant, K	—	0·24	—	—	0·24	—	0·24	0·24	0·25	0·24
219, Sakel, acid-washed	Increase in copper number, N_{Cu} ...	0·155	—	0·19	0·25	—	0·36	—	0·48	0·55	
	Velocity constant, K	0·24	—	0·23	0·23	—	0·25	—	0·25	0·24	0·24
219, Sakel, scoured and acid-washed...	Increase in copper number, N_{Cu} ...	—	0·18	—	—	0·29	—	0·39	0·52	0·66	
	Velocity constant, K	—	0·25	—	—	0·25	—	0·24	0·24	0·25	0·25
141, Broach, acid-washed	Increase in copper number, N_{Cu} ...	0·14	—	0·20	0·28	—	0·34	—	0·46	0·56	
	Velocity constant, K	0·22	—	0·24	0·25	—	0·23	—	0·24	0·24	0·24
141, Broach, scoured and acid-washed	Increase in copper number, N_{Cu} ...	—	0·175	—	—	0·30	—	0·385	0·53	0·66	
	Velocity constant, K	—	0·24	—	—	0·26	—	0·24	0·25	0·25	0·25

is probably the most significant technical difference between the two treatments, so far as cotton itself is concerned. The action of dilute acids in the region at present under discussion differs from that of water principally in the more efficient removal of the mineral constituents of the cotton, so it is possible that a portion of the material which contributes to the colour remaining after the scour is present initially in the form of salts which are less readily attacked by alkalis than the products liberated from them by the action of acids.

Table XIII.

Effect of Cold Grey Sour on Scouring Loss

(1% Caustic Soda at 100° C.)

Cotton	Loss in Weight (per cent.) scour only	Loss in Weight (per cent.) acid steep, 20° C., followed by scour
142, Upland	5·5	6·0
149, Texas	6·0	6·2
157, Sakel	6·4	6·8
158, Uppers	6·1	6·6
140, White Abassi	6·5	6·9
141, Broach	7·5	7·9

Table XIV.

Effect of the Steep on Subsequent Scouring

Yarn and Treatment	Properties of Scoured Material: Wax (%)	Methylene Blue	Copper Number
149, 36s Texan yarn, scoured for 6 hours in open kier—			
Without steeping	0·36	1·10	0·03
After steeping in water	0·22	1·07	0·04
After steeping in *N*/5 sulphuric acid	0·18	0·94	0·02
148, 50/2s Sakel, scoured as above—			
Without steeping	0·40	1·40	0·065
After steeping in water	0·26	1·29	0·07
After steeping in *N*/5 sulphuric acid	0·22	1·20	0·07
149, 36s Texan, scoured at 20 lb. with 1% sodium hydroxide—			
Without steeping	0·20	0·91	0·01
After steeping in water	0·15	0·90	0·03
After steeping in *N*/5 sulphuric acid	0·11	0·85	0·04
148, 50/2s Sakel yarn, scoured at 20 lb.—			
Without steeping	0·26	1·04	0·04
After steeping in water	0·19	1·03	0·02
After steeping in *N*/5 sulphuric acid	0·18	0·97	0·03
222, 36s Texan yarn, scoured for 3 hrs. at 100° C.—			
Without steeping	0·29	1·11	0·03
After steeping in water	0·19	1·06	0·01
After steeping in *N*/5 sulphuric acid	0·16	1·04	0·01
219, 50/2s Sakel yarn, scoured as 222—			
Without steeping	0·32	1·43	0·09
After steeping in water	0·19	1·40	0·03
After steeping in *N*/5 sulphuric acid	0·17	1·32	0·04
141, Broach 20s yarn, scoured as 222—			
Without steeping	0·33	1·62	0·04
After steeping in water	0·25	1·58	0·04
After steeping in *N*/5 sulphuric acid	0·23	1·49	0·04

(*b*) *The Effect of Slight Progressive Tendering*—When a scoured yarn is tendered by treatment with acids and then boiled with alkali, it suffers a loss in weight proportional to the copper number produced by the acid treatment, the loss (per cent.) being approximately sixfold the value of the copper number. Even the very early stages of acid attack cause a significant loss in strength, which is not, however, increased by boiling with alkalis until a copper number approaching 1 is reached.[1] On these grounds it is desirable that treatment with acids during the grey sour should be limited by conditions which produce a copper number of 0·2 due to the formation of hydrocellulose. Within this range (Table XV.) it is probable that the action of the acid facilitates the removal of certain constituents of the cotton which contribute to its absorption of Methylene Blue, but as the extent of tendering increases this effect is masked by the formation from the hydrocellulose of products which cause absorption of Methylene Blue. This is well demonstrated by the results shown in Table XVI., in which corresponding figures are given for scoured yarns; the effect will be dealt with more fully in later work on hydrocellulose.

Table XV.

Effect of Slight Progressive Tendering During Grey Sour

Sample and Treatment	Copper No.	Properties after scouring in the open kier			Properties after scouring at 20 lb. pressure		
		Wax (%)	Methylene Blue absorption	Copper Number	Wax (%)	Methylene Blue absorption	Copper Number
Sakel yarn, 149—							
Steeped in cold acid	0·51	0·22	1·20	0·07	0·13	1·04	0·03
Tendered by treatment with *N*/2 sulphuric acid at 40° C.	0·69	0·23	1·18	0·08	0·15	1·03	0·07
	0·80	0·20	1·16	0·11	0·14	1·02	0·04
	0·95	0·18	1·26	0·17	0·13	1·09	0·05
Texan yarn, 148—							
Steeped in cold acid	0·26	0·18	0·94	0·02	0·11	0·85	0·04
Tendered by treatment with *N*/2 sulphuric acid at 40° C.	0·40	0·18	0·88	0·06	0·11	0·84	0·06
	0·52	0·16	0·91	0·10	0·10	0·88	0·08
	0·67	0·15	0·96	0·16	0·11	0·93	0·17

Table XVI.

Effect of Acid Tendering of Scoured Yarns

Sample and Treatment	Copper No.	Properties after scouring in open kier (100° C.)		Properties after scouring at 20 lb. pressure	
		Methylene Blue absorption	Copper Number	Methylene Blue absorption	Copper Number
149, *Sakel yarn, scoured for 12 hours at 20 lb. with 1% NaOH*—					
Steeped in cold acid	0·01	0·98	0·01	0·90	0·02
Progressively acid-tendered samples	0·25	0·96	0·08	0·94	0·05
	0·5	1·00	0·12	0·96	0·09
	1·0	1·06	0·33	1·09	0·18
141, *Broach yarn, scoured as above*—					
Steeped in cold acid	0·01	1·24	0·01	1·26	0·02
Progressively acid-tendered samples	0·29	1·19	0·07	1·20	0·08
	0·55	1·13	0·16	1·12	0·07
	1·10	1·14	0·37	1·29	0·17

A small loss in strength due to the action of acids during a grey sour would probably be considered of little significance if the slight tendering were advantageous during subsequent scouring. Apart, however, from the effect on Methylene Blue absorption already noted, nothing is gained, whilst the white attained by the scour is adversely affected to an extent roughly proportional to the tendering of the grey material. It will be shown later in dealing with technical steeping processes that tendering during the grey sour often contributes to an inferior white, not only in the scoured but also in the fully bleached material, so that it is desirable, not only on grounds of loss in weight and loss in strength, but also from the standpoint of the appearance of the bleached material, that the conditions of treatment during acid steeping should be limited as suggested above.

The Effect of Steeping with Typical Enzyme Preparations

The enzyme preparations commonly employed in the cotton industry are used primarily for the purpose of eliminating the starch added during sizing. In some cases, however, they are stated to have additional advantages, for example, the power of hydrolysing or emulsifying fats, or of degrading proteins, pectins, or similar substances. The ensuing experiments have had, therefore, a twofold object—first, to find whether any of the preparations in common use acted in any way on the cotton itself, and, secondly, to ascertain whether any action occurred which limited the application of the control tests outlined on p. T30.

The experiments have been carried out with two cottons, representing the extremes met with in normal practice—a typical American yarn with a low scouring loss, and a typical Indian yarn with a high scouring loss. These have been submitted to the action of two or more samples of each of five preparations marketed for use in desizing—Malt Powder, Diastafor, Rapidase, Novofermasol, and Polyzime C. The conditions of treatment have been optimum with respect to the elimination of starch, save in the case of Rapidase, which was used at a temperature of 80–90° C., which, though stated to be optimum with respect to its action on starch, has since been found to be markedly higher than the optimum. The concentrations and ratios of enzyme to cotton have been kept higher than are generally met with in practice, so that in the absence of any action in the present experiments, it is very unlikely indeed that any notable effect would be encountered in technical practice.

The results of the steeping experiments (Tables XVII. and XVIII.) show that neither elimination of nitrogenous constituents, nor removal or formation of reducing substances, takes place as a result of the action of the preparations. Further, as the losses in weight incurred by corresponding treatment with water are in all cases practically identical with those caused by the use of the enzyme preparations, there is no evidence of other reactions leading to the solubilisation of non-cellulose constituents of the cotton. Measurements of ash content and ash alkalinity are not given in the tables, but identical results were obtained with water and with the enzyme solutions.

The tables contain a few figures which call for comment. For example, the treatment with malt powder has apparently resulted in a less thorough removal of nitrogenous material than occurs with water alone; this is due, however, to the absorption of nitrogenous material by the cotton from the malt preparation. The effect is marked owing to the relatively small amount of nitrogenous material eliminated and to the ratio of enzyme preparation

Table XVII.

American Cotton 142. Effect of Water and Enzyme Steeping

Treatment	Loss in weight (%)	Fall in Nitrogen content (%)	Fat and Wax (%)	Acid Value	Copper Number
Malt powder, 40° C.	1·6	18	0·52	41	0·31
Water, 40° C.	1·7	35	0·43	30	0·30
Diastafor, 60° C.	1·7	34	0·43	28	0·30
Water, 60° C.	1·7	38	0·42	23	0·30
Rapidase, 86·5° C.	2·3	48	0·38	27	0·30
Water, 86·5° C.	2·3	38	0·42	26	0·29
Novofermasol in 0·5% NaCl, 55–60° C.	1·7	45	0·64	61	0·31
0·5% NaCl	1·8	43	0·42	23	0·30
Polyzime C, 40° C.	2·2	40	0·47	32	0·30
Water, 40° C.	1·7	35	0·43	30	0·30

Table XVIII.

Broach Yarn 141. Effect of Water and Enzyme Steeping

Treatment	Loss in weight (%)	Fall in Nitrogen content (%)	Copper Number
Malt powder, 40° C.	3·5	18	0·38
Water, 40° C.	3·5	31	0·33
Diastafor, 60° C.	3·5	32	0·33
Water, 60° C.	3·7	37	0·30
Rapidase, 86·5° C.	3·9	42	0·29
Water, 86·5° C.	3·8	40	0·26
Novofermasol, 60° C. in 0·5% NaCl	3·3	37	0·35
0·5% NaCl, 60° C.	3·5	37	0·30
Polyzime C, 40° C.	3·5	31	0·33
Water, 40° C.	3·5	31	0·33

Table XIX.

Effect of Steep on Subsequent Scour

Steeping Process	Scoured in open kier (100° C.)		Scoured at 20 lb.		
	Methylene Blue absorption	Copper Number	Methylene Blue absorption	Copper Number	Log Viscosity (2% solution)
American yarn, 142—					
Diastafor, 60° C.	1·05	0·05	0·85	0·02	2·75
Novofermasol, 60° C.	1·05	0·05	0·87	0·02	2·63
Water, 60° C.	1·04	0·05	0·88	0·02	2·80
Malt powder, 40° C.	1·02	0·05	0·84	0·01	2·86
Polyzime C, 40° C.	1·05	0·07	0·86	0·01	2·78
Water, 40° C.	1·04	0·05	0·86	0·01	2·81
Rapidase, 86·5° C.	1·08	0·05	0·86	0·02	2·80
Water, 90° C.	1·04	0·05	0·90	0·00	2·78
Broach yarn, 141—					
Diastafor, 60° C.	1·62	0·05	1·30	0·01	—
Novofermasol, 60° C.	1·66	0·06	1·39	0·01	—
Water, 60° C.	1·61	0·04	1·38	0·01	—
Malt powder, 40° C.	1·59	0·03	1·37	0·01	—
Polyzime C, 40° C.	1·63	0·05	1·39	0·01	—
Water, 40° C.	1·60	0·04	1·34	0·01	—
Rapidase, 86·5° C.	1·62	0·05	1·34	0·02	—
Water, 90° C.	1·61	0·04	1·36	0·00	—

to cotton being higher than would obtain in normal works practice. There are also two abnormal figures for fat and wax; these are due to a similar cause—absorption of fatty material from the suspension of the enzyme preparation. The Novofermasol preparation, for example, contained 4·6% of fat, analysis of which (found, acid value, 174; saponification value, 200) indicated that it consisted essentially of free fatty acids. Further experiments, in which lower ratios of enzyme to cotton were used, and the possibility of absorption of fatty material from the enzyme preparation excluded, showed that in no case does appreciable hydrolysis of the fat and wax occurring naturally in the cotton take place, and that in corresponding experiments in which sized yarns containing tallow or Japan wax were used, hydrolysis of the fat and wax was never sufficiently marked to affect appreciably the removal during subsequent scouring operations.

It is clear, therefore, that so far as can be ascertained from the loss in weight on steeping, and the effect of the steep on the ash content, ash alkalinity, nitrogen content, wax content, properties of the fat and wax, and the copper number, steeping with the enzyme preparations commonly employed in the industry is without effect on the cotton itself. It was still possible, however, that the insoluble minor constituents of the cotton might have been modified in such a manner as would assist their removal during subsequent scouring. As no appreciable effect was to be anticipated on the fat and wax, measurements on the scoured samples have been confined to copper number, Methylene Blue absorption, and, after the pressure boil, the determination of viscosity in 2% solution in cuprammonium hydroxide, the last owing to statements which have appeared from time to time that steeping with enzyme preparations may lead to tendering.

The results (Table XIX.) clearly indicate that the insoluble constituents of the cotton which contribute to its absorption of Methylene Blue are in no way affected by treatment with the preparations employed. As the viscosities of the scoured samples show no appreciable differences, it may be concluded also that tendering has not occurred as a result of any of the treatments. Nor were the whites of the samples scoured after treatment with the enzyme preparations appreciably better than when water alone has been employed at the same temperature.

So far as cotton itself is concerned, therefore, the effects of steeping with the enzyme preparations commonly employed for the removal of starch may be expected to be identical with those of corresponding treatments with water.

Mr. H. Naylor, F.I.C., assisted in comparing the tendering action of acids on grey and scoured yarns.

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4—A NOTE ON THE CHEMICAL DECOMPOSITION OF WOOL AT 100° C.

By John L. Raynes
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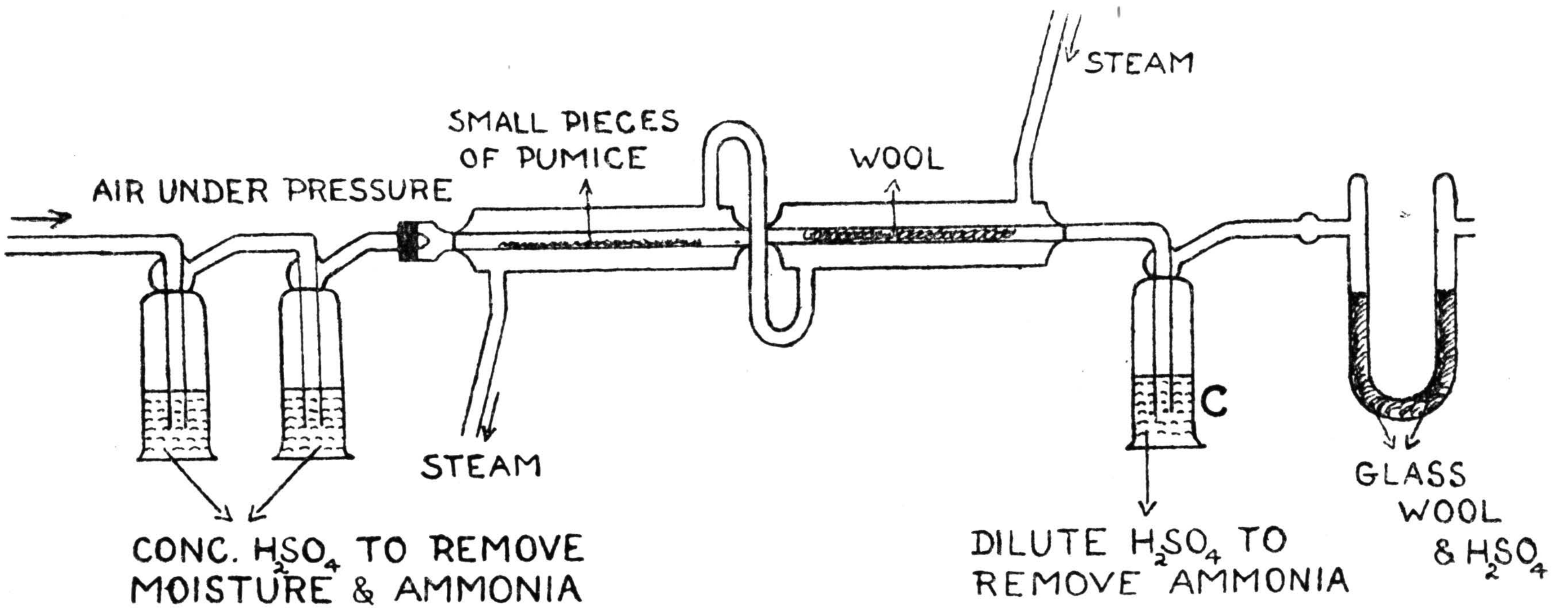
During the estimation of the nitrogen content of wool, it was observed that samples of the same wool had slightly different nitrogen values, according to the period of time they were dried in the steam oven. The longer they were heated the lower the nitrogen value. This indicated the loss of either free ammonia or of volatile nitrogen compounds during heating.

Experiment

A sample of woollen cloth was scoured by extraction with alcohol and washed thoroughly with warm distilled water. All excess water was squeezed out, and the wool was then sealed in a glass tube. After heating at 100° C. for 48 hours, the tube was broken under dilute acetic acid. (It was noticed that there was considerable pressure of gas in the tube, and on breaking quantities of H_2S were evolved.) The extracted liquor upon heating with caustic soda evolved considerable quantities of ammonia.

This experiment was then repeated with wool dried at 100° C.* previous to sealing in the tube. In 48 hours enough ammonia was produced to give a large precipitate with Nessler's solution.

It is well known that alkalis will readily decompose wool giving simpler amino-acids, together with free ammonia. Also all scoured wools contain appreciable amounts of free alkali, due to the hydrolysis in the fibre of natural or added soaps. Hence it was thought probable that the decomposition of wool when heated at 100° C. is due to the hydrolytic action of this alkali, and that possibly neutral wool would remain unaffected at this temperature.



The Decomposition of Neutral Wool when heated at 100° C.

To substantiate this, a quantity of neutral wool was prepared by the following method, for which the author is indebted to the Director of the British Research Association for the Woollen and Worsted Industries.

Preparation of Neutral Wool

A small piece of unscoured woollen fabric was dyed with a *p*H indicator. It was then placed with a quantity of the same material undyed, and the whole scoured by extraction with alcohol and ether, afterwards well rinsing with warm distilled water. To neutralise the free alkali present in the fibre, the wool, together with the dyed sample, was placed in a large volume of water, and $\frac{N}{100}$ sulphuric acid very slowly added from a burette until the wool was exactly neutralised, as indicated by the dyed portion. It was then washed thoroughly in ammonia-free distilled water, and dried by evacuation over concentrated sulphuric acid.

* Compare footnote on page T381 of Reference (1)

By means of the apparatus on p. 9, neutral wool containing known amounts of moisture was heated at 100° C. in a current of dry ammonia-free air, and any ammonia that was evolved was absorbed by the dilute acid contained in the wash-bottle, and subsequently estimated by Nessler's reagent.

Results

The following samples of wool were heated in a current of dry air at 100° C. for 26 hours.

(A) PURE NEUTRAL WOOL INITIALLY CONTAINING MOISTURE.

Moisture content=20·64% on weight of dry wool.

Nitrogen evolved as ammonia=0·0021% on weight of dry wool.

(B) PURE NEUTRAL "DRY" WOOL.

Nitrogen evolved as ammonia=0·00018% on weight of dry wool.

(C) WOOL CONTAINING ALKALI.

The above neutralised wool was treated with a solution of neutral Castile soap (4% on weight of wool) at 110° F. for one hour, and afterwards rinsed thoroughly in warm ammonia-free distilled water:

Initial moisture content=63% on weight of dry wool.

Nitrogen evolved as ammonia=0·105% on weight of dry wool.

(D) "DRY" WOOL CONTAINING ALKALI.

Nitrogen evolved as ammonia=0·0069% on weight of wool.

(E) PURE NEUTRAL WOOL CONTAINING MOISTURE.

Heated in a sealed tube at 100° C.

After heating for 26 hours, the tube was broken under dilute acetic acid (1%), and the liquor, after filtering, was examined quantitatively for ammonium salts.

Moisture content=47·1% on weight of dry wool.

Nitrogen evolved as ammonia=0·2176% on weight of dry wool.

Conclusions

From the above results it is evident that "dry" or initially moistened wool, in the total absence of alkalis, is not appreciably decomposed when heated in a current of dry air at 100° C. Moist wool, even if neutral, seems to be badly attacked by heating at 100° C. under such conditions that the moisture is retained. But slightly alkaline wool such as obtained by ordinary scouring methods, when similarly treated, is partially hydrolysed with evolution of ammonia, the action is much more considerable if the wool be moist.

The Action of Pure Water on Wool

During the experiments described in (1) it was hoped to ascertain whether sulphurous acid removes any substance from wool during the bleaching process. For this purpose a sample of wool, scoured with organic solvents, and then with warm distilled water, was extracted several times with cold distilled water. The final extract gave a slight organic residue when it was evaporated. The same piece of wool was therefore treated with about 20 successive quantities of cold water, being left for about 24 hours in each. It was found that approximately the same amount of matter was extracted each time, namely, 0·015 gram, from 40 grams of wool. The extract was found to contain nitrogen, and when ignited it left no residue. It must therefore be concluded that even cold water causes a very slight hydrolysis of the wool fibres.

The author is greatly indebted to Professor Kipping, F.R.S., for the constant interest which he has taken in this work.

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5.—A NEW METHOD FOR THE DETERMINATION OF THE FINENESS OF WOOL AND OF THE FLEECE

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METHODS FOR THE DETERMINATION OF THE FINENESS OF WOOL

Fineness is one of the most important qualities of wool, and much energy has been expended upon its measurement. Most of the scientific methods of measurement are based on a determination of fibre diameter, and nearly all results are stated in this form. On the other hand, the manufacturer uses a measurement, *viz.* the "counts," which represents the length to which a unit weight of wool can be spun. This quantity must depend largely on average fineness, and in as far as it does so is a statement of a weight-length ratio. The scientific methods for the measurement of fineness previously used can be grouped under three heads—(*a*) Those involving the magnification of the fibre; (*b*) those involving the use of accurate calipers; and (*c*) those involving the use of the micro-balance.

(*a*) The magnification of the fibre is by far the most widely used method. In its simplest form the fibre is mounted for microscopic examination, and its diameter determined by the use of the micrometer eyepiece. A modification of this method involves the projection of an enlarged image on to a screen; the diameter is measured on the screen, the magnification being known. A second modification involves the cutting of cross sections and a microscopic examination of these. These methods are in general use and are described in numerous papers.

(*b*) The use of engineer's calipers of extreme accuracy is described by Hill (1924), and in principle has a similar scope and a precisely similar object.

(*c*) The use of the micro-balance is described by Barker and King (1926). This method is very similar in principle to that suggested by the writer in this paper, in that both depend upon a determination of the weight-length ratio. Barker and King, however, did not use their method for this purpose, but converted the results into estimates of diameter. Portions of wool fibres all cut to the same length were weighed and their average diameter calculated from the weight so obtained.

The method suggested by the writer is extremely simple in principle, consisting in a determination of the length of fibre included in unit weight. What is measured is the number of centimetres of fibre that weigh a milligram.

THE NATURE OF THE INFORMATION PROVIDED BY THE VARIOUS METHODS

A comparison of the various methods in use for determining fineness falls naturally into two sections, first, an examination of the exact nature of the information provided, and, secondly, an examination of the efficiency of each method for the obtaining of this information from the point of view of accuracy and convenience. In this section the first question is discussed, questions of accuracy and convenience being discussed in the next section.

The methods briefly referred to above provide information as to fineness in two different forms, viz. diameter dimensions and the weight-length ratio. If fibres were studied that were solid homogeneous rods of uniform specific gravity, these quantities would be identical at least in the sense that either could be converted into the other by a mathematical operation. Barker and King present data that point to the conclusion that in the case of fibres that are practically free from an air-filled medulla there is a sufficiently accurate correspondence for practical purposes. Where fibres contain an air-filled medulla, however, the position is entirely altered; in such a case diameter measurement will indicate a far greater coarseness than will the weight-length ratio (Barker and King use this relation as the basis for an ingenious method for the estimation of the relative proportions of medulla, air, and solid wool substance in the fibre). As long as the exact nature of the information provided is clearly recognised, it would seem not to be a point of great importance as to which represents the most useful statement for scientific or technical purposes. One advantage of the weight-length ratio must be pointed out. It can readily and directly be related to other important fleece quantities, e.g.—

$$\frac{\text{Weight per unit area}}{\text{(Mgms. per sq. cm.)}} = \frac{\text{Density (No. of Fibres per sq. cm.)} \times \text{Average length (in cms.)}}{\text{Weight-length Ratio (cms. per mgm.)}}$$

Professor J. E. Duerden has pointed out to the writer that density might well be expressed not as the number of fibres per unit area, but as density in this sense multiplied by average thickness. Such a quantity could be most readily calculated from the terms of the above equation.

Wool fibres are of variable diameter. The diameter of a fibre can be expressed by plotting on a curve measurements taken at intervals along the fibre. A mean value for the fibre can be calculated, and the variance estimated in terms of the standard deviation. By means of the micro-balance, the weight-length ratio can be accurately calculated and, if desired, converted into terms of diameter. It would undoubtedly be necessary to make a great many microscopic measurements in order to obtain as accurate an estimate of the mean diameter as is directly obtained from the use of the micro-balance, but, on the other hand, this last method provides no measure of the variance. A sample of wool fibres consists of units of varying mean diameter. A complete description of the fineness of such a sample would be obtained by determining the mean diameter and the variance for each individual fibre. On the other hand, information in a shortened form could be expressed by using only the mean diameter of each fibre and from this calculating the mean diameter of the whole sample, the variance now being the deviations of the mean diameters of the fibres from this value. At present, the only methods that can give the complete information are the microscopic and the caliper methods. In practice, however, they are not usually employed in this way. The diameter of each fibre is measured usually at one, sometimes at two or more points, and a mean and standard deviation calculated. It must be pointed out that these values are sometimes treated as though each represented a complete fibre; for example, a few specially large fibres are noted, whereas they may actually be specially large portions of fibres. It would probably be fairer to consider that estimates of variance obtained in this way represent the variability of a sample considered as a single length of continuous fibre measured at various points along its length. The micro-balance enables the mean diameter of each fibre to be calculated, and from this a mean value for the sample and the variance of the individual mean diameters of the fibres compared with this. It should be noted that this information is not implied in that provided by the usual type of diameter measurement. It is possible that either might be specially desirable for certain purposes.

The weight-length method proposed in this paper gives an accurate estimate of the mean fineness of a sample, but does not give any estimate at all of the variance. There is no question that the most important quantity to determine is the mean value of the whole sample, and, for any purpose which is satisfied by the statement of single figures representing the relative fineness of different samples, it is adequate. It is probable that for some purposes and some wools this is sufficient for technical purposes, and in some cases is no less adequate for biological studies of fleece differences. It is impossible to conduct Mendelian experiments when the various characterisations can only be represented by complicated curves. For some purposes, however, a knowledge of the variance is necessary. For example, a single figure representing the average fineness of a Blackface fleece would have little meaning, however adequate it might be in the case of a Merino, a Southdown, or a Border Leicester. In such a case, there is the microscope or the micro-balance, and the choice must be determined by the exact nature of the information required, and the relative accuracy and convenience of the methods. The writer would be prepared, on the score of accuracy and simplicity, to urge the desirability of an estimate of the mean sample value being made by the weight-length ratio method, even if the variance had also to be calculated by microscope. It is, however, possible to approach the problem of the estimation of variance from other angles. The writer has described a method for the quantitative estimation of kemp, and by an extension of this method it may be possible to effect a sufficient preliminary separation (Roberts, 1926). It is hoped, too, to publish in a subsequent communication details of a method for the estimation of a quantity related to the variability of fineness and determined on a totally different principle.

SOME OBSERVATIONS ON THE ACCURACY AND CONVENIENCE OF THE VARIOUS METHODS

The writer is specially interested in the determination of fineness as a means of comparison of the differences between fleeces rather than for the examination of wool in bulk, though observations relative to the former consideration will often apply with some modification to the latter. In considering the fineness of a fleece, the first problem, which is common to all methods, is that of sampling. In certain cases it would be sufficient to know the fineness at one or more points; in others, knowledge is required concerning the variations throughout the fleece. It will probably be acknowledged, however, that if a method for the determination of fineness at a point is satisfactorily attained, the larger problem can readily be solved by an extension of the work. If it is desired to estimate fineness, say at the point of the shoulder, the first step will be to obtain a sample which might include the wool growing on, say, 1–2 square inches of skin. The exact area from which this initial sample will be taken will vary within certain limits, so that this process may be called "primary" sampling, the error of which must be determined. The actual determination will only be carried out on a fraction of the wool taken from the sheep. The sampling of the wool taken from the sheep in order to obtain a piece or pieces for determination may be called "secondary" sampling, and the error of this must also be discovered. One principle is fundamental—that it is absolutely necessary to separate out carefully for estimation a complete piece of the fleece and deal with every fibre contained in it. No one who has had experience of working with wool would deny that it is impossible to obtain a correct sampling by selecting fibres out of a mass of wool, because too great a proportion of the longer coarser fibres will inevitably be chosen. The question of accuracy involves a precise definition of the limits of sampling and experimental errors, and there is no question that, given sufficient time, the errors of all the methods can be satisfactorily determined. There is a great difference, however, in the laboriousness of the task. The far greater speed of the weight-length method suggested in this paper, and the fact that short cuts are possible owing to the greater simplicity of the quantities involved make a determination of the sampling and experimental errors far easier. Although a complete piece of fleece must be analysed, it does not follow that every fibre must be measured. It is possible to take every fourth, eighth, tenth, or sixteenth, &c., as long as random sampling is secured by separating each fibre and selecting for measurement every fourth or eighth, &c., and as long as the error involved in this simplification has been determined. Micrometer eyepiece methods do not lend themselves readily to this simplification, but projection methods make it rather more possible, while caliper methods and the micro-balance are perfectly adapted to it.

As regards the actual procedures of measurement, the direct diameter methods involve one measurement, while the weight-length methods involve two, i.e. weight and length. The last can be dealt with briefly. Weight as required for the suggested method can be determined with high accuracy which depends on the size of sample taken, on the efficiency of the balance, and on the efficiency of the method of weighing under standard moisture conditions. The writer has no experience of the micro-balance, but apparently it is an instrument of precision. The measurement of length is not quite so simple, but is also consistent with high accuracy. The method used by the writer, and also by Barker and King, is to stretch the fibre until it becomes straight.

Direct diameter measurements are not nearly so simple. With the micrometer eyepiece the unit of measurement will perhaps not be less than one-fifth of the total diameter in the case of a very fine fibre, while with both this method and projection methods a difficulty is presented by the facts that the fibre is not flat, that the image of the sides will often not be parallel, and that serrations are found which often have an appreciable size relative to the diameter of fine fibres. Another difficulty is that fibres are seldom circular in section, and even if when mounted the broader diameter is not most often presented, a large number of measurements will be required to obtain a true value. For convenience, fibres are often measured at some arbitrary point along their length, and, owing to rhythmical variations in fineness this may not give an accurate result. In theory, caliper measurements are free from some of these disadvantages, because two diameters are determined at right angles at each point. Calipers are not very much used as yet, however, and rather more data relative to accuracy and laboriousness will have to be obtained before an estimate of the value of this method can be made.

The preparation of fibres for measurement is another important point. For weight-length methods it is sufficient to clean the fibres by the well known processes, and standard processes are available. The mounting of fibres for microscopic examination is a more difficult problem. It is known that wool will increase appreciably in diameter as the result of the absorption of water and other fluids, while other fluids are not absorbed. Many methods have been used, and it may be that the results obtained are not strictly comparable nor perhaps sometimes consistent in the case of a single method with slightly variable conditions. Moreover, accidental injury to the fibres during preparation is unlikely seriously to affect their length, but it may have a great effect on diameter measurements owing to the appearance of artificial fine points.

As regards the length of time required for a single determination, little need be said. A determination of the sample mean by mounting the fibres for microscopic examination might well take two days, while a similar determination by the suggested method, using the simplifications that will probably be found to be satisfactory, might be well carried out in one to two hours.

As long as the mean only is required, the superiority of the suggested method over the micro-balance is that the operations of measuring length are the same, while instead of weighing each fibre individually, the whole lot is weighed in a single operation. The single operation could probably be made more accurate, especially as in the case of the micro-balance humidity corrections have to be made from a table, while the gross weight can be determined in terms of the actual dry weight.

DETAILS OF THE NEW METHOD

(*a*) *The Preparation of the Sample*—The selected sample is washed with at least three changes of distilled water, allowed to dry in the air overnight, and then washed with at least three changes of ether.

(*b*) *The Measurement of Length*—The washed sample is placed on a board covered with black velvet. The fibres are drawn out one by one, and their length determined by gently stretching them out until all the kinks disappear and they become straight. The length is read off to the nearest millimetre on a scale which is placed on the board. If the fibres that have been measured are gently rolled round they form a sort of ball which coheres and can be handled as a unit, but this is not a necessary process. After the whole sample is finished, the fibres are again washed in ether to remove any grease that may have become attached owing to handling.

(*c*) *Weighing*—The fibres must be weighed under standard conditions, the dry weight being the obvious one to determine. A standard method is that described by Barritt and King (1926), the principle being that the wool is heated to a given temperature in a current of dry air. A sufficient quantity of wool must be taken to provide for an accurate estimate of the weight-length ratio. An arbitrary minimum figure of 50 milligrams dry weight has been selected.

(*d*) *Sampling and Length Sampling*—The principles of the sampling have been discussed in the previous section, and primary and secondary sampling have been distinguished. The exact size of the sample taken in this latter process will depend on the nature of the wool. For very fine wools, the weight of 50 milligrams will be the limiting factor; for coarse wools, the number of fibres. Depending on these is the question of length sampling. It is possible to measure only a proportion of the fibres, selecting, say, every fourth or tenth, and weighing all. The error involved in this simplification is readily determined, and by a consideration of the three errors, the accuracy of the method can be gauged. It will probably be impossible to lay down a precisely similar method of sampling for all wools, and the size of samples taken and the proportion of fibres measured will have to be determined for different levels of fineness.

(*e*) The results obtained appear in a useful and significant form, ranging from, say, 320 cms. per mg. for Merino of 80's counts to 60 cms. per mg. for Lincolns of 36's.

SOME GENERAL OBSERVATIONS

Wool may be regarded, in bulk, as a dead substance or as a developing structure of a living organism, and the measurement of its properties can be arbitrarily grouped under four heads—

(1) Dimensional characteristics.
(2) Physical characteristics other than dimensional.
(3) Chemical characteristics.
(4) Biological characteristics.

Fineness, one of its most important qualities, can be regarded, for the sake of simplicity, as a dimensional characteristic. In few other fields is the microscope regarded as an instrument of precision for physical measurements, especially if alternative methods are available. The fineness of soil particles is a most important character and is measured not with the microscope, but by the sedimentation method or by the newer viscosity method. The analogy applies to all those characteristics of wool that are dimensional. The microscope is essential for histological study, and the recognition of many biological characteristics requires its aid, but the writer would claim that when the measurement of characteristics that can be expressed in physical terms is required, recourse should be made to accurate physical methods. The need for the standardisation of wool measurements has been dealt with recently by Henseler (1926), but there is no doubt that much work will have to be done and many new principles involved before a satisfactory system can be established. The exact details of the suggested method are being worked out, but as this work is certain to be of a protracted nature, and as the principles involved are so simple, the writer feels that the publication of the present communication will be justified if it serves to direct attention to the possibilities of approaching some aspects of wool problems from new angles.

ACKNOWLEDGMENTS

The writer desires to acknowledge with gratitude the help that he has received during this and kindred studies from Dr. F. A. E. Crew, Director of the Animal Breeding Research Department; from Mr. A. T. King, of the British Research Association for the Woollen and Worsted Industries; from Mr. E. A. Fisher, Director of the Research Association of British Flour Millers; and from Mr. G. W. Robinson, of the University College of North Wales. More detailed acknowledgments can be more fittingly made when the results of the work are published.

SUMMARY

It is suggested that the mean diameter of a sample of wool can best be determined by the calculation of a weight-length ratio, this quantity being

estimated as the number of centimetres of fibre that weigh a milligram. This method has advantages from the point of view of the simplicity and convenience of the form in which the information is obtained, and also has advantages of accuracy and convenience in the actual determination.

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THE JOURNAL OF THE TEXTILE INSTITUTE

ABSTRACTS

NOTES.—In the references to publications abstracted the name of the publication is followed by the Year, Vol. 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

(A)—MINERAL

Quartz Fibres: Preparation. H. B. Williams. *J. Optical Soc. America*, 1926, **13**, 378-380.

Directions are given by which fibres more than a metre long can be obtained. Fibres 0·0015 mm. in diameter on the fine side and 0·01 mm. on the coarse side present no difficulty. —B.C.I.R.A.

(B)—ANIMAL

Chemical Composition of Silk. *Silk J.*, 1926, **2**, No. 23, p. 43.

Sericin and fibroin have closely similar chemical composition, but the fibroin is practically insoluble in soap and water. It is believed that as the fibroin is extruded from the seriposters of the worm the sericin flows over it as a colourless or yellow liquid and the whole solidifies in contact with the air. Two fibres—"boin" are spun at the same time which are glued together —"bave." The shape of these varies, those of *Bombyx mors* are shown diagrammatically to be nearly circular; those of the Tussah moth as nearly square. —F.G.P.

Names and Descriptions of Various Silk-producing Moths. *Silk J.*, 1926, **2**, No. 24, p. 45.

Five species of the Bombyx genus are described. The principal is "mori," which produces one crop, as also does Tentor, a Bengal worm. Other Bengal species, Sinensis, Crocci, and Fortunatus produce up to eight crops a year. The other species, Arracanensis, is a Burmese worm. Many tropical countries have wild silk worms which are not mulberry feeders, amongst them three species of Antheroe, one of which, Yamamai, is indigenous to Japan. It is stated that the Atticus recini worm is used as an article of dress by the natives of India. A. altas and A. cynthia are two other Indian species. —F.G.P.

Sericulture in Algiers. *Silk J.*, 1926, **2**, No. 24, p. 55.

Last year was the first full 12-monthly period since the start of the experiments on which figures can be based; 17,600 lb. of fresh cocoons were produced by 227 growers. This number is expected to increase to 400 for the current year. The outlook is encouraging. The French Government is giving valuable aid. —F.G.P.

Kossa Silk Industry in the Indian Central Provinces. *Silk J.*, 1926, **2**, No. 24, p. 55.

Raigarh on the Bengal-Nagpur Railway is the principal weaving centre of the industry, which is little known outside. Kossa silk cocoons are about the size of a hen's egg and are gathered in the forests. It is of a drab colour, but it is thought that the Government could help to improve this and so increase the demand. The natives of the district use the silk for their saris. —F.G.P.

Native Mexican Silk Industry Reviving. *Silk J.*, 1926, **2**, No. 24, p. 56.

It is said that silk was obtained from indigenous caterpillars before the Spaniards conquered Mexico and that silk goods were commercially imported in the days of Montezuma. Cortez introduced China mulberry trees and European silk, and the industry grew but was eventually opposed by Spanish governments. Eastern competition finished it. During the last few years attempts have been made to revive sericulture and there are now some 4,000,000 mulberry trees. Small quantities of silk are raised by peasants and sent to Mexico City. An annual output of 3,600 kg. raw silk is estimated. —F.G.P.

Philippine Silk. *Silk* (N.Y.), 1926, **19**, No. 6, p. 50.

In 1821 a good quality of silk was imported to Europe, but the industry declined. Recently, however, a new society has been formed with a capital of $250,000 and 1,300 acres of land, with a view to starting production. —F.G.P.

Silkworm Culture in Jugoslavia. G. Gordon-Smith. *Silk* (N.Y.), 1926, **19**, No. 6, p. 35.

The Government is distributing seed, and the children are being taught sericulture in the schools. A monopoly in Northern Serbia has so cut the prices that the peasants are giving up the work, but elsewhere the reverse is the case. Numerous tables of output are given, but they are all several years out of date. —F.G.P.

Oak Silkworm. *Silk* (N.Y.), 1926, **19**, No. 6, p. 37.

The study of the Tussah silkworm in Chefoo has been so carefully carried out that disease has been practically eradicated; less than 2 per cent. of the stock for the last two years has suffered. This has exceeded the greatest hopes. The care is more difficult than with the mulberry worm, the greater size of moth requiring at least three times the space. The spring harvest this year was eight times that of last year. —F.G.P.

Silk Raising in Latakia, Syria. *Silk* (N.Y.), 1926, **19**, No. 6, p. 37.

57,790 mulberry trees have been replanted, and 456,544 kg. of cocoons raised, of which 267,724 kg. were exported, in spite of very inclement weather during the year. Travelling foremen instruct the villagers, model incubators are shown, seed is distributed, and prizes offered for good results. —F.G.P.

Standardisation of Wool in the Preparation of International Wool Statistics. H. Henseler. *Internat. Rev. Sci. and Pract. Agric.*, 1926, **4**, 513-514.

It is pointed out that any exact establishment of wool statistics for all the world demands a classification of wools that is as exact and uniform as possible. An outline is given of the scientific examination of wool as carried out at the Institute for Animal Breeding and Breeding Biology of the Technisaken Hochschule of Munich. The valuation of wool by touch and sight cannot be used for a general valid classification of wool and an objective valuation which all can perform and understand is desirable. Accordingly, a special form of Trichinoscope has been developed by Dr. Herbert Dochner of Chemnitz, which projects an enlarged picture of a sample of wool. The quality of the sample can then be gauged by comparing the projected picture with standard photographs previously obtained. —B.R.A.W. &W.I.

Production of Fine Wool in South Africa. M. Moss and M. E. Morey. *Wool Rec.*, 1926, **30**, 1381.

The request for fine wool is ceaseless, and in order to produce it the South African farmers are purchasing fine quality rams, with which they hope to improve the wool. Through lack of knowledge, these experiments very often fail, and so several Government agricultural colleges have been formed, where farmers can gain all the information they need. —B.R.A.W. &W.I.

(C)—VEGETABLE

Cellulose and Nitrocellulose: Constitution. R. O. Herzog and G. Laski. *Z. Physikal. Chem.*, 1926, **121**, 136-142.

The absorption spectra of thin films of cellulose and nitrocellulose, unmercerised and mercerised, over the widest possible range of infra-red wave lengths were examined. The apparatus for obtaining maximum dispersion is described in detail. The absorption curves for cellulose and mercerised cellulose are identical within the limits of experimental error; the curves for cellulose and nitrocellulose are different. All four spectra exhibit clear absorption bands in the regions of 2·9μ and 6·0μ; these two periods must be viewed as base and octave of the nuclear vibration of the hydroxyl group. There is a significant specific frequency at 3·35μ and a strong absorption near 7μ. These bands are to be correlated with the CH_2 groups. Cellulose, further, has a relatively weak absorption at 4·6μ which is scarcely noticeable with thin nitrocellulose films. Apparently, at this point a frequency characteristic of the CO-linkage is met with (c.f. the absorption spectra of carbon monoxide and acetone). 4·7μ is known to be a region of weak absorption of the hydroxyl group, so that possibly at this point two effects are superimposed. The frequencies characteristic of nitrate appear in the region 7μ to 8μ. The difference in the intensity ratios of single bands if definite atomic groupings of the molecule are replaced by others is striking. By the mutual influence (coupling) of the atomic vibrations the position of the internal characteristic frequencies is displaced in general only to a very small extent. On the other hand, the amplitudes of vibration of the single atoms are very essentially influenced by neighbouring atoms. This condition is, however, not entirely fulfilled by cellulose. The results afford further evidence of the very "subtle" nature of the effect of mercerisation on the configuration of the cellulose molecule. —B.C.I.R.A.

Paper-maker's Celluloses: Moisture Regain. H. Fay. *Zellstoff ü Papier*, 1926, **6**, 201-203.

Comparative measurements of the moisture regain at relative humidities of 32-80% of isolated fibres of different commercial celluloses used in paper-making are given. The test materials include bleached and unbleached Ritter-Kellner and Mitscherlich celluloses, bleached straw, aspen and esparto celluloses and bleached linen. Bleached (and further purified) celluloses regain less moisture than unbleached from the same boiling. The moisture regain is not proportional to the relative humidity but rises more rapidly towards maximum humidity. —B.C.I.R.A.

Cellulose: Constitution. —. Ebner. *Zellstoff ü Papier*, 1926, **6**, 389-392.

A reasoned summary of the state of knowledge of the constitution of cellulose beginning with the micellar theory of Nageli-Ambronn, and showing how the results of X-ray analysis of natural and artificial fibres have led to the conception of a cellulose micelle with four $C_6H_{10}O_5$ groups. —B.C.I.R.A.

Cellulose: Constitution. K. Hess. *Z. Angew. Chem.*, 1926, **39**, 1189-1190.
An exposition of the author's views based on his work on acetolysis of cellulose and on the properties of the di- and tri-acetyl and tri-methyl derivatives.
—B.C.I.R.A.

Birch Wood: Swelling. M. Hasselblatt. *Z. Anorg. Chem.*, 1926, **154**, 375-385.
The author obtains a swelling curve for birch wood which differs from the cellulose swelling curve of Katz. The greater swelling power of the wood is attributed to the presence of lignin constituents. The curve differs also from the linear swelling curve obtained by Von Plato for birch wood, but there exists a similarity in that, at high water contents, both run parallel to the abscissa axis, i.e., water absorption proceeds without change of volume or of vapour tension. This phenomenon is explained by taking into consideration the capillary nature of the tracheides composing the wood. It was sought to measure the water content in terms of the electrical conductivity properties of the wood.
—B.C.I.R.A.

Sisal Growing for Cuba: Parts I. & II. *Bot. Abs.*, 1926, **15**, 673-674 (from *Tropical Life*, 1925, **21**, pp. 134-135 and 150-151).
Cuba has long been a one-crop country, that is, sugar for more than 50 years has been the principal source of revenue. No other crop sufficiently remunerative to compete with sugar cane had, until recently, been found. Henequen, the plant producing sisal, appears able to do this. It is indigenous to Yucatan, which has always enjoyed a monopoly in its production. The frequent revolutions in Mexico have made the supply uncertain in Yucatan, and cordage manufacturers began to search for other localities where Henequen could be grown, finding proper soil and climatic conditions in Cuba. On the plantations there established, the quantity and quality of the fibre are far ahead of any obtained in Yucatan, and the net profits greater than from sugar cane. Cuba has millions of acres of land better adapted to the growing of Henequen than any in Yucatan. The top soil is richer, the limestone substrata are softer, and the rainfall is eight times as great. The advantages of sisal production in Cuba are stated as follows—Henequen lands are cheap, the plant lives 12-20 years and reproduces itself by means of suckers; it cannot burn and animals will not eat it; cultivation is easy and defibering machines not expensive; the crop may be stored a long time without deterioration; the demand is constant and the product not subject to speculation.
—L.I.R.A.

Cotton Cultivation in the U.S.A. D. R. Coker. *Text. World*, 1926, **69**, 3445 &c.
Breeding experiments in the eastern States are described. New strains of Cleveland Big Boll with a high yield of lint per acre and a staple of $1\frac{1}{16}$ to $1\frac{1}{8}$ inch have been produced. The author urges the desirability of cultivating big bolled varieties, and the needs of better methods of planting and a fairer system of direct buying from growers.
—B.C.I.R.A.

Cellulose: Effect of Heat. J. W. Bain and G. M. Chute. *Chem. Abs.*, 1926, **20**, 2411 (from *Trans. Roy. Soc., Canada*, 1926, **20**, 189-191).
In continuation of previous work absorbent cotton extracted for seven days by boiling water was heated for three hours in an electric oven at 200°. After heating, the uniformly brown-coloured cotton was extracted with boiling water, the extract concentrated and decolourised with animal charcoal, a syrupy liquid remaining. The cotton lost in one instance 5% in weight, and 3·36% of syrup was the average quantity obtained from nine lots. Optical determinations indicated 7·5%, and reduction with Fehling solution 13·6% of glucose in the syrup. Pentoses and methylpentoses were absent, and hexoses other than glucose were not found. Formic acid and probably small amounts of acetic acid were present.
—B.C.I.R.A.

Cotton Cultivation in Ceylon. *Text. Merc.*, 1926, **75**, 466.
A crop of unexpected bulk has been obtained from the land given out to natives for experimental cultivation in the Hambantota district and in Embilipitiya. The Department of Agriculture has provided technical knowledge so that troubles encountered from pests have been more or less negligible. The Department has been asked to carry on further cotton growing investigation work at the Cotton Experimental Station at Ambalantota. Two other cotton-growing centres will be established in the Hambantota district and Tangelle in this district has been recommended as a site for a Government ginnery. To encourage cotton cultivation in the northern province it is recommended that the Department should be helped to start a 25-acre Experimental Station at Vavunia. An anti-tropical diseases campaign has been started.
—B.C.I.R.A.

Cotton Ginnery: Zululand. Platt Brothers and Co. Ltd. *Text. Merc.*, 1926, **75**, 196 and 228.
The new ginnery erected by the Zululand Cotton Co-operative Association Ltd. is described. It consists of a battery of four saw gins constructed on the Murray system. The entire plant is capable of ginning and baling 2,500 lb. of cotton per hour, or a bale per hour per gin.
—B.C.I.R.A.

Flax Growing in Russia. *Text. Merc.*, 1926, **75**, 235.
A report from the *Commercial and Industrial Gazette* from the Government of Rybinsk states that the area grown with flax this year is considerably smaller than last year, the decrease being estimated

at 18·1% to 20%, even 25% in parts. Several reasons are given for the decrease in sowing, one being the use of land for clover and other fodder plants instead of flax. Owing to the appearance of the land bug deterioration in the quality of flax and yield is feared this year. In Pskov the decline of the area under flax has been placed at possibly 20% to 25%. This deficiency may, however, turn out to have been partially corrected by the re-sowing of damaged fields with flax instead of cereals and fodder plants, owing to the scarcity of seed of the latter, thus reducing the decline to not more than 10% to 15%.—L.I.R.A.

Flax; Improvement of Lithuanian——. *Text. Merc.*, 1926, **75**, 388.

At a conference recently held at the Lithuanian Chamber of Commerce and Industry, Kaunas, to discuss the question of the export of Lithunian flax in order to prevent the mixing of this flax with flax of inferior quality of other countries, the mixture being placed on the market under the Lithunian mark, the following conclusions were arrived at—(1) It is essential to introduce a trade brand as a standard for Lithuanian flax. (2) To establish in Lithuania a laboratory for the analysis of Lithuanian flax. (3) To organise in Lithuania a union of flax exporters. (4) To request the Ministry of Agriculture to adopt measures against adulteration of flax by Lithuanian agriculturists and merchants. (5) To conduct propaganda on behalf of Lithuanian flax export abroad exhibiting samples and prices. A special commission was appointed to look into these questions. —L.I.R.A.

Cotton Cultivation in India. *Text. Merc.*, 1926, **75**, 34.

The importance of the judicious use of fertilisers to improve the yield of cotton per acre is emphasised. In experiments made in different parts of India an average yield of 184 lb. per acre was obtained when fertilisers were applied, as compared with an average yield for India of 87 lb. and for the United States of 169 lb. per acre. A complete mixture containing nitrogen, phosphoric acid, and potash should be employed. —B.C.I.R.A.

Crop Studies in Montana; Cereal and Forage——. C. McKee. *Exp. Sta. Rec.*, 1926, **54**, 328 (from *Montana Sta. Rep.*, 1924, pp. 12-15).

While the acreage of flax grown under irrigation is small, tests showed that good yields may be obtained on land which can be irrigated uniformly. —L.I.R.A.

Indian Black Soil Colloids: Properties. A. Howard and H. A. Hyde. *Agric. J. India*, 1926, **21**, 318-320.

The harmful rôle played by soil colloids in the black soils of India on which cotton is raised on natural rainfall is discussed. Heavy rainfall introduces a limiting factor in growth which appears to be an excessive development of soil colloids, interfering with aeration and percolation. Pests are very prevalent in such seasons. At present safflower cake is added to the soil to put the colloids out of action; the need for research into the problem of colloid control is indicated. —B.C.I.R.A.

Sulphuric Acid on Cornfields; The Action of Dilute——. A. Rabate. *Internat. Rev. Science Pract. Agric.*, 1926, **4**, 411-412 (from *Compt. Rend. Acad. Sci.*, 1924, **179**, 1285-1287).

Dilute sulphuric acid sprayed on the soil rapidly attacks the mineral constituents, producing sulphates which, in dry weather, appear on the soil as a white powder. It increases the hydrogen-ion concentration, but colloidal clay minimises the sharp variations of acidity. The action is energetic and results in an increased yield which will not fall off if the sprayings are made on dry soil, or during drought. On plants it has a dehydrating, but not toxic, action, proportionately stronger when the plant is young and during dry, warm, bright weather. Experiments have been made of spraying 1,000 litres of 10 per cent. solution of sulphuric acid of 65° Beaume, per hectare; the sprayings were made in December-January in the warmer parts (Italy, Provence) and in March-April in the cooler areas (Touraine, Beauce). In these conditions various herbaceous plants are killed immediately (ranunculus, matricaria, medicago); others (poppy, vetches, vetchlings, cornflower) are only killed with a 12 per cent. solution; some plants (rye-grass, wild oat, garlic, grape-hyacinths) are resistant to the treatment. In fields of oats and spring barley, the application of a 4 per cent. solution is sufficient to kill sinapis; the time recommended for Central France is about the second fortnight in April. Cereals with smooth erect leaves, covered with cutin, with the ears still covered, are slightly scorched and bleached by the acid, but eventually produce strong stems and full ears, slightly late in reaching maturity. Sulphuric acid is also useful against cuscuta, mosses, algæ, and especially against certain fungi, such as *Leptosphæria herpotrichoides* and *Ophiobolus graminis*. It is always advisable to make a preliminary experiment on a plot of ground in order to ascertain the most suitable dose; the result is apparent in a few days. —L.I.R.A.

Field Experiments; The Arrangements of—. R. A. Fisher. *J. Min. Agric.*, 1926, **33**, 503-513.

The technique of plot arrangement is discussed with the object of showing how far present day estimates of field errors may or may not be taken as valid estimates. Great stress is laid on the absolute necessity for random distribution of plots, however far from equally the plots distribute themselves, rather than any systematic regular arrangement. For variety and simple manurial trials the Latin Square is judged to be the best arrangement. It is further reasoned that large and complex experiments have actually a much higher efficiency than simple ones. —L.I.R.A.

Pectin, Studies on: A Micro-method for the Determination of Methyl Alcohol and its Application to the Study of the Conditions governing the De-esterification of Pectinogen. D. R. Nanji and A. G. Norman. *J. Soc. Chem. Ind.*, 1926, **45**, 337T-340T.

A new method for the estimation of methoxyl groups is described. The pectin is hydrolysed with dilute alkali under standard conditions and the methyl alcohol separated by distillation and oxidised quantitatively to carbon dioxide and water by means of a standard alkaline permanganate solution. The permanganate used up is estimated volumetrically. The gel properties of the methylated pectins have been examined and it was found that tetramethyl pectin and trimethyl pectin are about equally efficient for forming gels, whereas dimethyl and monomethyl pectin do not give gels. —L.I.R.A.

Nitrogen in the Flax Plant, and its Elimination from Flax in the Processes of Manufacture; The Distribution of——. J. W. Porter. *J. Soc. Chem. Ind.*, 1926, **45**, 335T-337T.

The distribution of nitrogen in the flax plant and its fate in the processes of linen manufacture have been investigated. The nitrogen resides principally in the cortex and epidermis. Considerable light is thrown on the changes which occur, particularly in bleaching. The difficulty in bleaching linen is due to the resistant nature of the cortex, which also contains potassium and phosphates. —L.I.R.A.

Flax Sowing: Thickness of, and Thickness of Stem. W. Müller. *Faserforschung*, 1926, **5**, 239-255.

As a result of measurements on the length and thickness of stem, and the diameter of the fibres in plants pulled from a crop of flax, the author comes to the following conclusions—(1) The stem weight rises very quickly with increasing thickness of stem, whereas at the same time the percentage of fibre decreases only slowly. (2) Flax is most profitable in stems of 1·3-1·7 mm., because the arrangement of fibre results in the least waste. (3) No important differences in size and length of fibre were established in the different sizes of stems. (4) The higher the fibre content the greater the development of the fibre bundle in the radial direction and the larger the fibre bundles. (5) The number of fibre bundles increases with greater thickness of stem. (6) No decrease in strength with increasing stem thickness was noticed. —L.I.R.A.

Density of Stand for Flax. A. Strobel. *Faserforschung*, 1926, **5**, 227-238.

The author describes a series of experimental plots in which flax was sown singly at various distances between the seeds, so that the average space for each plant ranged from 9 to 10·8 sq. cms. He found that greater space for each plant resulted in an increase in—(1) The total yield of seed and also the relative increase of seed. (2) The weight of stem, seed, capsules, and roots. (3) The number of side branches and capsules. (4) The thickness of the stem. (5) The amount of wood and pectin. (6) The length of the vegetative period, and a decrease in—(1) The length of the plant up to the first branch. (2) The yield of seed per acre. (3) The yield of straw per acre. (4) The oil content. (5) The content of fibre and water. The degree of correlation between the various characters remained unchanged, however. Notwithstanding the above conclusions, the author finds it impossible to give an optimum rate or method of sowing, on account of the great differences in the soil conditions of various fields. —L.I.R.A.

Flax Facts. T. E. Stoa. *Exp. Sta. Rec.*, 1926, **54**, 332 (from *N. Dakota Sta. Circ.*, 1925, 26).

A popular discussion of the uses of linseed oil and meal and flax straw is presented, with notes on the migration of flax culture, wilt control, and production and consumption of flax seed. —L.I.R.A.

Cotton Plant: Manuring. T. D. Hall. *Chem. Abs.*, 1926, **20**, 2384 (from *J. Dept. Agric. Union S. Africa*, 1926, **12**, 234-248).

Pot and plot experiments were carried out with cotton on a red, sandy loam that had responded adversely to applications of lime and basic slag. Mixtures of superphosphate and ground rock phosphate gave almost as good results as superphosphate alone. Rock phosphate alone gave lower yields and the best results were obtained with mixtures of nitrogen fertilisers and phosphates. Potash had no effect and applications of lime not only depressed the yield but also depressed the quality of the cotton. The poor results with basic slag appeared to be due to its lime content. —B.C.I.R.A.

Experimental Cotton Plots: Design. M. A. Bailey and T. Trought. *Minist. Agric., Egypt, Techn. and Sci. Service*, Bull. No. 63, 1926, 29 pp.

The following recommendations are made as the result of experiments described. For comparative trials with Egyptian cotton in Egypt it is recommended that paths should not be left between beds but that ridges adjacent externally to the bed should be uprooted at picking time, that variety beds should be repeated ten times, that trials should be carried out over a period of at least three years, and that beds should be in the form of long strips (up to 16 times as long as wide) and sited along the length of the ridges, to facilitate sowing. Where possible the area of the strips should be 1/5 feddan (1 feddan = 1·038 acres).

Where sufficient land or seed is not available the number of repetitions of 1/5 feddan strips should be reduced and the strips divided into two or even three equal parts at harvest (each part being weighed separately) to maintain the requisite number of comparisons between adjacent beds. Results should be computed by the method of differences. —B.C.I.R.A.

Cotton Production in the Sudan. R. Hewison. *Emp. Cotton Grow. Rev.*, 1926, **3**, 313-321.

This region comprises the provinces of Upper Nile, Nuba Mountains, Bahr-el-Ghazal, and Mongalla. The area is some 270,000 square miles and the inhabitants number approximately 3,500,000. Cotton growing is at present confined to an area served by river transport, between the 29th and the 34th meridians. With a rainfall ranging from 28 in. in the north to 40 in. in the south, with freedom from frost and with a practically certain dry picking season the climatic conditions are favourable. Cotton growing has increased rapidly and a 4,000 bale crop in 1925, which seriously strained the administrative ginning and transport resources of the country is likely to be succeeded by a 10,000 to a 12,000 bale crop. Even at existing price levels (i.e., prior to August 1926) there is every possibility of cotton being produced in these provinces with a fair return to the cultivator. —B.C.I.R.A.

Cotton Seed Control. W. L. Balls. *Empire Cotton Grow. Rev.*, 1926, **3**, 331-350.

Because big differences among the hairs on one seed are inevitable, cultivation, picking, classification and seed control can never yield a strictly uniform cotton. Also, no matter how pure the strain, irregular weather and unsuitable climates for a particular variety are detrimental to the growth of a uniform staple. Apart from these limitations, however, seed control is effective in preserving the uniformity necessary for manufacturing purposes. "When replaced in the same environmental conditions all the true descendants of a pure line will exactly resemble their pure-line ancestors." This is regarded as a sound working theory for seed control work, though the highly unlikely occurrence of a mutant is one possible exception. A pure line once contaminated has only a few years of usefulness to expect, and there is always, therefore, an imperative need for seed renewal. Subsequent to the selection and fixing of a pure line, an automatic system of seed renewal, based on an initial sowing in bee-proof cages covering one-fifth acre, will supply sufficiently pure seed for 50,000 acres after three years' propagation. The origin of "310" cotton dates from 1907 when Mr. E. A. Benachi supplied the author with a bag of seed from a short-lived variety known as *Sultani*. Facts connected with the fixation and the subsequent history of this strain are given. In reply to the query "why low-yielding pure lines should be grown at all seeing that high yield is wanted from the cotton fields," the inferiority in yield per plant is admitted, but this, it is considered, can be balanced by a slightly closer spacing of the crop giving more plants to the acre. It is not stated, however, why impure stocks may not also be more closely planted, thus securing greater yields. —B.C.I.R.A.

Cotton Cultivation, Gatooma (Rhodesia). *Emp. Cotton Grow. Rev.*, 1926, **3**, 391 (from *Rhodesia Agric. J.*, 1926, **23**, 576).

The experiment station 1925-26 crop was very light owing to severe bollworm attack. Varietal tests showed several exotic varieties as superior to Improved Bancroft; and it is hoped to find a better substitute for existing stocks among them. —B.C.I.R.A.

Cotton Cultivation in Colombia. A. S. Pearse. *Internat. Cotton Bull.*, 1924, **41**, 465-470.

One quarter of the raw cotton required for the 52,000 spindles in Colombia is imported from the U.S.A. The remainder of the cotton is mainly grown in Boyacá, Santander, Valle de Cauca, Huila Atlantico, and Magdalena. Though much of this cotton is of superior staple, an average of only 12's is spun.

Perennial varieties yielding from three to four years are grown along the coast and in the hilly sections. They grow to a height of about 20 feet, which necessitates the almost complete severing of the branches to bring the cotton within reach during the harvesting season. This practice forces maturity in the unopened balls and much soft and unripe cotton is collected. Delayed picking also results in the production of over-ripe cotton and much is gathered from the ground in a soiled condition. These perennial varieties harbour insects but they have compensatory advantages where labour is scarce or where, as on the hilly ground, cultivation is difficult.

Boyacá and Santander grow cotton as an annual crop and with the construction on motor roads to the Lower Magdalena River prospects have improved.

The most promising section in Colombia is the Valle de Cauca, a perfectly level plain of 1,500 square miles in extent at an elevation of 3,000 feet and supporting a population of 300,000. Mean temperature is 75° and the annual rainfall amounts to 44 in. There are two rainy seasons with rainfall peaks in April-May and October-November; and the dry months are January-February and July-August. Practically all the finest varieties have been introduced into this area and present stocks are very mixed and degenerate. Annual cultivation and the single variety community system are recommended. Pink Bollworm has been introduced with imported seed. It has developed into a larger species than exists in India and Egypt and has already been responsible for considerable delay in cotton growing development. Removal and burning of stalks six months after sowing are therefore urged.

Importation of new seed stocks from abroad is considered undesirable, because the indigenous and acclimatised varieties offer sufficient material for selection. The Government has accordingly forbidden new seed introductions; and seed farms are also being established to develop supplies of single variety seed. —B.C.I.R.A.

Cotton Cultivation and Production in Algeria. *Internat. Cotton Bull.*, 1926, **4**, 471.

In 1925 about 12,000 acres were planted to cotton in Algeria, the chief varieties being Pima, Durango, Yuma, and Mitafifi, of which the first is most popular. Practically all of the cotton is grown under irrigation. —B.C.I.R.A.

Tanguis Cotton Deterioration: Peru. J. H. Pardo. *Internat. Cotton Bull.*, 1926, **4**, 485-488.

In 1916 the first exports of the newly formed variety Tanguis took place and by 1925, 83 per cent. of Peruvian cotton was grown from this variety. The attractive qualities of the early Tanguis were wilt resistance, high yield (averaging 670 lb. of lint per acre), exceptionally high ginning out-turn (up to 41 per cent.), profitable yields up to even the fifth year, and a remarkably white staple, with a length of $1\frac{5}{16}$ in. to $1\frac{1}{2}$ in. Now Tanguis shows evident signs of deterioration, especially in its staple, with lack of uniformity in strength, length, colour, and lustre. Cleanliness seems also to have been neglected, and practically no effort has been made to preserve the old reputation by selection and breeding.

Genetically Tanguis cannot be considered a fixed type, and it appears that degeneration has occurred more largely by the splitting up of the original stock than by hybridisation. Tanguis is very susceptible to environmental change and, conversely to the behaviour of "full rough," its lint becomes smoother the farther north it is grown. In the upper valleys it also produces a shorter lint.

The problem in Peru seems to require the same remedies as have been recommended in Egypt by Psalti. They include Government purchase of good seed from large estates for distribution among the smaller growers, the division of Peru into zones for the production of separate strains, and the ginning of only one type of cotton at each ginnery. Moreover, the growers should be educated in the first principles of seed selection. —B.C.I.R.A.

Cotton Cultivation in the Sudan (Zeidab). R. A. Wardle. *Internat. Cotton Bull.*, 1926, **4**, 492-494.

Cotton is grown on an area covering 16,000 acres. A little maize and lubia may be grown in the future but up to the present time the rotation has consisted of cotton, fallow, fallow. Seed is sown 40 cm. apart on ridges 70-80 cm. apart, and the variety is Webber, which yields over an inch staple. Every 15 to 18 days the land is irrigated with a quantity of water equivalent to 100 mm. rainfall. Sowing commences about the beginning of April, flowers appear in July, and picking starts in late August or early September and continues to the end of the year. The yield varies between 100 and 400 lb. Exceptional dryness prevailed in 1925. Insect and other pests were little in evidence and no damage by blackarm disease, thrips, cotton stem-borer, pink bollworm, and Egyptian bollworm was observed. Locusts, grasshoppers, and crickets were responsible for leaf damage. The plant seems to succumb easily to whitefly or plant bug and this susceptibility is thought possibly associated with the shortness of the tap root in the Zeidab plants. The physiological factors governing the production of Plant Asal (honey) are suggested to merit inquiry. Labour supply, tenants' remuneration, and the layout of the land are also discussed. —B.C.I.R.A.

Cotton Cultivation in the Sudan (Gezira). R. A. Wardle. *Internat. Cotton Bull.*, 1926, **4**, 494-498.

Some of the difficulties attending the sudden expansion in acreage from 20,000 feddans to 80,000 feddans under cotton are discussed. They involve reorganisation of labour power and food supply. A further 20,000 feddans is being cleaned to add to next year's acreage. The total 100,000 feddans is as much as can be dealt with for the next few years. Sowing begins in July and subsequent to the end of the rains in September waterings are given every 12 days. Picking commences in December and continues until May. At the Wad Medani Research Farm two of the main problems under consideration are concerned with thrips and blackarm damage. The former is considered the most serious and remedies are being sought in weed destruction, heavier watering and the screening of the fields with hedges of Cajanus. Blackarm disease was serious in 1924-25 and the use only of seed from uninfected areas, late sowing as near the commencement of the dry season as possible and irrigation before sowing are recommended. —B.C.I.R.A.

Cotton Cultivation in the Sudan (Gezira). E. E. Canney. *Internat. Cotton Bull.*, 1926, **4**, 499-502.

From climatic considerations the growth of the Sakel variety in the Gezira appears inadvisable. The early months are too wet and the later months too dry. Climatic unsuitability is shown by the difficulty experienced in maintaining the standard Sakel type from locally grown seed even for a few years. It is also revealed in the great susceptibility of Sakel to blackarm in this area. The resistance of Sakel to this disease is invariably lost when grown under excessively humid conditions. The months of maturity and picking in the Gezira are much more arid than are those even of Assuan in Upper Egypt where Deltas quality cotton has invariably failed to compete successfully with the hardier Ashmouni variety. Acala, being probably the climatically most suited variety, should prove the most economically profitable. High yields, relative ease in maintaining stocks, greater staple uniformity year after year and freedom from serious pest damage are the compensations to be gained for the slight loss in average staple length.

—B.C.I.R.A.

Indian Cottons: Measurable Characters; and Cotton Hair: Study. A. J. Turner. *Agric. J. India*, 1926, **21**, 274-294.

The author reviews the more recent work on the structure and physical properties of the cotton hair and its practical application. The paper is based mainly on work done at the Shirley Institute but some statistics of staple length and ribbon width of standard Indian cottons determined in the Technological Laboratory at Bombay are reproduced. —B.C.I.R.A.

Cotton Plant: Breeding. T. Trought. *Agric. J. India*, 1926, **21**, 305-312.

The problem of improving the cotton plant is discussed. A method of selection by pure line work is briefly described which can be usefully supplemented by acclimatisation work. The importance of the root system and the necessity for the production of local unit species is emphasised. Artificial hybridisation at the present stage of knowledge does not introduce any certainty of improvement along directed lines, but combined with selection probably increases the chance of obtaining desirable combinations of characters.

—B.C.I.R.A.

Cotton Cultivation in India (Deccan). T. F. Main. *Agric. J. India*, 1926, **21**, 345.

A note on the possibility of introducing cotton as a crop in the canal areas of the Bombay Deccan. There has been a development of cotton growing on wells in the Sholapur district not far from the canals, where yields up to 1,500 lb. of seed cotton per acre have been common on manured land. —B.C.I.R.A.

Cotton: Ridge Cultivation in India. B. M. Desai. *Agric. J. India*, 1926, **21**, 377-379.

Experiments in different methods of ridge cultivation gave an increase of 24·4 per cent. seed cotton. The combined effect of ridging and manuring resulted in an increase of 42·6 per cent. seed cotton. Ridging methods should find application in areas of high rainfall. Methods and implements of ridging are described. The question of permanent ridging causing inferior soil aeration was raised in the discussion. —B.C.I.R.A.

Cotton Hair: Length and Diameter Correlation. R. Y. Winters and P. J. Naude. *N. Carolina Agric. Exp. Sta.*, 47th Annual Rept., 1924, p. 33.

The results of a study of the relation between length and diameter of cotton hairs show that as the length increases the percentage of lint and the diameter of the hair decreases. The correlation between length and diameter of hairs in the case studied was $0{\cdot}2929 \pm 0{\cdot}03560$. The correlation between length of hairs and percentage of lint was $0{\cdot}2650 \pm {\cdot}03621$. Increase in size of seed was found to be slightly associated with longer hairs. The correlation between these two characters was $+0{\cdot}11303 \pm 0{\cdot}03845$. —B.C.I.R.A.

Cotton Seed Coat Hair Population: Density and Convolutions Correlation. R. Y. Winters and T. C. Chang. *N. Carolina Agric. Exp. Sta.*, 47th Report, 1924, p. 33.

Increased density of hair population on the cotton seed coat is definitely associated with increased number of convolutions per inch. Increased length was found to be associated with decrease in number of convolutions per inch. The basal half of the hair had fewer convolutions than the other half.

—B.C.I.R.A.

Cotton Seed Coat Hair Population: Development. R. Y. Winters and L. I. Henning. *N. Carolina Agric. Exp. Sta.*, 47th Annual Rept., 1924, p. 33.

The density of cotton hair population on the seed coat was determined by cutting out a section of the seed coat of known area with a sharpened leather punch and counting the number of hairs attached to it. The results of a number of determinations showed that as the hair population increased, the hair diameter, the lint index and percentage of lint increased, and the length of hair and weight of seed decreased. Decrease in length was associated with increased diameter. —B.C.I.R.A.

Cotton Production in the Italian Somaliland. G. Scassellati-Sforzolini. *Bull. Impl. Inst.*, 1926, **24**, 471 (from *Agric. Coloniale*, 1926, **20**, 121).

Out of numerous varieties placed under trial Sakellaridis has always given the best results, and selected seed of local growth has been sown for several years in succession without any appreciable depreciation in the quality of the product. It is recommended, however, that fresh seed should be obtained from Egypt from time to time. Seed is sown either from April to June or in the autumn months October and November. Irrigation requirements vary with the season but as a general rule the least possible quantity should be used, since excessive humidity encourages disproportionate growth. The smaller plants are generally the healthier and the more productive. Cotton has been cultivated since 1922, with yields reaching 2·7 quintals of lint per hectare; and the probable area in 1926 will be 1,800 hectares. The pink bollworm (*Gelechia gossypiella*), the red cotton stainer (*Dysdercus spp.*), and a beetle (*Syagrus rugiceps*) are the principal pests. —B.C.I.R.A.

Cotton Hair: Breaking Load and Diameter. R. Y. Winters and J. B. Cotner. *N. Carolina Agric. Exp. Sta.*, 47th Annual Report, 1924, p. 32.

Considerable differences were found in the average diameters and tensile strength of a number of cotton hairs of the five varieties: Cleveland Big Boll, Mexican Big Boll, King, Cook, and Rowden. There was a direct relation between diameter and tensile strength, the varieties with the broader hairs having the greater breaking load. Mexican Big Boll, with the greatest diameter, 22·576 microns, gave the greatest breaking load, 54·54 decigrams. The respective figures for Cleveland Big Boll were 18·836 microns and 31·43 decigrams. The correlation between hair diameter and tensile strength for all varieties was $0{\cdot}623 \pm {\cdot}013$ showing a positive relation. —B.C.I.R.A.

Modern Views on Cotton: Alkali-cellulose. A. J. Hall. *Dyer and Cal. Printer*, 1926, **56**, 206-208.

This concluding article of the series discusses evidence indicating that cellulose combines chemically with caustic alkalis during mercerisation. Alkali-cellulose—$(C_6H_{10}O_5)_2{\cdot}NaOH$ or $(C_6H_{10}O_5)_2{\cdot}2NaOH$—is fairly stable, but slowly absorbs oxygen and undergoes changes during storage ("ageing") such that cellulose regenerated from it by acidification is definitely different from the original cellulose. An investigation of the ageing of alkali-cellulose is likely to have important results of industrial value. —A.J.H.

Cotton Cultivation Tests in U.S.A. (S. Carolina). *Exp. Sta. Rec.*, 1926, **54**, 636 (from *S. Carolina Sta. Rpt.*, 1925, pp. 20-35, 82, and 83).

The successful production of open bolls is greatest from the earliest blooms. Rapid fruiting varieties yield best under boll-weevil conditions. The times for the development of squares and bolls appear independent of fertiliser, spacing, and cultural practices. More rapid fruiting occurs on dry than on wet soils, the square developing and the boll maturing quicker. Defoliation does not accelerate maturation and the reverse is sometimes noticeable. Closely spaced cotton put on squares much faster than wider spaced stalks and 6 to 9 in. spacing gave the highest yield at Florence. The best yields from the coast sub-station were had from 3·5 ft. rows and 10 in. spacing. Delinted seed gave perfect stands in much less time and the plants began blooming first and continued fruiting most rapidly early in the season. The first blooms and the heaviest fruiting occurred in the first plantings, which also matured a larger percentage of the total crop. Topping reduced yields. It is profitable to poison early against boll-weevil if from 10 to 20 per cent. of the young buds are attacked. Up to July 16th in 1925 bolls produced under low fertility conditions were harder (determined by resistance to needle puncture) than those on plants in more fertile soil. Three year averages place Cleveland strains first among short staples and Carolina Foster, Delfos, Lightning Express, and Webber 49 leading the long staple varieties.
—B.C.I.R.A.

Cotton: Variety Trials in U.S.A. (Texas). G. N. Stroman. *Exp. Sta. Rec.*, 1926, **54**, 427 (from *Texas Sta. Bull.*, 1925, **332**, pp. 3-20).

"Bennett Lone Star" led in mean yield of lint and was most variable. "Belton" made the maximum mean yield of seed and was the most variable variety. "Mebane" and "Bennett Lone Star" were close seconds in lint yield and seed yield respectively. The range was from 42·84 per cent. of lint for "Star" and 42·67 per cent. for "Kasch" down to "Snowflake" with 29·67 per cent. "Snowflake" with $1\frac{5}{16}$ in. was outstanding in mean length of lint and was most variable. It also led in the number of 4-lock bolls whilst "Star" and "Watson" led in 5-lock bolls. The latter outweighed the former in practically all cases. Average ranges of 72·9 days to 77·3 days to first bloom and of 111·8 days to 115·8 days to first open boll were observed in the 16 varieties under trial, showing that earliness might be developed through selection for this character.
—B.C.I.R.A.

Cotton Cultivation in Morocco. G. Carle. *Exp. Sta. Rec.*, 1926, **54**, 532 (from *Rapport sur la Culture du Coton au Maroc en* 1924. Paris: Assoc. Coton Colon., 1925, 84 pp.).

Conditions involved in cotton culture in Morocco are compared with those of important cotton countries, and the status of native production and the results of varietal, cultural, and selection tests with the crop are reviewed. The prospects of the industry in Morocco are considered, and measures are suggested to assure its development. The major problems are environmental limitations, seed supply, cultural methods, and preparation of the fibre. —B.C.I.R.A.

Cotton Hair: Strength and Fineness. J. Dantzer and O. Roehrich. *Ind. text.*, 1926, **42**, 207-209 and 264-266.

The results reported by Kuhn are adversely criticised and a scheme for establishing the staple length and uniformity, fineness and strength of a cotton in about two hours, including half an hour for the preparation of a Baer diagram is described. The strength in grams is first determined using "the well-known Yves Henry apparatus," which is ostensibly an O'Neill apparatus. Since the measurements are made on the middle cm. of the hairs they

represent the strength in the median zone. The strength per sq. mm. is then determined as follows—Two parallel lines 1 cm. apart are drawn on the surface of a cork and two slits are cut in its edges perpendicular to the lines. A prepared pull of cotton is inserted in the slits and cut along the parallel lines. One thousand of the centimetre pieces are counted and weighed and from the weight the metric number is calculated, thence the breaking length and strength per sq. mm. This is not, however, sufficient to characterise a cotton exactly for the metric number is that of the median zones only. The average strength for the whole hair is obtained by counting out a sufficient number of hairs of, say, the 25 mm. region of the Baer diagram, to give a length of 10 m. as before, weighing, and calculating its strength by simple ratio from the result of the Yves Henry test. It is the strength of the whole hair which should be used in formulæ for calculating the strength of yarns, such as that of Gegauff. Results are tabulated for 12 cottons of varied types. They show that the average strength for short staple cottons is only 33 kg. per sq. mm., for medium American is 39 kg., for medium Egyptian is 45 kg., and for the long staple cottons is still higher. There is an average diminution of strength of 28·2 per cent. when the whole hair is considered instead of the median zone, and the time required for determining the average number or strength of a cotton can be shortened by simply diminishing the weight of the 1,000 centre zone pieces by 28 per cent. and calculating the ratio. For the determination of "fineness" in the median zone and considering the whole hair, surface area is calculated from the appropriate weight, 5 per cent. of this value is added to allow for the lumen, and from a graph connecting area of section and diameter of circumscribing circle, calculated on the basis that cross-sections occupy 57 per cent. of the area of the circle containing them, the diameter is read directly. The method of deducing the 57 per cent. is shown.
—B.C.I.R.A.

Cotton Plant Non-volatile Constituents: Isolation. F. B. Power and V. K. Chesnut. *J. Amer. Chem. Soc.*, 1926, **48**, 2721-2737.

The non-volatile constituents of dried lateral branches of the cotton plant were examined in detail. From an alcoholic extract of the dried material, after steam distillation, a dark coloured aqueous liquid and a black, oily resin were obtained. From the former the following were isolated—potassium nitrate and potassium chloride, quercetin, betaine, choline, and succinic acid. From the resinous product were obtained a phytosterol, a phytosterolin, pentatriacontane, an acid of phenolic character, a mixture consisting of valeric, caproic, and butyric acids and other substances described. —B.C.I.R.A.

Boll Weevil: Control. D. Iseley. *Exp. Sta. Rec.*, 1926, **55**, 55-56 (from *Arkansas. Sta. Bull.*, No. 204, 1926, 17 pp.).

A report of investigations made with a view to aiding growers in locating early infestations and in determining when dust applications can be made with greatest advantage.
—B.C.I.RA.

Ascochyta gossypii: **Occurrence; and Angular Leaf Spot Disease: Prevention.** *Exp. Sta. Rec.*, 1926, **55**, 41-42 (from *Arkansas Sta. Bull.*, No. 203, 1926, pp. 44-51).

The cotton disease caused by *Ascochyta gossypii*, first described from Arkansas but since reported from other States, has been found to be dependent on weather conditions for its occurrence. Delinting cotton seed with sulphuric acid is claimed to eliminate the probability of angular leaf spot infection. —B.C.I.R.A.

Cotton Anthracnose Control in U.S.A. (N. Carolina). S. G. Lehman. *Exp. Sta. Rec.*, 1926, **54**, 147-148 (from *N. Carolina Sta. Tech. Bull.*, 26, 1925, pp. 3-71).

A detailed account is given of investigations on the control of cotton anthracnose by dry heat treatment methods. A machine for the treatment of seed in considerable quantity is described.
—B.C.I.R.A.

Boll Weevil Control in U.S.A. (Georgia). *Exp. Sta. Rec.*, 1926, **54**, 158 (from *Georgia Coastal Plain Sta. Bull.*, 5, 1925, pp. 19-21).

Tests of different methods of poisoning with calcium arsenate. —B.C.I.R.A.

Cotton Plant Diseases in Egypt. H. R. Briton-Jones. *Minist. of Agric., Egypt, Tech. & Sci. Service*, Bull., 1925, No. 49 (Botanical Series).

An account of mycological work in Egypt during the period 1920-1922 deals extensively with the sore shin disease and more briefly with root-rot, angular leaf spot, a wound parasite of cotton bolls, some instances of fusarium wilt and an instance of a physiological wilt disease of cotton.
—B.C.I.R.A.

Aphis gossypii: **Occurrence in Egypt.** W. J. Hall. *Minist. of Agric., Egypt, Tech. & Sci. Service*, Bulletin, 1926, No. 68, pp. 18-20.

The species show extensive variations and probably includes *A. malvæ*, *A. bauhiniæ*, and *A. parvus*. Seedling cotton is attacked from the end of March to the beginning of June. During June and July the cotton is rarely attacked but in August and September heavy attacks are quite common. Very considerable variation in size is found, the spring alatæ tending to be much larger than those of late summer and autumn. The microscopic characters also are very variable. A list of some of the host plants of the species in Egypt is given. —B.C.I.R.A.

Cotton: Bacterial Tendering. A. C. Thaysen and H. J. Bunker. *Biochem. J.*, 1926, **20**, 692-694.

Experiments are reported which confirm the now generally accepted view that neither *B. subtilis* nor *B. mesentericus* is capable of decomposing cellulose.

—B.C.I.R.A.

Cotton Insect Pests: Control. A. H. Lees. *Ann. Appl. Biol.*, 1926, **13**, 506-515.

The author suggests that a study of the relationship of internal conditions in plants to endurance against insect attack would be a profitable field for research. Fourteen cases are cited in which host plants have been modified in insect endurance; for instance, the red cotton bug on *Hibiscus cannabinus* at Pusa was found to follow the destruction of fine roots, and boll weevil attack in Texas was checked by a sufficiently raised temperature attained by spacing the cotton plants far enough apart for the sun to reach them freely. It is assumed that changes in external factors have their counterpart in changes in internal conditions in the plant.

—B.C.I.R.A.

Cotton Wilt Disease in India (Berar): Investigation. E. J. Butler. *Agric. J. India*, 1926, **21**, 268-273.

Some inoculation experiments on seedling cotton were performed with cultures of a fungus obtained from the roots of wilted cotton plants from a field of Jari cotton in the Berars. Batches of seedlings grown in inoculated soil showed normal plants growing beside wilted ones. The results indicate that the disease is caused by a *Fusarium* which is capable of pathogenic action under certain conditions not yet elucidated and that these conditions are probably not connected with the composition of the soil. The particular Fusarium strain is possibly one of *Fusarium vasinfectum*. —B.C.I.R.A.

Cotton Leaf Hopper: Occurrence in the U.S.A. A. B. Cox. *Internat. Cotton Bull.*, 1926, **5**, 53-57.

The cotton flea, properly the leaf hopper, has long been known as a comparatively harmless insect in the U.S.A. belt, though it becomes quite numerous in the cotton fields in warm wet autumns. More or less serious damage is, however, reported from S. Texas this year; but, as the conditions have been unusual, a repetition is not thought likely to occur soon. Weed destruction is the most effective control method. —B.C.I.R.A.

Pink Bollworm Control: U.S.A. *Internat. Cotton Bull.*, 1926, **4**, 543.

For complete destruction of pink bollworm larvæ in the seed it is necessary to break up all seed masses so that each seed comes in contact with the heating medium. Three and a half minutes' exposure at a temperature of 145° F. is effective, germination remaining unharmed up to a temperature of 165° F. Disinfecting machinery should be equipped with reliable heat control apparatus and a good recording thermometer. —B.C.I.R.A.

Thuberia Weevil: Occurrence in the U.S.A. *Internat. Cotton Bull.*, 1926, **4**, 542.

The expansion of cotton growing in the S.W. States has brought the cultivated cotton areas into contact with the Thuberia weevil infested areas in the mountains of S. Arizona. During the past year 15,000 acres of cotton have become infested with the pest. The Salt River Valley cotton areas are menaced through the already infected Santa Cruz River areas and the Colorado River Valley is also endangered. An area of cotton production covering 140,000 acres is involved. The insect is hardy and can pass the winter successfully on the cultivated plant. Unlike the common weevil it neglects the squares and attacks only the bolls. Texas has quarantined against Arizona and certain infected sections of New Mexico, and steps are also being taken to save Oklahoma from invasion by the pest.

—B.C.I.R.A.

Cotton Insect Pests in Australia: Control. E. Ballard. *Empire Cotton Grow. Rev.*, 1926, **3**, 365-373.

A report for January-June, 1926.

—B.C.I.R.A.

Red Bollworm in Nyasaland: Occurrence and Control. C. B. R. King. *Emp. Cotton Grow. Rev.*, 1926, **3**, 352-364.

Except for Uganda, North-western Rhodesia and Tanganyika (the area about the north-western margin of Lake Nyasa excluded) the red bollworm or the Sudan bollworm (*Diparopsis castanea*, Hamps.) has been reported in all the principal African cotton areas south of the Sahara. The damage in Nyasaland has been always considerable since the nineties, but its presence was not definitely reported until 1911. Cotton sown in December yields a first flush of cotton bolls in April or May, which usually suffers heavily, nothing being left to pick in some seasons; but most planters get a second crop mostly of fine grade in September or October after a long dry spell. Cold rainy weather lasting three or four days in the dry season, however, will bring on a further mild attack of bollworm. Yields since 1917 for European-grown cotton have ranged from 35-75 lb. lint per acre. Natural control is not effective enough to allow a good yield, and the best artificial control results have been had from hand picking. Emergence usually occurs in warm moist weather or after rain, and the moths are then easily caught. An appendix gives the pests of major importance, those liable to become major pests in some seasons and in some places, minor pests and general feeders of little importance. —B.C.I.R.A.

Cotton Diseases in Haiti. H. D. Barker. *Rev. Appl. Mycol.*, 1926, **5**, 538 (from *Intern. Rev. Sci. and Pract. Agric.* N.S., 1926, **4**, 184-187).

Cotton bacterial rot has caused severe damage to the bolls in wet seasons. They become soft, watery, and rotted at almost every stage of growth, finally turning brown or black while remaining attached to the plants. No control measures have as yet been found satisfactory. A cotton mosaic frequent on native varieties, is under study, especially in relation to varietal resistance and the environmental factors that affect the disease, the nature of which is obscure. —B.C.I.R.A.

Flax Rust, *Melampsora lini* **(Pers.) Lev; Factors Affecting the Development of——.** H. Hart. *Rev. Appl. Mycol.*, 1926, **5**, 555-556 (from *Phytopath*, 1926, **16**, 185-205).

This is a more detailed account of the factors affecting the infection of fibre flaxes by rust (*Melampsora lini*) and the development of the parasite than that already noticed. The disease is stated to be particularly severe in the Red River Valley of North Dakota and in Minnesota, causing an average annual loss of nearly 1 per cent. of the crop. The æcidospores of the fungus begin to germinate after 45 minutes at optimum temperature and the uredospores after 1½ hours. The viability of the latter may be retained for nearly three months at a temperature of 7° C. and a relative humidity of 60 per cent. The germ-tubes of the uredospores were observed to enter the host through the stomata, forming an appressorium outside, and a substomatal vesicle below the stoma. In the case of the practically immune Argentine variety, some of the host cells, which seem extremely sensitive to the rust hyphæ, are killed within a week after inoculation, and the fungus is unable to establish itself. Light was found to be essential to the formation of uredospori after the establishment of the pathogen within the host. Increased light accelerates and decreased light retards their development. They may be formed at any temperature between 7° and 30° C. Severe infection occurs at 16° to 22°, and slight at 7° to 14° and 26° to 30°. Plants supplied with phosphates were more severely rusted than those receiving nitrates or sulphates, in consequence of their luxuriant growth. The fungus penetrates the cortical tissues of flax stems and often attacks the fibres. The hyphæ have never been found to extend into the xylem. —L.I.R.A.

Seed-treatment with Chemical Stimulants; The Influence on Germination of——. A. Becker. *Rev. Appl. Mycol.*, 1926, **5**, 568 (from *Landw. Jahrb.*, 1926, **63**, 501-553).

This is a comprehensive account of a series of experiments carried out at the Bonn-Poppelsdorf Agricultural College on the stimulation of germination in a number of agricultural plants by chemical treatment. As already stated, the apparent stimulus to germination given by certain preparations is considered to be really the result of a fungicidal action of the disinfectants, which enables the treated plants to make normal growth and thus to produce a yield superior to that from the untreated seed. In no case was there any increase of yield which could be definitely attributed to seed stimulation as distinct from disinfection. A bibliography of 79 titles is appended. —L.I.R.A.

Cotton Root Rot in India (Punjab): Control. J. C. Luthra. *Rev. Appl. Mycol.*, 1926, **5**, 595 (from *Rept. Dept. Agric. Punjab* for year ending 30th June 1925, Part I., viii.-xv.).

The incidence of root rot was found to be reduced from 34 to 8 per cent. by trenching operations. The removal of kankar (concretionary limestone) also gave beneficial results. —B.C.I.R.A.

Fusarium lini **and** *Colletotrichum lini*; **Comparative Studies on the Physiology of——.** Y. Tochinai. *Rev. Appl. Mycol.*, 1926, **5**, 623-624 (from *J. Coll. of Agric. Hokkaido Imper. Univ.*, 1925, **14**, 171-236).

The writer discusses at considerable length the physiology of nutrition and growth of *Fusarium lini* and *Colletotrichum lini*, the causal organisms respectively of wilt disease and anthracnose of flax. —L.I.R.A.

Fusarium lini, **Bolley; Physiologic Specialisation of——.** W. C. Broadfoot and E. C. Stakman. *Rev. Appl. Mycol.*, 1926, **5**, 490 (from *Phytopath*, 1926, **16**, 84-85).

At least eight forms of *Fusarium lini* may be distinguished by their parasitic action on several varieties of flax. Six of the forms differ greatly in virulence. Two are about equally virulent, except that one consistently caused loss of chlorophyll above the cotyledons in all varieties of flax inoculated. Neither cultural and physiological characters nor spore morphology afford reliable criteria for the differentiation of these forms, some of which produce heavy infection on certain resistant varieties of flax. —L.I.R.A.

Grasshopper Pests in the U.S.A. (Mississippi): Control. *Rev. Appl. Entomol.*, 1926, **14**, Ser. A, 476-477 (from *Qtrly. Bull. State Plant Bd. Mississippi*, 1926, **6**, 19-20).

When attacking cotton, grasshoppers may be controlled by dusting with calcium arsenate. The most injurious species is *Melanoplus differentialis*. —B.C.I.R.A.

Boll Weevil Control in U.S.A. (Georgia). S. H. Starr. *Rev. Appl. Entomol.*, 1926, **14**, Ser. A, 476 (from *Georgia Coastal Plain Expt. Sta.*, 5th Ann. Rept., 1924, Bull. 5 pp., 19-21).

In experiments in the control of *Anthonomus grandis* good results were obtained by applying a syrup consisting of 3 lb. calcium arsenate, 1 U.S. gal. molasses, and 3 U.S. gals. water to the growing points of the cotton plants with a hand mop, 7 to 10 days before the first squares appeared, repeating the treatment two or three times at weekly intervals, and subsequently dusting with calcium arsenate.

—B.C.I.R.A.

Pink Bollworm in Australia (Queensland): Life History. F. G. Holdaway. *Rev. Appl. Entomol.*, 1926, **14**, Ser. A, 459-460 (from *Bull. Entomol. Res.*, 1926, **17**, 67-83).

Platyedra scutigera, previously thought to be *P. gossypiella* is described. Early stage larvæ are found outside the bolls, entrance being made at any point under the calyx. The larvæ work in the tissues of the carpels and eventually attack the seeds. On the coast where cotton grows in proximity to *Hibiscus*, one of the primary food products, the infestation may be as high as 70-90 per cent. Details of the life history are given and the characters differentiating *P. scutigera* from *P. gossypiella* are discussed. There are also two other species of Platyedra occurring on native *Malvaceæ* in Queensland, though they have not been found to attack the crop. —B.C.I.R.A.

Cotton Insect Pests in West Africa (French). P. Vayssière and J. Mimeur. *Rev. Appl. Entomol.*, 1926, **14**, Ser. A, 457 (from "*Les Insectes nuisables au cotonnier en Afrique occidentale française*," 1926, 176 pp.).

A collection of papers forming a guide to the insect pests that attack the cotton crop of French West Africa, with recommendations for their control.

—B.C.I.R.A.

Wild Cotton Bollworm Occurrence in Mexico. A. W. Morrill. *Rev. Appl. Entomol.*, 1926, **14**, Ser. A, 456 (from *J. Econ. Entomol.*, 1926, **19**, 572).

Larvæ of the thyridid, *Rhodoneura terminalis*, were found infesting about 5 per cent. of the green bolls of a wild cotton, *Gossypium davidsoni*, on the west coast of northern Mexico. This moth has been found in Salvador, where the larvæ were reported to be infesting the stems of cotton, Costa Rica, and Santa Domingo. All the larvæ found by the author were inside the bolls. The insect must be regarded as a potential pest of cultivated cotton. —B.C.I.R.A.

Wagad Cotton: India (North Gujarat). M. L. Patel and D. F. Mankad. *Mem. Dept. Agric. India*, 1926, **14**, 59-112.

Wagad constitutes 75 per cent. of Dholleras, a crop averaging 400,000 to 600,000 bales annually of slightly shorter staple than Broach Deshi. Broach Deshi or Lalis and the inferior Khandesh variety known as Mathio make up the remainder. Working on six strains selected in 1917-18 which are described in detail, various characters are found hereditary. Lint weight and seed weight are correlated though lint length and seed weight are not. The ideal Wagad for North Gujarat must be essentially a pure strain, with staple, yield, and ginning out-turn as high and as little variable as possible. More especially the vegetative growth should be vigorous, the number of fruiting branches should be high though not long, early flowering is desirable and the bolls should be large and as little open as possible. Wagad is one of the closed boll types. —B.C.I.R.A.

Rain-grown Cotton in the Sudan: Possibilities. R. A. Wardle. *Mem. M/cr. Lit. and Phil. Soc.*, 1925-1926, **70**, 59-69.

The range of climatic conditions in the Sudan divides the country into four main zones, namely, the continuous rainfall area, the heavy rainfall area, the medium rainfall area and the area of low rainfall. The continuous rainfall area is very similar to Uganda and should produce the same staple, i.e., exceeding 25 mm. in length. Egyptian varieties are under trial but their success is doubtful. In the Sudan area of high rainfall climatic conditions approximate to those of N. Nigeria, except that the monthly precipitation averages less. Sowings commence with the earliest rains and the somewhat irregular appearance of the heavier rains makes the crop rather uncertain. Conditions for long staple are not promising in the medium and low rainfall areas where the rainfall is short and erratic in appearance and temperature variations also are severe. Drought resistance and early maturity are essential in the suitable variety and "these qualities cannot be accompanied by the degree of length, strength, and uniformity of seed hairs, and the high proportion of hairs which can be separated from the seed, that give cotton its commerical value." American varieties yielding lint exceeding 25 mm. have, however, been grown but yields are low. The yield varies in the best years from 100 lb. lint to 30 lb. lint in the bad rainfall years. —B.C.I.R.A.

Non-cellulosic Cotton Constituent: Isolation. F. Micheel and W. Reich. *Annalen*, 1926, **450**, 59-65.

A substance associated with cellulose in the fibre, which is not removed by the ordinary materials of washing, scouring, and bleaching, is described. To prepare it, the product obtained after the complete acetolysis of cellulose and subsequent saponification, is acetylated with 2-3 times its weight of pyridine and the same quantity of acetic anhydride. A strongly swollen precipitate separates which may set to a gel. Chloroform is added in sufficient quantities to cause de-swelling and complete the precipitation and the product is washed with choroform. One gram of dry substance can fill in the swollen state and at the beginning of precipitation a porcelain vessel 15 cm. in diameter and 7 cm. in height. After precipitation with warm glacial acetic acid in ether a colourless powder is as a rule obtained, which is not always completely soluble in glacial acetic acid. Analyses of a number of products obtained from different cottons are given. Very characteristic are the high ash content and the presence of nitrogen. Calculated from the nitrogen percentage, it appears that cotton contains about 0·3 per cent. of the substance. It gives a characteristic Röntgen diagram so that the product must be assumed to be crystalline or to contain crystalline constituents. The diagram has no similarity to that of cellulose or of mercerised cellulose. —B.C.I.R.A.

Cellulose Fibre: Refractive Power. A. Frey. *Kolloidchem. Beih.*, 1926, **23**, 40-50.

In applying the immersion method to measuring the refractive indices of the anisotropic components of cellulose fibres, the indices of the whole fibre (n_o and n_a), not the required indices ($n\alpha$ and $n\gamma$) are obtained; n_o and n_a are, however, functions of the refractive powers of the imbibition fluids (n_I and n_{II}). By a skilful choice of immersion liquids and sufficiently long imbibition of the fibre the condition can be reached that the imbibition fluid in the fibre possesses the same composition as the immersion fluid outside. When this condition is fulfilled $n_I = n_a$ and $n_{II} = n\gamma$, in which case also n_o and n_a coincide with $n\alpha$ and $n\gamma$. The immersion method is more complicated for dispersoid systems than for crystals. Recorded values for $n\alpha$ and $n\gamma$ for cotton, ramie, flax &c., show that pure cellulose fibres possess approximately constant refractive indices and double refraction; the mean values of $n\alpha$ and $n\gamma$ are 1·533 and 1·594 respectively. If the micellæ run at an angle to the fibre axis, in which direction the measurement is made, the values obtained must be corrected by means of an ellipse equation. Incrustations of lignin and pectin substances change the refractive indices of the fibre and reduce the double refraction. —B.C.I.R.A.

Waxes of Cottons of Different Origin and their Characteristics. L. V. Lecomber and M. E. Probert. *J. Text. Inst.*, **16**, T338-T344.

(D)—Artificial

Threads of Silk. *Daily Mail*, 4/12/1926, p. 7.

A non-technical note of the manufacture of viscose from wood-pulp at the newly-started works of Rayon Manufacturing at Ashstead, Surrey. More than one ton a day is being spun and the output is expected to be more than doubled shortly. —F.G.P.

Viscose; Production of——. F. G. Oliver. *Ind. Chem.*, 1926, **2**, 152.

About 80 per cent. of the production of rayon is viscose made from bleached sulphite pulp from Sweden, Norway, and Canada. It is a finer quality than that used for paper. The pulp, which is almost free from ash, wax, and resinous matter, is dried in stores at 30° C. It is kept in iron cages which are steeped in sheet iron tanks containing 17-18 per cent. caustic soda. The impregnated sheets, from which the lye is run off, are pressed and disintegrated, and then aged at 23° C. for two days or longer. The mass is put into tightly closed drums and carbon bisulphide sprayed in under pressure; this gives orange red xanthogenate which should be soluble in water. The bisulphide is drawn off and the xanthogenate dissolved in 6-7 per cent. caustic for several hours, grinding if necessary. This is viscose, which is again aged for four days at 15-18° C. and then press-filtered. The solution is forced through spinnerets into the coagulant (10 per cent. sulphuric acid containing metallic sulphates and sugar). A thread of cellulose hydrate is formed. Remaining sulphur is removed with sodium sulphide and the hanks are bleached in dilute chlorine. Soaping is needed before drying. —F.G.P.

Artificial Silk: Spinning. —. Hansen. *Kunstseide*, 1926, **8**, 253-257.

Uneven dyeing seldom occurs with artificial silk which has been spun on centrifugal machines but is more frequent in the product of bobbin spinning machines. This is due to an inherent deficiency in the machine itself, for as winding proceeds the thread becomes progressively thinner. Methods proposed for overcoming this deficiency may be divided into two groups. In the first group it is sought to increase the amount of spinning solution fed to the nozzles as the diameter of the bobbins increases. In the second group the quantity of spinning solution is maintained constant and the number of revolutions of the driving shaft for the bobbins is reduced as the diameter of the bobbins increases. The first method is not satisfactory. The second method is further discussed as applied to belt-driven, friction-driven, and electric-driven machines. —B.C.I.R.A.

Viscose: Ripening. R. Bernhardt. *Kunstseide*, 1926, **8**, 173-175, 211-213, 257-260, and 314-319.

A study of the chemical changes taking place during ripening is described in which the changes in total carbon disulphide, xanthate, thiocarbonate, and free carbon disulphide, hydrogen sulphide, carbonoxysulphide and carbon dioxide were followed. It was first established by experiments on pure cellulose xanthate and on thiocarbonate in the presence of different concentrations of acetic acid that considerable xanthate decomposition occurs in acetic acid solution, but that the stability can be increased by reducing the solubility product by the addition of heavy metal salts, particularly silver salts. Methods for estimating xanthate, thiocarbonate, and free carbon disulphide have been devised. The separation of xanthate and thiocarbonate is based on acidification with acetic acid to a concentration of 0·2 per cent., by which the thiocarbonate is destroyed, whilst the decomposition of the xanthate is retarded by the addition of silver salts. The concentration of free carbon disulphide is found to be at a maximum shortly after the preparation of the viscose solution is complete; it decreases gradually as ripening proceeds and reaches a minimum shortly before gelatinsation of the viscose. A method of estimating carbon oxysulphide is described and its formation in increasing amount as ripening proceeds is established. It does not occur free in viscose but probably in solution in sodium hydroxide as sodium dioxy-monothiocarbonate. A colorimetric method for estimating sodium sulphide is described which enables the thiocarbonate and hydrogen sulphide contents of viscose to be estimated. Ripe viscose contains no sodium sulphide. The results indicate that the polymerisation theory of Cross and Bevan is substantially correct, with the limitation that monocellulose xanthate does not exist. The statements of these authors concerning the reactions of the carbon disulphide liberated from the xanthate are, however, revised. The carbon disulphide combines with hydrogen sulphide to form trithiocarbonate; dithiocarbonate does not exist in the viscose. Hydrogen sulphide is formed by hydrolysis of carbon disulphide, the mechanism of the reaction being as yet unknown. Trithiocarbonate is certainly not formed; the intermediate product is rather carbon oxysulphide or sodium dioxy-monothiocarbonate. The carbon dioxide formed during ripening is equivalent to the hydrogen sulphide formed if the hydrogen sulphide equivalent to the carbon oxysulphide content is taken into account. The hydrogen sulphide corresponding to the carbon dioxide is entirely utilised in the formation of trithiocarbonate.

—B.C.I.R.A.

Spinstra Artificial Silk: Properties. *Boll. Cotoniera*, 1925, **20**, 71-72.

The product is described as a new viscose fibre particularly suitable for mixing with cotton and wool. It is produced by the Spinnstoffabrik Zehlendorf, Berlin. It has a higher tensile strength than older fibres of the same type, is extremely fine, and possesses optimum elasticity and lustre. It has a denier number per single filament of 2·5 as compared with 7·5 for ordinary artificial silk. It has been produced as fine as 1·5 denier per single filament but this is regarded as less convenient for general practice. —B.C.I.R.A.

Artificial Silk and Cellulose: Zymolysis. P. Karrer and P. Schubert. *Helv. Chim. Acta.*, 1926, **9**, 893-905.

Continuing previous work, the authors measured the relative degradation caused in various artificial silks by the action of snail cellulase. "Celta" (Emmenbrücke) and Köln-Rottweil viscose are much more easily saccharified than other artificial silks. They are found to differ also from other artificial silks in having less serrated outlines in cross section. Experiments with Köln-Rottweil viscose of varying degrees of serration and a distinctly lobed sample of Bobinger viscose confirmed the fact that lobed filaments are degraded to a much less degree than smooth rounded ones. The deduction is drawn that the cause of the greater or less stability of viscose filaments towards enzymes is to be sought in their membranes; that one form of surface, which depends on the nature of the precipitant, facilitates enzyme attack, while another confers stability. These differences may be due to the accumulation of small quantities of salt in the surface layer, or to the ability of the membrane to change its capillarity. These views are confirmed by the results of exposing cellulose filaments, which are resistant to enzyme attack, to the action of cellulase for a long time. The rate of degradation does not decrease as with regenerated celluloses but increases with increasing time. This is most easily explained by assuming that a sensitive resistance in the filament surface gradually disappears as the surface is destroyed. Results of improved methods in the degradation of natural cellulose are communicated. With filter paper, doubling the enzyme concentration raised the amount of degradation 1·15 to 1·24 times. With an enzyme preparation containing the enzyme out of 22 snails a total degradation (44·5 per cent.) of natural cellulose was obtained. —B.C.I.R.A.

Cellulose: Application. G. J. Esselen. *Ind. Eng. Chem.*, 1926, **18**, 1031-1034.

The trend of future progress in the development of cellulose chemistry, in the "pure" branch and in the pulp and paper, artificial silk and other derivatives, and textile branches is discussed. —B.C.I.R.A.

Cellulose Esters: X-ray Structure. R. O. Herzog. *Helv. Chim. Acta*, 1926, **9**, 631-633 & 798.

The author gives detailed experimental evidence of the crystalline structure of a cellulose acetate and a cellulose nitrate, the existence of which he has reported earlier. Both esters possess rhombic symmetry; the cellulose acetate contains $2C_6H_7O_2(C_2H_3O)_3$ residues in the unit cell, and the nitrate $4C_6H_8(NO_3)_2O_3$ residues in the unit. —B.C.I.R.A.

Cellulose: Constitution and Hydrolysis. J. S. Remington. *Ind. Chem.*, 1926, **2**, 402-406.

The question of cellulose constitution was approached by an experimental investigation of the hydrolysis or krafting of sulphite and other pulps in laboratory beaters, using in the beaters water, alcohols, organic acids, &c., and by the complete electrolysis of glucose solutions in an apparatus described. Some fermentation experiments are also recorded in which weighed quantities of pulp were beaten up and put into jars with 20 per cent. malt extract (125° Lintner), previously dissolved in water, and left at room temperature for 60 days. At the end of this period the pulps were squeezed out, dried and weighed, when a loss of 22·5 per cent. was found; the pulp was run on a model paper machine and the resulting paper was found to be much stronger than similar pulp treated four times in the beater alone. Relative strength tests are recorded. A graphical representation of the possible action of rosin-sizing on cellulose is given. —B.C.I.R.A.

Celluloid: Properties and Application. *Chem. and Met. Eng.*, 1926, **33**, 650.

Depending upon its composition, the solid substance varies in specific gravity from 1·3 to 1·5 at 15° C., has a softening or melting point of 60 to 93·4° C., an ignition point of 160-190° C., a coefficient of expansion of 0·00010 to 0·00060 per inch per degree C. at 37° C., a dielectric strength of 850 to 1,500 volts per mil., a refractive index of 1·450N_D to 1·500N_D, a thermal conductivity of 0·00030 to 0·00045, and a spectral transmission of 80 to 85 per cent. in the visible range and up to wave lengths of 0·2 micron which falls from 80 per cent. to 0 in the wave length zone of from 0·2 to 0·3 micron, being practically opaque in a large portion of the infra red region. It has a tensile strength of 8 to 10 kg. per sq. mm. with a yield point of 6-8 kg. per sq. mm. and an elongation of 25 to 40 per cent. and is free from brittleness. It is almost unaffected by hydrocarbon solvents, oils, and low concentrations of acids, except acetic and formic acids, at normal temperatures. It is attacked by acids at high temperatures and by alkalis and organic solvents at all temperatures. It absorbs moisture with a very slight change in volume, up to 1·5 to 3 per cent. of its weight, resulting in slight softening and increased plasticity. It should not be used where it would be exposed for a long time to temperatures above 60° C. Its uses in industry include tank linings, protective coatings, gauge glass and windows, face masks, coloured inspection tables, burette readers, equipment models, glare shields, unbreakable containers, funnels and piping, stencils, slide rules, drawing instruments, and panels for electrical instruments. —B.C.I.R.A.

Wood Pulps: Properties. R. Michel-Jaffard. *Chim. et Ind.*, Spec. No., 1926, **16**, 621-626.

The properties of alfalfa, straw, and various wood pulps are reviewed and compared with those of cotton and rag pulps, and it is shown that, though the differences are considerable, they may replace rag pulps in those branches of paper making, e.g., superfine writing papers, blotting paper, and filter paper, for which rags have hitherto been the principal raw material, by suitable selection among the available pulps. For example, bisulphite pulps are finding increasing use in the manufacture of fine papers and alfalfa pulps for "full" and "inert" papers, that is, papers which are thick for a given weight per sq. metre, and which are not susceptible to moisture changes. The modification of the properties of pulps by special treatment, especially in connection with raw material for celluloid and cellulose acetate, also affords many possibilities. —B.C.I.R.A.

Manufacture of Bleached Sulphite Wood-pulp for the Rayon Industry. T. Woodhouse. *Silk J.*, 1926, **2**, No. 23, p. 44.

Describes, with illustrations, the processes from the logging in Norwegian forests to the baling of dry sheets of pulp. —F.G.P.

Hemicelluloses of Beech Wood. M. H. O'Dwyer. *Biochem. J.*, 1926, **20**, 656-664.

The hemicelluloses, previously thought to be true carbohydrates, are now shown to contain acid groups (glycuronic and galacturonic) and are, therefore, more nearly allied to pectin than to cellulose. Two hemicelluloses have been extracted from beech wood by dilute caustic soda, one by the addition of acetic acid to the alkaline extract and the other by adding two volumes of alcohol to the filtrate after adding acetic acid. The first hemicellulose yields xylose and glycuronic acid (11 per cent.) on hydrolysis with acid, while the second yields arabinose, galacturonic acid (63 per cent.) and a small amount of galactose. The amount of the second hemicellulose is small compared with that obtained by direct precipitation with acids. With non-lignified tissues, however, the second hemicellulose predominates. —L.I.R.A.

Cellulose: Constitution. K. Hess. *Kolloidchem. Beih.*, 1926, **23**, 93-108.

In a summary of present knowledge of the constitution and properties of cellulose the author vindicates the micellar theory of Nageli-Ambronn, and shows that the conception of a micelle built up of bands of molecules of the size $C_6H_{10}O_5$ is supported particularly by (1) the specific rotation of cellulose in cuprammonium solution, (2) the "unimolecular" dispersion in glacial acetic acid solution, and (3) the conversion of acetyl cellulose to cellobiose. —B.C.I.R.A.

Trimethylcellulose: Preparation and Properties. K. Hess and H. Pichlmayr. *Annalen*, 1926, **450**, 29-40.

The preparation of crystalline trimethylcellulose from cellulose A from viscose silk, from viscose and cuprammonium silk, and from cotton linters is described. All the products obtained are practically identical, the preparation from cellulose A having a methoxyl content of 45·4 per cent. (theoretical 45·6 per cent.) and $[\alpha]_D$ in benzene —18·52°. Photomicrographs of trimethylcellulose crystallised from different solvents are reproduced, and the cryoscopic properties of the substance measured in a vacuum are described and compared with those of cellulose acetate under the same conditions. The similarity existing points to trimethylcellulose being a direct substitution product of cellulose, in the molecule of which there is, beyond the introduction of methyl groups, no other change than perhaps bridge displacement. The importance of trimethylcellulose as a starting point for studies of cellulose constitution is evident. —B.C.I.R.A.

Cellulose: Acetolysis. K. Hess and H. Friese. *Annalen*, 1926, **450**, 40-58.
The authors have prepared a further reaction product which they detected in the initial stages of the acetolysis of cellulose to cellobiose acetate and glucose derivatives according to the process of Ost. The substance is obtained if the sulphuric acid concentration is reduced to about one-tenth of that used by Ost and the reaction (at 30°) is interrupted after 2-3 days. The new product, which has the same percentage composition as cellulose acetate, is quickly converted into cellobiose and isocellobiose and must be regarded as a new intermediate product in the formation of these bioses from cellulose. Unlike cellulose diacetate the new compound, dissolved in glacial acetic acid behaves cryoscopically as a biosan and does not associate even in the course of 100 hours. It is concluded that the product is not a cellulose acetate but a hexacetylbiosan. This is confirmed by saponification and methylation, by which hexamethyl derivatives result, and it is evident that hexamethylbiosan stands in the same relation to trimethylcellulose as hexacetyl biosan to cellulose acetate. That two molecules of the cellulose acetate initially resulting from the cellulose are joined together is evident but it is not yet known which oxygen linkages are involved. The association is viewed as a true polymerisation. The acetate and methylate of the biosan are snow-white powders which are strongly doubly refracting. The properties of the new biosan are compared in a table with those of a cellobiose anhydride prepared in a different way by Bergmann and Knehe. —B.C.I.R.A.

Cellulose: Constitution. F. Micheel and K. Hess. *Annalen*, 1926, **449**, 146-155.
The constitution of trimethylglucose and its relation to trimethylcellulose were examined anew. The authors have prepared 2-3-5-6-tetramethyl-(α, β)-methyl glucoside-(1-4) by methylating 2-3-6-trimethyl-(α, β)-methyl glucoside-(1-4), which has previously been prepared by Irvine and Hirst from trimethylcellulose. This tetramethyl-methyl-glucoside on saponification gave a tetra-methylglucose which was identical with the tetra-methylglucose prepared from *d*-glucose. Accordingly, the glucoside resulting from trimethylglucose at 100° possesses the same ring as does normal glucose. The fact that other workers find that the trimethyl-methyl-glucoside prepared from trimethylglucose at room temperature or at 30° has the ring of hetero (or γ) glucose, is explained by ring isomerism in the glucosides formed at the respective temperatures. Further light on the wandering of the O-ring of trimethylglucose is thrown by experiments causing the isomerisation of 2-3-6-trimethyl-methyl-glucoside-(1-5) to 2-3-6-trimethyl-methyl-glucoside-(1-4). —B.C.I.R.A.

Cellulose: Constitution. G. Schultze and K. Hess. *Annalen*, 1926, **450**, 65-74.
The authors challenge the experimental results of Pringsheim on which the conception of "cellosan" as a molecular unit of cellulose is based, and criticise Pringsheim's theory of cellulose constitution. —B.C.I.R.A.

Viscose Spinning Baths: Effect on Filament Cross-section. A. Herzog. *Leipziger Monats. Text.-Ind.*, 1926, **41**, 352-354.
The influence of the spinning bath as regards composition and concentration on the form of the cross-section of viscose filaments is shown. Ammonium chloride or sulphuric acid baths of specific gravity of 1·05 give cross-sections which are more or less circular. Solutions of sulphuric acid with either sodium sulphate or magnesium sulphate of increasing concentrations have the effect observed when a membranous cell undergoes plasmolysis in strong salt solutions. —B.C.I.R.A.

Cellulose: Heat Decomposition. H. I. Waterman and J. N. J. Perquin. *Rec. Trav. Chim.*, 1926, **45**, 638-653.
Experimental work on the "Berginisation" of cellulose, in the form of cotton wadding, at temperatures of 225°, 300°, and 450°, in the presence of hydrogen at pressures of 110 kg./cm^2. is described. Autoclaving in the presence of a dispergating agent such as a Borneo oil fraction prepared according to Edeleanu gave the most striking results. Although the experiment was carried out with high hydrogen pressures, which were regarded as essential to the decomposition, the process is not one of direct hydrogenation since the quantity of hydrogen consumed is less than when the cellulose is autoclaved with hydrogen present but without the dispersing agent. The results appear to confirm Bergin's view that great importance attaches to the presence of the dispersing agent in experiments in which cellulose, in a liquid medium (without the addition of a catalyst), is transformed in greater part into an oil by heating to 450° in the presence of hydrogen at high pressures. The reaction products under different autoclaving conditions are set out in a table, and previous work on the subject is reviewed. —B.C.I.R.A.

Cellulose: Constitution. H. Brunswig. *Cellulosechem.*, 1926, **7**, 118-121.
The author examined the relation between the nitrogen content and the solubility of

nitro-cellulose esters prepared in the way described. The curve shows five well-defined points; the esters corresponding to nitrogen contents of 10·2 and 12·8 per cent. respectively, being completely soluble in ether-alcohol. It is concluded that the observed relation between nitrogen content and solubility cannot be satisfied by a simple $C_6H_{10}O_5$ cellulose molecule; the molecule must be multiplied by at least four giving a molecular size of $C_{24}H_{40}O_{20}$. —B.C.I.R.A.

Alkali-cellulose: Esterification and Constitution. G. Kita, T. Mazume, I. Sakrada, and T. Nakashima. *Cellulosechem.*, 1926, **7**, 125-133.

(1) In esterifying alkali cellulose with a fatty acid chloride, the authors investigated various factors, including the degree of purity of the acid chloride, the excess alkali in the alkali-cellulose, the quantity of the acid chloride used, the temperature of preparation and esterification of the alkali-cellulose and its age and dryness. With different acid chlorides the degree of esterification was found to be dependent on the nature of the acid. Esterification with the acid chlorides of higher fatty acids effected the removal of the combined alkali which is not easily accomplished with benzoyl chloride, and the results accord with Vieweg's alkali absorption curve for cellulose.

(2) Following the lines of Vieweg's investigations the authors examined the effect on the esterification of sodium chloride, sodium carbonate, and alcohol. The salts in reasonable concentration were practically without effect. Curves connecting esterification and alkali concentration in the presence of alcohol of 10, 35, and 50 per cent. concentration showed a definite horizontal portion at an alkali concentration above 15 per cent., corresponding to the formation of a compound. From their results, the authors conclude that in the presence of alcohol in the alkali hydroxide, alkali is taken up chemically as well as physically; the influence of the alcohol is practically nil at alkali concentrations which correspond to the horizontal part of the curve for the alkali absorption from pure alkali hydroxide, and that only the chemically combined absorbed alkali takes part in the esterification.

—B.C.I.R.A.

Viscose: Ripening. (1) E. Berl and Johann Bitter. (2) E. Berl and A. Lange. *Cellulosechem.*, 1926, **7**, 137-147.

(1) The authors began their study by investigating xanthate formation in the case of higher alcohols such as glycol and glycerol, and found that only one hydroxyl group is concerned in xanthate formation. In seeking to determine how many hydroxyl groups take part in the formation of cellulose xanthate, a number of xanthates were prepared from cellulose compounds methylated to different degrees. The results point to the necessity of two hydroxyl groups being available, thus supporting the assumption of Cross and Bevan. The higher requirement of hydroxyl by cellulose is ascribed to the specific properties of the fibre structure. From the experimental work, mainly consisting of ultra-microscopic observations, the following theory of viscose ripening as a hydrolytic process is advanced. The cellulose fibre in consequence of the high surface area of its micellar structure can absorb alkali hydroxide and water from alkali solutions of high concentrations. A complete mechanical saturation is effected in the course of two hours. Alkali absorption in the fibre which is evidenced superficially by the mercerisation effect is accompanied by a loosening of the internal forces which bind together the units of the cellulose structure. Such a loosening gives rise to the liberation and hydration of hydroxyl groups. The existence of high alkali concentration leads to the establishment of the alcoholate equilibrium. Thus, ripening gives rise to a cellulose which is changed physically and chemically; physically in that it is looser in structure with a larger area of surface, chemically in that, first, hydrated and free hydroxyl groups are present, and, secondly, alkali is present as alcoholate and as adsorbed combined alkali. The carbon disulphide now acting is adsorbed in consequence of increased surface area. In this condition of high concentration the xanthate reaction with the alcoholate group begins, promoted by pressure. In consequence of the alcoholate equilibrium being disturbed new alcoholate groups are made available to the carbon disulphide until this is all used up. During the formation of xanthate groups, a disintegration of the cellulose to a high degree of dispersity occurs, since through the introductiin of the xanthate groups the cellulose micelles are displaced so far out of their mutual spheres of influence that the cohesion of the fibre is lost. Disperse degradation occurs here, therefore, as a physical change induced by a chemical reaction—xanthate formation. In these circumstances the reaction product goes into solution in water or dilute alkali in a colloidally disperse condition. Ripening of the xanthate occurs through the water present in intimate contact with the colloid. As with the salt of a weak acid and strong base, hydrolysis occurs with the formation of sodium hydroxide and free cellulose xanthic acid, an equilibrium being established. The free unstable xanthic acid breaks down to carbon disulphide and free cellulose, whereupon further free xanthic acid is formed and in turn breaks down. The carbon disulphide in an extremely fine state of division reacts with free alkali forming tri-thiocarbonate and finally sulphide. The colloidally-disperse degraded cellulose particles become aggregated in consequence of their powers of association to particles which gradually

grow larger until finally the mass coagulates to a gel of hydrated cellulose.

(2) The above theory that the ripening process is not a polymerisation of cellulose but a cementing together of small micellar aggregates to larger ones is confirmed by viscosity determinations. The products tested were obtained by precipitating Lintner and Zellstoff viscoses with neutral sodium chloride or acid bisulphate solutions, washing to complete neutrality and drying. The resultant products were carefully nitrated and their viscosities measured in acetone solution. All the curves show a viscosity minimum in the initial stages of ripening. —B.C.I.R.A.

Viscose Artificial Silk: Strength and Lustre. K. Atsuki. *Chem. Zentr.*, 1926, **ii.**, 1912 (from *Cellulose Ind.* (Tokio), 1926, **2**, 23-24).

The poorer mechanical properties of viscose filaments as compared with cotton, when in the damp state are due to changes in the cellulose, the difference and irregular arrangement of the cellulose particles, the presence of small colloid impurities such as β-cellulose, excessive caustic soda treatment which is favourable to cellulose oxidation, incomplete dispersion of the viscose, and to incomplete coagulation. A viscose with an elastic limit at 4 kg./sq. mm. load and 2 per cent. extension, a maximum at 10 kg./sq. mm. and 11 per cent. extension has an elastic feel and is specially suitable for weaving. Lustre is dependent on the size and arrangement of the cellulose particles and the existence of minute hollow spaces which are formed by gas evolution during coagulation.

—B.C.I.R.A.

The Swelling of Cellulose. R. O. Herzog. *Chem. Absts.*, 1926, **20**, 3078 (from *Kolloid Z.*, 1926, **39**, 98-107).

Electrolyte-free polysaccharides do not swell in water. The swelling is greatest when the concentration of the electrolyte is equivalent to the combining capacity of the cellulose. The compounds of cellulose with alkali hydroxides and with Schweitzer's reagent are highly dissociated. The compounds of cellulose with nitric acid and with alkali salts and alkali earth salts are but little dissociated. In the first case one deals with hydrated ions: in the second case, with hydrated mols. The effect of ionogens on hydration has the same trend when compared with hydrophilic properties that solubilities have when the same comparison is made. The mass of water imbibed cannot be related to the heat of mercerisation. The swelling breaks apart the cellulose crystals and at least partially destroys the material which held them together in their natural state. Mercerisation is accompanied by contraction, and softening of the cellulose, and by a disappearance of the X-ray diagram. The tension due to contraction seems to be independent of the mercerising agent. Swelling changes both the tensile strength and the elasticity of the cellulose fibres. Natural cotton fibres are stronger than artificial fibres. Mercerisation under tension gives the strongest ramie fibres. A definite density of about 1·36 for calcium thiocyanate as a swelling solution gave an extensibility as high as 39·7 per cent., which is greater than for either a larger or a smaller concentration. Swelling and losing water causes changes in the ability to absorb water in the outer layers of the cellulose particles as well as in the mechanical properties of the fibres. —L.I.R.A.

Cellulose Particle: Swelling. R. O. Herzog. *Brit. Chem. Abstr.* A, 1926, 902 (from *Pulp and Paper Mag.*, 1926, **24**, 699-703).

The particle size of cellulose, as deduced from the coefficient of diffusion of the nitrated material in acetone, is in reasonable agreement with that deduced from X-ray measurements. By treatment with sodium hydroxide in the absence of air, the particle size first falls and then slowly rises; in the presence of air a continuous fall occurs. Other chemical reactions, e.g., with dilute sulphuric acid, do not diminish the particle size. In the ripening of viscose a rapid fall is followed first by a slow rise, and then by a rapid rise and jelly formation. When cellulose swells in an electrolyte, one or several C_6-groups are in stoichiometrical relation to each mol. of the electrolyte, and a compound of the Werner type may be assumed. In such cases water enters the fibre by the attractions of the ions on the surface of the crystalline or colloidal particle, as an envelope around ions similarly attracted, and in chemical combination with the complex compound of the cellulose and electrolyte.

—B.C.I.R.A.

Cellulose Constitution and Wood Cellulose Isolation. O. Routala and J. Sévon. *Chem. Zentr.*, 1926, **ii.**, 1805 (from *Annal. Acad. Sci. Fennicæ*, 1926, **26**, Ser. A, 26 pp.).

The authors investigated the chemical reactions of the sulphite cooking process. In the first hour solution of the incrustations begins and proceeds regularly from 80° to 100°, becoming slower only towards the end. The carbohydrates and lignin go into solution proportionately up to the stage at which 23 per cent. of the weight of wood has dissolved. The sugars going into solution during the first few hours consist mainly of pentoses; only later do hexoses dissolve. The pentosan content decreases continuously. The removal of resins and fats is largely mechanical. The absorption of calcium sulphite by the wood proceeds within certain limits independently of temperature, and reaches its maximum for all the processes investigated in the same time. From their researches the authors think it fair to conclude that wood consists of a mixture of compounds of lignin with carbohydrates,

even with cellulose itself. The hydrolysis of the compounds and the formation of calcium lignosulphonates is the chief reaction in the sulphite cooking process. Deductions are drawn regarding the constitution of the cellulose molecule.
—B.C.I.R.A.

Manufacture of Cellulose Acetate Silk. C. E. Mullin. *Text. Colorist*, 1926, **48**, 813-815.
A summary of processes of manufacture, reference being made to the influence of conditions of manufacture on the solubility of cellulose acetate in acetone and chloroform, the use of catalysts in acetylation, and the stability of cellulose acetates containing sulphuric acid residues.
—A.J.H.

Synthetic Fibre: Promising Future. *Text. Amer.*, 1926, **45**, No. 6, p. 13.
Vistra is said to be coming forward as a textile fibre. Like viscose it is made from wood pulp but is spun in 50 in. lengths which are cut 1-2 in. and spun up into threads of 2-fold 100's or 2-fold 200's. Some cotton is added to increase the strength, which is liable to great variations. It is said somewhat to resemble silk in lustre, a claim made for all new fibres but not realised, yet vistra, it is stated, is near enough to deceive customers.—F.G.P.

Cellulose: Adsorption of Alkali. S. Liepatov. *Brit. Chem. Abstr.*, 1926, A. 573 (from *J. Russ. Phys. Chem. Soc.*, 1925, **57**, 31-47 & 48-54).
(1) The behaviour of cotton towards electrolytes is analogous to that of starch. Acids are very slightly adsorbed, this action being most marked for medium concentrations of the acids. Alkalis are readily adsorbed and when the solutions are dilute the adsorption follows the ordinary formula. On account of the swelling of the yarn, adsorption of alkali from concentrated solution follows a more complex course, the curve showing an abrupt change in direction due, not to chemical action, but to change in structure of the yarn caused by the swelling. The presence of electrolytes either diminishes or affects but little the adsorption of alkali by cellulose, any diminution of the adsorption being closely related to the decreased swelling of the cellulose. The results indicate that adsorption of alkali by cellulose must be regarded as a chemical adsorption.
(2) Sodium and potassium hydroxides are adsorbed by cellulose in very nearly the same proportions, but barium hydroxide is adsorbed in much larger quantities. The adsorption of alkalis by cellulose is expressed by the ordinary adsorption equation, but is said to involve a chemical reaction of hydrolytic nature.
—B.C.I.R.A.

Stability of Nitro-cellulose. See Section 6.

Fluorescence of Sulphite Cellulose. See Section 6.

2—CONVERSION OF FIBRES INTO FINISHED YARNS

(A)—Preparatory Processes

Worsted Drawing and Spinning. S. Kershaw. *Wool Rec.*, 1926, **30**, 1324.
Investigations have been carried out which show that drawing is the most important of all operations during the making of a fabric. Often Continental yarns are used in the making of Yorkshire fabrics, but the latter would benefit greatly if Continental machinery was used. The twist in yarns has a great effect on the fabrics, both in strength and appearance. Improvements have been made in order to make the yarn smooth and of more even size, and also to ensure the greater speed for ring rovers.
—B.R.A.W.&W.I.

French Drawing and Ring Spinning. A. Pouncelet. *Text. Merc.*, 1926, **75**, 421.
The main characteristics of the French system is that the wool is worked in a dry state, no twist is inserted in any of the drawing operations, and the fibres are straightened out by means of porcupines, and kept parallel to one another in all the operations of drawing. The French system offers many advantages for the production of carpet yarns, for raw material is low in price, the transformation costs very low, and the production very high.
—B.R.A.W.&W.I.

New Binding Machine for Raw Silk. Dr. Colombo. *Silk* (N.Y.), 1926, **19**, No. 5, p. 43.
Describes a machine for binding skeins to an exact weight which enables the spinner to keep check on output. The silk is humidified in a steam box. —F.G.P.

(B)—Spinning and Doubling

American Yarn: Spinning Data. C. R. Harris. *Cotton* (U.S.), 1926, **90**, 978-979).
Some data relating to spindle speed, hank roving and yarn twist multiple in use in American mills for spinning 6 to 60's yarns from different cotton staples are tabulated. An appeal is made to U.S. spinners to furnish records of these and other spinning data employed in their mill to further the work of setting up standards in the cotton industry. —B.C.I.R.A.

Werning High Draft System. C. Ros. *Leipziger Monats. Text.-Ind.*, 1926, **41**, 333-334.
In a reply to Toenniessen the author maintains that the Werning system is satisfactory for large scale production, and shows two yarns in which the piecing effected is good. —B.C.I.R.A.

Worsted Spinning. See Section 2A.

French Ring Spinning. See Section 2A.

(C)—Subsequent Processes

Artificial Silk Solvent Recovery Plant. G. Weissenberger. *Kunstseide*, 1926, **8**, 321-327.
The spinning parts are encased and the vapour-charged air is withdrawn from them and from the apparatus in which the spinning solution is prepared by a ventilator and is passed to air filters, thence to three washing towers arranged in series through each of which it passes upwards and counter to a stream of absorption liquid which is pumped to the top of the third tower and passed thence down each of the three towers. A fourth tower, irrigated by a heavy oil of high boiling point, and a drop catcher, are provided to retain any absorption liquid or vapour carried forward by the air. The treated air escapes by a pipe at the top of the fourth tower. The charged absorption liquid is pumped to an elevated tank, preheated, and passed to an evaporator in which it flows slowly over surfaces of increasing temperature. The alcohol and ether vapours are cooled and condensed whilst the absorption liquid gives up its heat to newly entering charged liquid and is returned to the third tower. The condensate is passed to a distilling apparatus and the rectified ether and alcohol flow through separate meters back to the factory. The plant is capable of dealing with up to 10,000 cu. metres of air per hour and the yield is about 95 per cent. —B.C.I.R.A.

Mercerising Liquor: Recovery. *Chim. et Ind.*, 1926, **16**, Special number (5te Congrès de Chimie Industrielle), 520-525.
Patented processes for the recovery of sodium hydroxide after use in mercerisation are reviewed and a method is described in which the lye is clarified during the recausticising process by forming a precipitate of sodium resinate and of calcium carbonate in the solution; lead acetate (pyrolignite) may be added to increase the efficiency of the process but is not necessary. Sodium carbonate and lime are added to the lye which is then boiled. Rosin soap, prepared separately, is added. Heating is continued for a time, then steam is shut off and, when cold, a clear solution can be run off and the deposit washed to extract sodium hydroxide. By way of example it is stated that if to 5·5 cub. metres of lye of 7·1° Bé. are added 200 kg. of sodium carbonate, 200 kg. of lime, 2 kg. of lead pyrolignite and 2 kg. of colophony saponified with 0·3 kg. of sodium carbonate, about 4·4 cub. metres of purified lye of about 10° Bé. and 1·8 cub. metres of deposit are obtained. —B.C.I.R.A.

Amidated Cotton: Preparation; and Amine Yarn: Dyeing. P. Karrer and W. Wehrli. *Helv. Chim. Acta.*, 1926, **9**, 591-597.
The so-called "immune yarn" of the Sandoz Company, obtained by partial esterification of cotton with toluene-sulphonyl-chloride, which is immune towards substantive dyes reacts with ammonia, primary and secondary amines and hydrazine to give cellulose containing an amino group. The amidation is effected in several weeks with aqueous ammonia in the cold and is complete in one hour at 100°. In the ammonia treatment a yarn with a sulphur content of 1·9 per cent. lost 7·6 per cent. of its weight and then contained 1·3 per cent. sulphur and 0·7-0·8 nitrogen; this corresponds to the entrance of one HN_2-group per 9-11 $C_6H_{10}O_5$ residues. The ammonium salt of toluene-sulphonic acid was identified in the solution. Amidated cotton or "amine yarn" dyes quickly and deeply with acid dyestuffs, generally even more quickly than wool. The behaviour of amine yarn towards a number of dyestuffs is shown in a table. Maximum fastness to soap is shown by the after-chrome dyes, the pyrazolone dyes follow and then the acid dyes of the anthraquinone series. Methylamine, benzylamine, &c., also react with "immune yarn" to give products with a high affinity for acid dyes; with aromatic amines such as aniline and α-naphthylamine the immune yarn takes up the dye less strongly. Pyridine is probably added to the immune yarn. In addition to cotton treated as above, celluloses partially esterified with different aromatic and with certain aliphatic sulphonic acids may be employed for amidation. The affinity of the amine yarn for acid dyes is attributed to salt formation between the amino groups of the yarn and the dyestuff. —B.C.I.R.A.

Hirt-Kappeler Cross Spool Winding and Gassing Machine. Mabag, Machinenbau A.-G. Langenthal. *Leipziger Monats. Text.-Ind.*, 1926, **41**, 339-340.
In an improved form of cross-winding machine it is arranged that the thread guide does not determine the position of the thread on the bobbin, and the pull on the thread on reversal is thus avoided. The machine consists essentially of a series of drums each having its edges turned to some millimetres. Angles are cut in the circumference of the slightly projecting surface of the drum to a depth of the turning. A thread guide rod operated by a heart-shaped cam carries a thread guide which catches the thread automatically. Since the thread guide does not control the position of the thread on the bobbin or pirn, the head of the heart-shaped cam may be rounded off, so that no jerk is given to the thread guide, and a smooth thread reversal is effected even at high speeds. While the drum revolves, the thread passes backwards and forwards over it, lying loose on the surface until it passes over an angle and is caught and conveyed to the bobbin. By inserting a special type of burner illustrated the machine may be converted into a yarn gassing machine. —B.C.I.R.A.

Sercerising. *Text. Colorist*, 1926, **48**, No. 570, p. 419.
Cotton yarn is passed through a bath in which silk has been dissolved to a gelatinous consistency. Another bath follows, which congeals the silk. The effect is to produce a thread somewhat resembling rayon. It is not considered to be a commercially important process. —F.G.P.

Silk Wool for Knitting. *Text. Colorist*, 1926, **48**, No. 570, p. 419.
Woollen yarn is soaked for ½ hour in a cold bath of ¾ l. of hydrochloric acid (32° Tw.) in 100 l. water. After whizzing it is put in a bath of 1½ kg. bleaching powder in 100 l. cold water for ½ hour. When drained the acid bath is repeated for ¾ hour. Again whizzed, it is placed in a bath of 600 gr. Marseilles soap in 100 l. water at 75° C. After another draining, it goes into the acid bath for the third time and is finally washed. —F.G.P.

Throwing, as Related to Piece Dye Silks. L. C. Lewis. *Silk* (N.Y.), 1926, **19**, No. 3, p. 71.
The silk is soaked in an emulsion of good neutral soap and pure oil (olive or neatsfoot) for several hours; the usual tendency is to soak too long. Whizzing should be very carefully done, and the silk hung up to dry before winding. If the silk is wound wet irregularity arises on the bobbins. Crepe twist is put in the yarn in stages. The bobbins of yarn are soaked or steamed to set the twist, the silk being afterwards rewound on to fibre or wood spools ready for the pirn winders. —F.G.P.

Attachment for Redrawing Quills and Cops. *Silk* (N.Y.), 1926, **19**, No. 3, p. 76.
Describes an accessory on which imperfect pirns may be placed to be run off on to clean ones. It is said to work quite satisfactorily. —F.G.P.

3—CONVERSION OF YARNS INTO FABRICS

(A)—Preparatory Processes

Weft Pirn Winder. W. Schlafhorst & Co. *Leipziger Monats. Text.-Ind.*, 1926, **41**, 338-339.
A new high efficiency weft pirn winder is characterised by simplified spindle mechanism, vertical arrangement of the spindle which is mounted in bearings at both ends, and encasement in an oil bath. It is possible to run the spindles at a speed of 4,000 revolutions per minute. Details are given. —B.C.I.R A.

(B)—Sizing

Temperature of Sizing on Weaving; Influence of the——. *Avenir Text.*, 1926, **8**, 389-397.
Experiments are described showing the effect of temperature of sizing on the behaviour of the yarn during weaving. Several lengths of the same yarn prepared in the same way were sized with the same size, but the temperature was different for each lot. The yarn was woven on similar looms under exactly the same conditions and the number and nature of the breakages and faults were noted. In all the experiments it was found that the number of faults was greater, the higher the temperature of the size, i.e., within the limits of the experiment 75° C. to 100° C. The effect of temperature in sizing was found to be more marked in finer and more compact yarns. The results obtained are explained in a theoretical consideration of the process of sizing. —L.I.R.A.

Artificial Silk: Sizing. W. Bruckhaus. *Kunstseide*, 1926, **8**, 319-320.
A general article. Recipes are given for a bone glue and gelatin size for hard twisted warp or open weft yarns, a bone glue size for hard and soft twisted yarns and a glue size for weft yarns. —B.C.I.R.A.

Sizing of Silk as Applied to Ribbons, III. I. Ginsberg. *Silk* (N.Y.), 1926, **19**, No. 5, p. 36.
Lumineux ribbons, when dyed, are sized through squeeze rollers, stretched and dried on cylinders. The size recommended is 50 l. water, 5 kg. glue jelly, 5 l. rice starch paste, 2 l. flea-seed slime, ½ l. thin tragasol, ¼ l. 5 per cent. citric acid, but no indication is given of the composition of the ingredients. Similar information is supplied for better quality ribbons. —F.G.P.

(C)—Weaving

Ramagé Fabrics: Weaving. *Kunstseide*, 1926, **8**, 238-240.
Point paper diagrams and weaving directions are given for ramagé fabrics, which are compound fabrics of artificial silk and wool, &c., including figured jacquard designs in which artificial silk lustre effects are introduced. —B.C.I.R.A.

Artificial Silk: Weaving. R. Hünlich. *Kunstseide*, 1926, **8**, 260-263.
Some general points of practical importance in the weaving of artificial silk are discussed. —B.C.I.R.A.

Towel Fabric: Weaving. T. Woodhouse and A. Brand. *Cotton* (U.S.), 1926, **90**, 1077-1079.
Methods of inserting the coloured weft of towelling are described and include—(1) the simple chain device which stops the loom when it is time to change the shuttle, and (2) the revolving box motion actuated by pattern chains which enable weft of more than one colour to be introduced. —B.C.I.R.A.

Warp Threads: Reeding. J. Funke. *Leipziger Monats. Text.-Ind.*, 1926, **41**, 336-338.
A number of point paper diagrams are given illustrating how different patterned fabrics may be built up by reeding the warp threads in different ways. —B.C.I.R.A.

Filter Cloths: Weaving. L. Stein. *J. Inst. Brewing*, 1926, **32**, 469 (from *Tageszeit. Brau.*, 1926, **24**, 827-828).
For cloths used in the brewing industry, two important factors are the fineness of the weave and the closeness of texture. For mash filtration where speed is essential "linen cloth" or "sail cloth" weave is preferable. For filtration of turbidities, heavy or medium twill of close texture should be used. —B.C.I.R.A.

Electrical Warp Stop Equipment. J. Bolton. *Silk* (N.Y.), 1926, **19**, No. 5, p. 40.
A device applicable to silk looms whereby a broken end lets fall a very light wire which actuates an electric stop action. Previously the fineness of silk warps has precluded the use of the usual cotton stop mechanism. —F.G.P.

(D)—Knitting

The Warp Loom and Rayon. W. Davis. *Silk J.*, 1926, **2**, No. 23, p. 47.
Ties produced in this way are said to be a fashionable variant of ordinary knit goods, and girdles, ribbons, hat bands, &c., are popular. The fact that the material may be cut as required without unravelling is a great advantage, and the fabric has a finer texture than that made on the knitting machine. Several patterns of cloth are described. —F.G.P.

Braiding Machine Bobbin Drive: Theory. W. Krumme. *Leipziger Monats. Text.-Ind.*, 1926, **41**, 383-386.
The kind of braiding produced on a braiding machine depends on the bobbin distribution, the bobbin sequence, and the form of the bobbin path, and determines the sizes and positions of the worm wheels which operate the bobbins. The "quadratic" arrangement of the worm wheels and the arrangement in which two wheels are moved up to one another are treated theoretically, and angular data are given for determining the correct positioning of wheels of the same diameter in a circle and of wheels of different diameters in a circle. —B.C.I.R.A.

Damping of Knitting Yarns. W. Davis. *Wool Rec.*, 1926, **30**, 1256.
The damping of yarns for knitting purposes has been found to be essential, in order that they should have curling properties. The general method is to pass the yarn through a tank containing the lubricant, and then between two plates which squeeze out a proportion of the lather. There are several lubricants in use, but neatsfoot oil is the commonest. Several suggestions have been made for a more effective control over the damping of a yarn, one being to use cloths soaked in water whilst the machine is not in use. B.R.A.W. & W.I.

(G)—Fabrics

Satin-making Industry of Nanking. *Silk J.*, 1926, **2**, No. 24, p. 50.
The production of lustrous black satins has for centuries been a staple industry of Nanking. Hangchow, Soochow, and other cities are famous for colours. The fall of the empire in 1912 was a great blow to Nanking as all the Court satin came from there. 5,000 bales of 133⅓ lb. is the annual consumption and is all hand reeled. Half the satin is black, the remainder green and grey. The secret of the black dye is very closely kept, passing from father to son and has never been revealed. The operations take 20 days. The satin production is entirely a home industry. The political disorders of the country are affecting Nanking's satin adversely. —F.G.P.

Silk Pongees from the Far East. *Silk J.*, 1926, **2**, No. 23, p. 51.
Wild silkworms of Manchuria feed on oak; the cocoons are brought into Shantung in October, and after being suffocated with hot air are stored for six months, when they are softened by heat, and spun in groups of 6 to 8. The raw silk is transported on mules to Changi, where it is stretched and sized for weaving on looms with bamboo reeds. A small proportion of cotton is introduced in the weave. The material has an ugly dull look until boiled for three hours with pig fat. In addition to other well-known uses, pongees are employed for aeroplane cloth. —F.G.P.

Cotton Fabrics: Selection. R. O'Brien. *U.S. Dept. Agric. Farmer's Bull.*, No. 1449, 1926, 22 pp.
The pamphlet is written for the domestic buyer and deals with appropriate fabrics for various uses, fabric construction, weaves, knitted fabrics, finishing and judging finishing, dyes and the fastness of colour, concluding with a glossary of some common cotton fabrics. —B.C.I.R.A.

Felt Hat Industry. A. Jackson. *Dyer and Calico Printer*, 1927, **57**, 14-15.
A description of methods and machinery for dyeing and felting woollen materials. —A.J.H.

Historic Notes on the French and Italian Umbrella Industry. *Silk* (N.Y.), 1926, **19**, No. 5, p. 38.
The earliest recorded umbrellas date from the time of Assurbanipal in Assyria and are coeval in China and Egypt. Martial and Pliny allude to them at the time Julius Cæsar discovered Britain. Umbrellas were brought into France from Italy in the 16th century and were in common use 100 years later. In 1630 the French umbrella had a stick 45 in. long, 10 whalebone ribs with copper forks, a cover of leather, waxed linen, varnished paper, or oiled silk, and weighed up to about 6 lb. Towards the end of the 18th century vividly coloured taffetas were used but in 1825 the sombre shades became popular. Gradually the trend has been towards elegance and lightness. The manufacture of the coverings is very difficult and Italian fabrics are highly appreciated in the markets of the world.

In Milan and Como there are about 1,600 looms producing silk-cotton covers and 800 for silk only, about half the output is exported. —F.G.P.

4—CHEMICAL AND OTHER PROCESSES

(B)—Scouring and Degumming

Hemp and Linen Yarns: Scouring. (1) T. Tromp. (2) T. Dokkum. *Med. Rijks-voorl. Vezelhandel, Delft,* 1926, No. 15, 161-171.

(1) It is shown that non-cellulosic material present in unbleached yarns can be removed, to the limit content of 4 per cent. prescribed by the Netherlands Marine Department, by boiling with a 1 to 2 per cent. soda solution. The experimental data for warp and weft hemp yarns treated with 1 per cent. and 2 per cent. soda solutions show an increase in the breaking strength of the scoured over the unscoured yarn and a greater increase in the extensibility. Curves showing the effect on the strength and extensibility of the yarns after 2, 4, 6, 8, and 10 hours' boiling are given. Higher soda concentrations are favourable to the scouring process but not to the mechanical properties of the yarns. A short after-treatment with cold, dilute hydrochloric acid improves the appearance without seriously affecting the strength of the yarn.

(2) Similar curves are given for linen yarns and a type of scouring kier is illustrated. —B.C.I.R.A.

Silk-soaking Tubs. C. A. Luft. *Silk* (N.Y.), 1926, **19**, No. 3, p. 41.

Cypress and redwood are the best materials as they are resistant to rotting from moisture, are fibrous and tough and do not splinter readily. White cedar and white pine are also largely used. The wood is uniform in hardness. Pitch pockets and unsound knots should lead to rejection of a plank; timber must be well seasoned and thoroughly smoothed. Wood-to-wood contact at joints is good practice, but white lead is often employed. 36 in. × 30 in. × 26 in. deep is the most usual size for soaking tubs. —F.G.P.

(G)—Bleaching

Bleaching Powder: Manufacture. G. Angel. *Chem. Met. Eng.*, 1926, **33**, 460-464.

The Backman plant described consists essentially of a reinforced concrete tower with intermediate floors and a central, vertical shaft provided with scraper arms causing the lime to move from one floor to the next in a direction counter-current to the chlorine. The Backman chamber is claimed to possess advantages over other systems in respect of labour costs, little supervision, non-necessity of absorption towers, continuous working over a period of three to four months, low power consumption, &c. The quality of the product is good owing to the steady stirring and efficient cooling arrangements, &c. —B.C.I.R.A.

Progress in Textile Bleaching and Dyeing. A. J. Hall. *Chem. Age* (Dyestuffs Suppl.), 1926, **15**, No. 385, p. 35-37.

An account of the most important changes in methods of bleaching and dyeing textile materials since the war. Reference is made to artificial silks, mercerisation of cellulose acetate silk fabrics, "immunised" cotton, Aktivin, wetting-out agents, Naphthol AS colours, and solubilised vat dyes. —A.J.H.

Papermakers' Rags: Bleaching. W. Schmid. *Papier-Fabr.*, **24**, 1926 (Verein Zellstoff Ingenieure Section), 598-599.

The methods of bleaching rags for paper making are described. For light cotton and linen rags bleaching is carried out in small hollanders with a calcium hypochlorite bleach; but heavier linen and hemp wastes or rags for filter paper making are treated with chlorine gas in a bleaching chamber described. —B.C.I.R.A.

Sulphite Cellulose: Bleaching. L. Rys (Eichmann & Co.). *Papier-Fabr.*, **24**, 1926 (Verein Zellstoff Ingenieure Section), 529-533.

During the bleaching of sulphite cellulose with hypochlorite solutions a chlorination occurs in which the end products of the reaction go into solution. It is not certain whether insoluble chlorination products are also formed at the beginning of the reaction. Under the same conditions, the quantity of chlorine combined organically is greater the higher the lignin content of the bleached cellulose. The experiments show that the chemical equilibrium in hypochlorite solutions during bleaching can be expressed by the reversible equations—

$$\begin{matrix} 2NaOH \longrightarrow NaClO \\ Cl_2 \longleftarrow NaCl \end{matrix} + H_2O$$

in which the left side represents chlorinating and the right side oxidising actions. Under the same conditions, the ratio between oxidation and chlorination remains practically constant as soon as a definite value is reached. The time necessary for a definite consumption of active chlorine rises with diminishing chlorination. Although the alkalinity or acidity during the experiment was not strictly followed, it appears that there is a strong tendency to the attainment of a neutral point or a point not far removed from neutrality. —B.C.I.R.A.

Bleaching of Vegetable Fibres with Sodium Perborate or Perborate Detergents; Catalytic Action of Iron and Copper Compounds in the——. Y. Dalstrom. *Brit. Chem. Abs.* B. 1926, 740 (from *Svensk. Kem. Tidskr.*, 1926, **38**, 96-101).

Contrary to the conclusions of Heermann

it is concluded that the presence of iron and copper salts does not promote the deterioration of vegetable fibres during their treatment with solutions containing sodium perborate. In concentrated perborate solutions copper and copper plus iron salts are injurious, but iron salts alone are not harmful. The presence of the sodium salts of fatty acids is of special importance in this connection. When they are present the copper and iron salts do not exhibit their catalytic properties. The bleaching action of a solution of sodium perborate containing a sodium salt of a fatty acid is greater than that of a similar pure solution of sodium perborate or one containing sodium carbonate. —L.I.R.A.

Wetting-out of Textile Materials. A. J. Hall. *Text. Colorist*, 1926, **48**, 809-812.
The use of wetting-out agents for processes of bleaching, dyeing, mercerising, and carbonising is discussed. Wetting-out agents reduce the surface tension of liquids and thereby considerably assist their penetration into fibres otherwise resistant to wetting. At the present time the numerous wetting-out agents being sold may be grouped into six classes—(1) Preparations containing Turkey red oil, e.g. Monopole soap and Avirol (Böhme), (2) preparations of Turkey red oil and an organic solvent, e.g. Avivan (Berheim), Tetrapol, Koloran, and Flerhenol, (3) soaps, e.g. Marseilles soap, resin soap, (4) naphthalene sulphonic acids and their alkyl derivatives, e.g. Nekal, Leonil, Oranit and Neomerpin N, (5) naphthalene sulphonic acids and an organic fat solvent, e.g. Neomerpin, and (6) soaps and organic fat solvent, e.g. Terpurile, Zyklorane, and Solventol. Methods for comparing the efficiency of wetting-out agents and the results of such comparisons are given. —A.J.H.

Bleaching Sulphite Cellulose. See Section 6.

(H)—Mercerising

Contraction on Mercerisation; The Theory of——. W. Gordon. *Chem. Absts.*, 1926, **20**, 3087 (from *Kolloid Zeitschrift*, 1926, **39**, pp. 107-110).
A cotton fibre is assumed to be a cylinder composed of many small liquid crystals distributed in an amorphous cementing substance. The drops are assumed to be symmetrical to the axis of the cylinder and symmetrical with respect to a plane perpendicular to that axis. The material of the drops has the properties of an incompressible liquid with a surface tension. The drops are so numerous that they determine the behaviour of the fibre. Based on these assumptions mathematical formulas are developed. The contraction on mercerisation is not far from that calculated from these formula. —L.I.R.A.

Silk Mercerised with Nitric Acid. *Text. Colorist*, 1926, **48**, 419.
Silk may be contracted by soaking in nitric acid; the maximum effect being obtained in a bath of 45 per cent. HNO_3 at 15° C. for ½ hour. —F.G.P.

Mercerisation Effects on Cotton. See Section Ic, "Modern Views on Cotton."

(I)—Dyeing

Indanthrene Vat Dyes: Estimation. G. Durst and H. Roth. *Z. Angew. Chem.*, 1926, **39**, 900-903.
The following three determinations were made in the analysis of indanthrene vats—(1) The quantity of free hydrosulphite, by precipitating the dyestuff with formaldehyde in the presence of acetic acid and titrating the filtrate by the ferric ammonium sulphate method. (2) The quantity of indanthrene dyestuff present, gravimetrically by precipitating with ferric ammonium sulphate in acetic acid solution and acid or alkaline washing strictly according to the instructions given. (3) The quantity of free caustic soda, by precipitation with neutral barium chloride and neutral formaldehyde and titrating without previous filtration with acetic acid. and phenolphthalein as indicator.—B.C.I.R.A.

Direct Cotton Dyes: Application. H. C. Roberts. *Text. World*, 1926, **69**, 4,245.
Continuing his articles on dyeing cotton piece goods without kier boiling, the author deals with the application of the direct cotton colours in jig dyeing.—B.C.I.R.A.

Hosiery Dyeing Machine. Klauder-Weldon Dyeing Machine Division of the H. W. Butterworth & Sons Co. *Text. World*, 1926, **70**, 769.
The machine was designed to prevent damage by exposure of the hosiery to rough edges of sheet or cast metal surfaces, or bolt or rivet heads inside the cylinder. It is constructed by flanging adjoining parts outwardly and riveting them on the outer side of the cylinder. Additional baffles are provided in the floor of the machine which prevent movement of the mass of goods as a whole and secure quick and level dyeing by providing for a gentle opening up of the goods. The mechanical action of these baffles varies from almost none to the most drastic requirements, and depends on the class of goods being dyed. It is determined by the height of the liquor level in the machine. —B.C.I.R.A.

Strip Type Yarn Dyeing Beam. J. Brandwood & Son. *Text. World*, 1926, **70**, 477.
The beam is composed of ribs or strips set edgewise to the yarn, which replace the usual perforated barrel and give maximum liquor circulating efficiency. It is constructed of suitable nickel alloys for dyeing and with bronze heads for bleaching. The internal reinforcing rings are so set as to give maximum rigidity and to be out of contact with the yarn and the flow. They offer very little resistance to the circulation of the bath. The open construction is also of advantage in preventing the holding of much water after dyeing is completed. —B.C.I.R.A.

Naphthol AS Dyes: Application. *Text. Merc.*, 1926, **75**, 424.
An account of the general methods of applying the Naphthol AS products to loose cotton and to cotton in the form of sliver, cheeses, warp-beams, hanks, pieces, and hosiery. Details are given of combinations of naphthols and bases suitable for fancy coloured goods, towellings, and table covers, shirting zephyrs, damask, and satin for quilts, artificial silk, and schappe silk. —B.C.I.R.A.

Artificial Silk: Hank Dyeing Machine. Sellers & Co. Ltd. *Text. Merc.*, 1926, **75**, 465.
The hanks are suspended from highly-glazed porcelain reels mounted on spindles, the ends of which are attached to a crank-motion operated by machine-cut spur gearing. The reels are mounted on head-stocks, which are lifted by rams actuated by hydraulic pressure from a belt-driven pump having an accumulator attached. The reels are arranged in groups, a separate lifting ram operating each group, and they are automatically reversed by the action of a gear box fitted with machine-cut gears, for alternately changing the direction in which the reels revolve. The motion is automatically changed by the clutch motion. Each reel accommodates approximately 2¼ lb. of pure silk, 4 lb. of artificial silk, and 6 lb. of cotton. —B.C.I.R.A.

Dyeing; The Theory of——. A. Lottermoser, *Melliand's Textilber.*, 1926, **7**, 845-847.
A review of attempts which have been made from time to time to formulate theories to account for the various phenomena observed in dyeing. Numerous references to the literature are given. —L.I.R.A.

Colours: Standardisation. —. Klahre. *Melliand's Textilber.*, 1926, **7**, 848-849.
The advantages of the standardisation of colour are discussed, and it is pointed out that convenient means are now available in the Ostwald classification and the Pulfrich photometer. A scheme of standardisation is outlined. —B.C.I.R.A.

Vat Dyes: Reduction. H. Pomeranz. *Melliand's Textilber.*, 1926, **7**, 854-857.
A lecture on the reduction of vat dyes by ferrous hydroxide, dealing with the theoretical basis and some practical aspects of the ferrous hydroxide discharge of indigo and the ferrous sulphate vat in indigo dyeing. —B.C.I.R.A.

Indigo Vat: Effect of Added Substances. H. Pomeranz. *Melliand's Textilber.*, 1926, **7**, 862-863.
Attention is drawn to the analogy between Haller's observations on the effect of nitrobenzene and of Aktivin on the indigo vat, and Kalb's observations on the formation of dehydroindigo in the action of oxidising agents on indigo (*Ber.*, 1909, **42**, 3,642) and the action of added substances of an oxidising nature is traced to a chemical change of the indigo white. —B.C.I.R.A.

Textile Oils in Dyeing and Finishing Cotton. F. E. Burnham. *Dyer and Cal. Printer*, 1926, **56**, 216-217.
A summary of the uses of Turkey red oil and soluble oils. —A.J.H.

Dyeing of Logwood Black; Earliest Use of Bichrome in the——. D. Paterson. *Dyer and Cal. Printer*, 1926, **56**, 224-225.
One of the earliest uses of bichrome was in 1820 for the after-treatment of yellow shades on silk and cotton produced by means of logwood on a lead mordant. Probably the earliest use of bichrome as a mordant was in 1855, when woollen fabric was boiled in a mixture containing bichromate of potash, tartar, and sulphuric acid and afterwards entered into a bath containing logwood whereby a black shade was produced. It is, however, recorded that Thomas Clarke, of Loughborough, dyed logwood black on a chrome mordant in 1846. —A.J.H.

Over-oxidation of Indigo. L. Mills. *Dyer and Cal. Printer*, 1927, **57**, 5.
Attention is drawn to the loss of dye which occurs when an excess of reducing agent is present in Indigo vat liquors, particularly when reducing agents containing zinc are used. A loss of 7·5 per cent. of Indigo was observed in an hydrosulphite-indigo vat containing 50 per cent. excess of hydrosulphite. —A.J.H.

Naphthol AS Dyes. A. J. Hall. *Dyer and Cal. Printer*, 1927, **57**, 6-8.
The general properties and methods of application of Naphthol AS dyes to cotton materials are described. The chemical constitution of a number of bases and naphthols is given. —A.J.H.

Cellulose Acetate Silk: Dyeing. K. Wolfgang. *Kunstseide*, 1926, **8**, 209-211.
Recent patented processes for dyeing acetate artificial silk are reviewed. —B.C.I.R.A.

Artificial Silk: Dyeing. L. Kirberger. *Kunstseide*, 1926, **8**, 250-253.
A general article. Particular attention is given to the dyeing of cellulose acetate silk with the Azols and mention is made of the dyeing of mixed fabrics containing artificial silk. —B.C.I.R.A.

Dyeing Fabrics for Rubber-proofing. *M/cr. Guard. Comm.*, 1926, **13**, 760.
All types of fabrics—cotton, wool, natural and artificial silks, and unions—are being rubber-proofed. Since vulcanised rubber is used, the dyes used must be fast to the cold, dry heat, and steam heat methods of curing used. Direct, sulphur, and azoic dyes have proved most serviceable, vat dyes being excellent but generally too costly. The dyes usually applied to cellulose acetate silk are generally fast to proofing. Fabrics

for proofing should contain no metals, e.g. copper and manganese (Aniline Black dyed fabrics may be proofed satisfactorily), and should be free from grease or acid. The limit of permissible copper content is 0·01 per cent.; copper present in dyed fabrics being frequently traceable to copper fittings in dyeing and printing machinery. —A.J.H.

Artificial Silk; After-treatment of——. *M/cr. Guard. Comm.*, 1926, **13**, 789.
A commented summary of recent patents dealing with the dyeing, lustring, and delustring of cellulose acetate silk. Oxidation blacks may be dyed continuously by means of 2 : 4-diaminodiphenylamine, or in separate stages with *p*-aminodiphenylamine. Delustred cellulose acetate silk may be relustred by immersion in boiling solutions of neutral inorganic salts. —A.J.H.

Silk Dyeing in Skeins. *Silk J.*, 1926, **2**, No. 23, p. 49.
Emphasises the necessity for keeping the skeins moving to prevent unequal dyeing, and the need for very smooth sticks, such as bamboo or malacca canes. "Port of Oxford" cedar is a very hard wood used to some extent in America. Rinsing should be very thorough. Most of the water is whizzed out, the remainder being dried out by heat after the skeins have been well stretched, and polished on the lustring machine. —F.G.P.

Practical Hints for Dyeing Rayon Goods. R. Sansone. *Silk J.*, 1926, **2**, No. 23, p. 50.
A concrete trough is fitted with mechanically driven copper bobbins from which the skeins are rotated in the dye liquor. They work in both directions. Another machine for dyeing on bobbins or reels is described. In both the absence of handling is a great advantage. —F.G.P.

Aniline Black: Toxicity. F. S. Beattie. *Amer. Dyestuffs Rep.*, 1926, **15**, 567-570.
The author shows how remote are the possibilities of poisoning during aniline black dyeing or other dyeing processes, provided that the workman takes reasonable care. —B.C.I.R.A.

Cotton Warps: Dyeing. L. W. Sidebottom. *Amer. Dyestuff Rep.*, 1926, **15**, 667-673.
The processes involved in dyeing cotton warps by the chain method are described. They include ball warping, boiling out, doubling, bleaching and dyeing, splitting, drying, and beaming. —B.C.I.R.A.

Cerium Chloride: Application. *Amer. Dyestuff Rep.*, 1926, **15**, 700-701 (from *Text. Argus*).
It is claimed that the affinity of cotton for dyestuffs can be retarded by treatment with a strong solution of cerium chloride. To obtain two-colour effects the yarn is impregnated with the salt, dried, and subsequently woven with untreated cotton yarn, the fabric being dyed either with direct or sulphur colours. The colour imparted to the cotton by the cerium chloride may be removed if necessary with sodium bisulphite solution acidified with acetic acid. —B.C.I.R.A.

Fastness of Developed (Naphthol AS) Dyes on Cellulosic Materials. A. J. Hall. *Chem. Age*, Dyestuffs Suppl., 1926, **15**, 43.
Naphthol AS dyes are important because while having general excellent fastness they are considerably cheaper than vat dyes. The chemical constitution of many of the naphthols and bases forming the Naphthol AS range is given. After-treatment of cellulosic materials dyed with these dyes is found to affect their fastness to light and washing, and also their shade considerably. These changes are associated with migration to or from the lumen of the dyed fibres and crystallisation or agglomeration of the dye particles. Hot-soaping usually increases the fastness of dyed cotton fibres, whereas in particular instances similar treatment decreases the fastness of dyed viscose fibres. It is possible to soap dyed viscose fibres so that the Naphthol AS dye particles migrate to the surface and become easily removable by washing. —A.J.H.

Dyeing of Vat Colours. J. S. Heuthwaite. *Dyer and Cal. Printer*, 1926, **56**, 186-187.
A comparison of the fermentation and hydrosulphite vats for indigo, the working of a hydrosulphite-ammonia vat being described. —A.J.H.

Difficulties in Colour Matching. D. Paterson. *Dyer and Cal. Printer*, 1926, **56**, 210-211.
Difficulties of colour matching due to peculiarities of the human eye are described. Compound shades obtained by combination of dyes having sharp absorption bands in their absorption spectra are particularly apt to be supersensitive to slight variations in the quality of the daylight by which they are observed. —A.J.H.

Vat Dyes on Wool. *Dyer and Cal. Printer*, 1926, **56**, 211 (from *Färb.-Ztg.*).
Vat dyes having an affinity for wool are assuming increasing importance and are applied from a dye liquor containing the minimum quantity of a caustic alkali, precipitation of the "acid" form of the leuco dye being avoided by the addition of a protective colloid, e.g. glue. —A.J.H.

Colour: Terminology. Committee on Colour Terminology Questionnaire. *J. Optical Soc. Amer.*, 1926, **12**, 43-57.
The questions put in a questionnaire on colour terminology are quoted and a statistical survey of the replies is presented. —B.C.I.R.A.

Dyes and Indicators: Spectrophotometry. E. B. R. Prideaux. *Chem. and Ind.*, 1926, **45**, 664-668, 678-682, and 697-699.
A general account of the spectrophotometric examination of dyes and indicators.

Part I. deals with the theory and instruments and Part II. with types of absorption curves, the determination of *p*H by absorption coefficients and the recognition of dyes. —B.C.I.R.A.

Azo Dyes; The Identification of the Naphthalenoid Reduction Products of——. R. B. Forster and T. H. Hanson. *J. Soc. Dyers and Col.*, 1926, **42**, 272-275.
The amino compounds obtained by the suitable reduction of the azo dyes are isolated by steam distillation or solvent extraction and identified by colour reactions. In examining the colour reactions 0·1 gm. of the substance is dissolved or suspended in 10 c.c. of water in a boiling tube to which is added 1 c.c. of strong ammonia. The contents of the tube are well shaken and any colour changes of the ammoniacal solution noted. A portion of the solution is then poured on to filter paper and the colour noted. The stain on the filter paper is then spotted, both while moist and after drying, with a number of reagents of definite strength. A table is given showing the colour reactions obtained with various amino compounds when spotted in this way with solutions of ammonia, hydrochloric acid, ferric chloride, vanadium chloride, potassium bichromate, nickel chloride, uranium sulphate, potassium ferricyanide, copper sulphate, Schweitzer's reagent, ferrous ammonium sulphate, cobalt nitrate, and silver nitrate. —L.I.R.A.

Dyeing of Natural Silk Fabrics. R. Sansone. *Text. Colorist*, 1926, **48**, 818-821.
Methods and apparatus are described. —A.J.H,

Modern Dyeing and Dyeing Machinery. M. A. R. Selisch. *Text. Colorist*, 1926, **48**, 821-823.
Brief notes on dyeing processes with reference to Monel metal hosiery dyeing machinery. —A.J.H.

Dyeing Fast Shades on Woollen Piece Goods. *Text. Colorist*, 1926, **48**, 833-834.
Suitable dyes both for dyeing and shading are given. —A.J.H.

Sulphur Colours. W. B. Nanson. *Text. Colorist*, 1926, **48**, 383.
A full black may be obtained on rayon at ordinary temperature without reducing the lustre; colours may also be dyed. It is well to remember that all colours are not so fast as black, and tests should be made. —F.G.P.

Brief Resumé of the History of Dyeing Silk Piece Goods. D. P. Knowland. *Silk* (N.Y.), 1926, **19**, No. 5, p. 32.
The industry began to be general in 1870, about which time the tannin mordanting process came into vogue. The gradual improvement in dyeing due to the introduction of fresh dyes is traced. —F.G.P.

Orchil in Modern Dyeing. J. F. Springer. *Silk* (N.Y.), 1926, **19**, No. 4, p. 45.
Although not especially fast to light, the natural dyestuff, Orchil, can be made to yield many shades of fuchsia and maroon which are of good cover and very level. It is also fast to rubbing and cold water. —F.G.P.

Uneven Dyeing due to Spinning Causes: Artificial Silk. See Section 1D.

Dyeing of Amine Yarn. See Section 2C.

Progress in Textile Dyeing. See Section 4G.

Dyeing of Felt Hats. See Section 3G.

Analysis of Auramine and Indigosol Dyes. See Section 6.

(J)—Printing

Developments in Calico Printing. R. Sansone. *Dyer and Cal. Printer*, 1926, **56**, 212-213.
Plant suitable for dyeing Para Red is described. —A.J.H.

Coloured Discharges on Indigo: Printing. J. Pokorný. *Leipziger Monats. Text.-Ind.*, 1926, **41**, 393-396.
A full account of the author's method of obtaining coloured discharges on indigo. —B.C.I.R.A.

(K)—Finishing

Lock Ring for Calender Bowl Ends. E. L. Parry. *Dyer and Cal. Printer*, 1926, **56**, 189.
A self-tightening split lock ring for cotton calender bowls is described. —A.J.H.

Immunised Cotton. A. J. Hall. *Dyer and Cal. Printer*, 1926, **56**, 184-185.
A summary of recent investigations relating to cotton immunised by means of *p*-toluenesulphochloride. Immunised cotton is resistant to the usual preparatory processes for textile materials, e.g. scouring, bleaching, and mercerising, but it should not be subjected to a dry heat exceeding 110° C. Its advantage over cellulose acetate silk lies in its non-susceptibility to boiling water. Immunised cotton has no affinity for direct cotton dyes but may be dyed by methods similar to those used for cellulose acetate silk. —A.J.H.

Artificial Silk: Delustring and Weighting. *Dyer and Cal. Printer*, 1926, **56**, 128 (from *Silk*).
The loss in feel and tendency in later processes to become sticky are against the use of aluminium salts or compounds of these salts with sulphonated or ordinary vegetable oils. The use of barium salts for precipitation on the fibre has been more successful. The goods are put into a lukewarm bath containing 2-3 per cent. of sulphuric acid. After moving about for some time they are transferred to a 3-5 per cent. bath of barium chloride at 70° C. and kept from 20-30 mins. till all the barium sulphate has been precipitated on the fibre. Delustring is then complete and the goods can be dyed; they dye well and uniformly but it is pointed out that the dyebath must not contain Glauber's

salt. The dull appearance is not decreased by dyeing, and in winding and weaving there are no difficulties due to stickiness. The process increases the weight of the material by 3 to 5 per cent. Experiments for weighting artificial silk in a process similar to that for natural silk have been satisfactory. In weighting with tin-phosphate-silicate compounds the artificial silk loses its glassy lustre and the loading affinity is even greater than that of neutral silk. The increase for a viscose silk of 120 denier in three processes was 185 per cent. as compared with 169 per cent. for an Italian organzine of 19/21 denier under the same treatment, whilst a nitrocellulose increased in weight 182 per cent. as compared with 161 per cent. for a Japanese trame silk. —B.C.I.R.A.

Finishing of Worsted Cloths. E. A. Johnson, *Text. Mfr.*, 1926, **52**, 312.
The two main causes of cloudy and shady work are the faults in dyeing and finishing. Goods must be evenly treated in every respect, but it is possible that faulty wool scouring may cause shady work. The operations of pressing and conditioning are very important, but methods should be adapted according to the material under treatment. —B.R.A.W. &W.I.

Unshrinkable Process of Wool. E. R. Trotman. *Text. Mfr.*, 1926, **52**, 310.
Unshrinkability is produced by the action of an aqueous solution of chlorine, but different grades of wool are affected in varying degrees, while dry chlorine has little or no effect. The wool is afterwards dechlorinated. After the process, the well-marked scales are practically invisible and it is due to this, that the wool develops bad-wearing properties. Wool which has been chlorinated tends to become harsh to handle, but a process has been formed by which the softness is restored. The wool should then be tested carefully and examined under a microscope.
—B.R.A.W. &W.I.

Weighting of Silk. F. H. Untiedt. *Brit. Chem. Abs.*, 1926 (A), 1091 (from *Trans. Faraday Soc.*, 1926, **22**, 178).
A complete patent bibliography of the U.S., British, German, and French patents on the weighting of silk is given, together with abstracts of the patents.
—B.L.R.A.

Use of Textile Oils in Finishing. See Section 4I.

Dyes used for Fabrics prior to Rubber-proofing. See Section 4I.

5—LAUNDERING AND DRY CLEANING

Soap Solution: Activity Coefficient. M. Randall, J. W. McBain, and A. McL. White. *J. Amer. Chem. Soc.*, 1926, **48**, 2517-2522.
The activity coefficients of a number of soaps including lower esters such as potassium acetate are calculated. The activity coefficient so calculated offers evidence in favour of the micellar theory.
—B.C.I.R.A.

Cocoanut Oil and Linseed Oil Soaps; Germicidal Efficiency of, and of their Mixtures with Cresol. F. W. Tilley and J. M. Schaffer. *Exp. Sta. Rec.*, 1926, **54**, 393-394 (from *J. Infect. Diseases*, 1925, **37**, 359-367).
The opinion that cocoanut oil soap has a marked bactericidal and germicidal power has been confirmed, and its efficiency was found to be increased by the addition of a slight excess of alkali and of sodium chloride, but the latter addition is of no practical value on account of the tendency to flocculation. In general the bactericidal efficiency of cresol soap mixtures was greatest in mixtures containing half as much soap as cresol. Saponified cresol solutions containing cocoanut oil soap were found to have a greater bactericidal efficiency than those containing linseed oil soap, and this efficiency was not decreased by the addition of sodium hydroxide in fairly large excess or by the addition of sodium chloride to dilute solutions containing cocoanut oil soap. It was found that 21 per cent. of cocoanut oil as soap can satisfactorily replace 28 per cent. of linseed oil as soap for holding in solution the 50 per cent. of cresylic acid contained in saponified cresol solutions. —L.I.R.A.

Solvents, New: Made by the Hydrogenation Process. E. H. Killheffer. *J. Soc. Dyers and Col.*, 1926, **42**, 282-283.
An account of the properties and uses of tetralin, decalin, hexalin, cyclohexanone, hexalin acetate, and methyl hexalin. Examples are given of the use of such solvents in soap mixtures. Thus for removing stains the following mixture may be used—22¾ lb. of linseed oil, 34¼ lb. methyl hexalin, 9¼ lb. potash lye, and 13¾ lb. water. After saponification is complete the mass is cooled and 20 lb. of tetralin added. —L.I.R.A.

Change in Colour of Dyed Fabric on Ironing. R. Haller. *Chem. Abs.*, 1926, **20**, 3086 (from *Kolloid Z.*, 1926, **38**, 248).
Certain blue benzidine dyes on cotton change to red when touched with a hot iron. The effect is produced by a change in size of the particles, the small ones being red and stable only when warm, and the larger ones being blue. The change is reversible. —B.L.R.A.

Constituents of Fats and Soaps. See Section 6.

6—ANALYSIS, TESTING, GRADING, AND DEFECTS

Drying Fibres. *Text. Colorist*, 1926, **48**, 179.
When fibres are dried in an oven for analytical purposes it sometimes happens that

while one sample loses weight another gains slightly. In order to avoid such anomalies the method of drying by means of dry air is suggested. The samples are first washed in benzene to remove grease, and then with water and air dried. The fibres are loosely packed into glass towers placed in the oven and dry air passed through. Even without heating the samples can be dried in this way, but the time is greatly reduced by raising the temperature. Some figures for 95°-100° C. are—Cotton after 1¼ hr. moisture=0·01%; wool, after 1½ hr.=0·07%; silk, after 1¾ hr.=0·02%; rayon, after 2 hrs.=0·04%. To remove these last traces the temperature must be maintained often as long as four hours. At 85°-90° C. an additional hour is needed. If ordinary moist air is used, even 110° C. is not sufficient. A phosphorus pentoxide desiccator is not much use, but is improved if warmed to 60° C. —F.G.P.

Pyrometer, Surface; for Heated Rollers. Cambridge Instr. Co. Ltd. *Text. Mfr.*, 1926, **52**, 271-272; also *Text. Merc.*, 1926, **75**, 101; and *Engineering*, 1926, **122**, 507.
A description is given of a new self-contained pyrometer used to find the temperature of calender rollers, drying cylinders, &c. The chief advantage of this instrument is its quickness of action, a steady reading being obtainable in three to five seconds after application. The instrument is of the thermo-electric type, and, as the element consists of a long thin strip of copper and constantan which is laid on the roller, the objections due to the usual heavy element are avoided. The strip, being light, does not damage the surface of the rollers. A milli-voltmeter shows the electro-motive force produced, and by adjusting the zero to the temperature of the cold junction of the thermo-couple, the temperature of the surface to which the instrument is applied can be observed directly. The temperature of the cold junction is given by a small thermometer which is visible under the scale of the milli-voltmeter. —L.I.R.A.

Yarn Inspection Drum. J. Nesbitt Ltd. *Text. Merc.*, 1926, **75**, 104.
The drum is constructed of tinned iron with spun brass ends, and its surface is treated with flat black paint. To facilitate the speedy removal of yarn after examination the drum is slotted across the entire width. A three-step pulley drive for the traverse motion provides a simple method of regulating the rate of traverse to suit yarns of varying thicknesses. The standard machine enables wrapping of 5, 10, or 20 threads per inch to be made, but these spacings can be modified to suit requirements. Yarn may be wrapped from four ring tubes or cops with each operation. A holder for cheeses, hanks, or ordinary bobbins may be provided. —B.C.I.R.A.

Hosiery Seaming Yarn: Strength. W. Davis. *Text. Merc.*, 1926, **75**, 169, 198, and 231.
Tensile strength and elongation tests on processed yarns for seaming hosiery are reported. Waxing an unbleached 3/60's sewing cotton increases its breaking load by about 3%, and its elongation by 1%. Increases of the same order are obtained on waxing the dyed yarn. The greater strength and elongation of the yarn after mercerisation are also shown. Tests on 3/40's yarn, unbleached, bleached, bleached and waxed, and bleached and polished show that waxing has added some strength to the yarn but has reduced the elongation; the effect of polishing is to give a very considerable increase of breaking load over the other two conditions, but there is a marked reduction in the amount of stretch before the yarn breaks. —B.C.I.R.A.

Hosiery Sewing Cottons: Strength. W. Davis. *Text. Merc.*, 1926, **75**, 459.
A further discussion on the effect of waxing, bleaching, and dyeing on the strength and elongation of hosiery sewing cottons of finer counts (about 30's) such as are used for seaming milanese fabrics, and of the type used for sewing on buttons and making buttonholes. —B.C.I.R.A.

Dyes: Fastness Testing. S. G. Barker and H. R. Hirst. *Text. Merc.*, 1926, **75**, 521.
The equipment and work of the Wool Research Association for determining the fastness of dyes to sunlight were described. Fading tests carried out at stations in India, Burma, and Ceylon gave for the same periods amounts of fading proportional to the relative humidity of the atmosphere during exposure. Further work on the humidity effect is in progress. At present it can be stated that the fading-humidity curve follows that for adsorption of water on wool fibres. —B.C.I.R.A.

Oils and Fats in Faulty Fabrics. R. G. Fargher. *Text. Merc.*, 1926, **75**, 524.
Faults in finished cloth due to the presence of oils and fats in either local or general excess are discussed. —B.C.I.R.A.

Cotton Products: Mill Testing. *Text. World*, 1926, **69**, 307, 1271, 1819, 2737, 3955, and **70**, 319.
A general discussion of tests for waste, weight, strength, twist, &c., which are required at the different machines in order to control the uniformity of the finished product. The article deals with lap, sliver, roving, and yarn testing, cloth analysis, and the control of waste throughout the processing of cotton.—B.C.I.R.A.

Bleached Cotton: Yellowing. J. M. Matthews. *Text. World*, 1926, **70**, 593-595.
In a general article the author discusses the causes of the yellowing of bleached cotton and the methods of eliminating

them. Among the causes suggested are the presence of salts of iron, insufficient rinsing, the presence of residual free alkali or mineral acid, over-bleaching, excessive heating, &c. —B.C.I.R.A.

Yarn: Weaving Contraction. W. A. G. Clark. *Text. World*, 1926, **70**, 751.
The mathematical basis of the determination of yarn contraction in weaving is discussed, and a chart showing yarn contraction percentages in the weaving of ordinary plain cotton cloths with any combination of yarns and construction is reproduced. A table of symbols for use in cloth formulas has been drawn up and is recommended for general adoption.
—B.C.I.R.A.

Knitted Fabric: Barring. *Text. World*, 1926, **70**, 1579.
Photographs of four defective samples of spun-silk, plain-knitted fabrics are reproduced. The defects are all due to yarn irregularities occurring at frequent and decreasingly frequent intervals, and in one instance, in which the defect line runs from right to left and then left to right, at irregular distances. It is said that the very frequent irregularities probably originated in spinning, whilst those at less frequent intervals originated in some of the reducing and drawing operations.
—B.C.I.R.A.

Streaky-dyed Stockings: Causes. *Text. World*, 1926, **70**, 1723.
Variations in yarn size and twist are stated to be the probable cause of streaks examined in dyed, mercerised cotton stockings. The finer lengths of yarn make thin places in the fabric and the hard twist in the finer lengths makes the dyed yarn a darker shade. Combining the two gives greater prominence to the variation than either alone would give. It would seem likely, also, that the soft-twisted lengths would be more completely mercerised than the harder twisted lengths, and would therefore reflect light more readily and appear lighter in shade. —B.C.I.R.A.

Knitted Artificial Silk Fabric Faults: Causes. G. R. Merrill. *Text. World*, 1926, **70**, 2024-2025.
The causes of some faults in knitted artificial silk fabrics and plated fabrics, including horizontal streaks, banded effects, and cut and chafed yarns are discussed.
—B.C.I.R.A.

Viscose Artificial Silk: Identification. W. T. Schreiber and H. A. Hamm. *Text. World*, 1926, **70**, 2029.
A test for differentiating between viscose and cuprammonium silks is based on the liberation of hydrogen sulphide from viscose by heating with acid of a specific concentration. Five grams of the artificial silk sample, 100 ccs. of water, and 3 cc. of concentrated sulphuric acid are introduced into a "diaphragm" flask, and the opening of the flask is covered with a piece of lead acetate paper. After four hours' heating on a steam bath the paper is examined for a brown or black stain, which indicates viscose silk. Cuprammonium silk gives no colouration. [The novelty of the diaphragm flask is a means for clamping the lead acetate paper over the neck.] —B.C.I.R.A.

Viscose Artificial Silk: "Damp" Strength. H. D. W. Smith. *Text. World*, 1926, **70**, 2227-2228.
Tests of breaking load and elongation of wet viscose artificial silk yarns at two minute intervals during drying show that the strength of the wet material gradually increases and the elongation decreases until the material reaches a damp condition just before it feels dry to the touch. In this state the elongation decreases rapidly to a value considerably below the air dry value and then increases again to normal air dry value when the material has reached the air dryness. For unsized viscose yarns both bleached and dyed the minimum elongation recorded was about two-thirds of the wet elongation, and the strength increased continuously. For sized yarns the minimum elongation dropped as low as one half to one quarter that of the elongation when wet. With the decreased elongation the strength dropped to a lower value and then increased rapidly to the dry value. In practice, therefore, the yarn should be kept thoroughly wet in finishing, and dried with great care as to tensioning. A suggested explanation of this point of maximum brittleness is that the viscose reverts from the dispersed to the dispersing phase.
—B.C.I.R.A.

Wear Testing Machines. W. F. Edwards. *Text. World*, 1926, **69**, 3817.
The general principles on which wear testing machines are designed are discussed. The instruments mentioned include a reciprocating blade type, one with two pairs of blades staggered so as to impart a double bending motion and to rub both surfaces, and another with emery tapes. —B.C.I.R.A.

Cellulose Acetate Jellies: Elasticity. H. J. Poole. *Trans. Faraday Soc.*, 1926, **22**, 83-101.
The load-strain curve for cellulose acetate jellies bends continuously towards the load axis. This is taken as direct evidence for the existence of a sponge-like or fibrillary structure of rigid material in the jelly. The elasticity of these jellies has been measured at various concentrations of cellulose acetate in a solvent consisting of benzyl alcohol and water in constant ratio, and has been found to follow approximately the square of the concentration. This, in conjunction with previous deductions, suggests that the material of the rigid phase exists as a result of a dynamic solvation equilibrium between the cellulose acetate and the solvent. Permanent deformation was not induced in cellulose acetate jellies by heating and

cooling temporarily deformed specimens. It is argued from this that the structure first formed on gelatin is mainly of a permanent nature and that it changes its elasticity by reason of changes in solvation rather than by dissolution into the liquid phase. Equilibrium in elastic properties was only reached after a considerable period following a change in temperature. The time taken to reach equilibrium at a given temperature was different, however, according to whether the jelly had been warmed or cooled, and was greater in the latter case, and it is deduced that the attractions between the cellulose acetate molecules which give rise to the elasticity are of a strictly local character, and also that the sphere of effective attraction is smaller than the molecule itself. The creep under stress exhibited by these jellies was studied and a coefficient of inner resistance proposed to denote the force normal to a face required to produce unit velocity of creep in unit cube of jelly in the absence of all elastic controlling forces. Values of this coefficient were computed, and are shown to run parallel with the viscosity of the parent sols. The effect of variation in solvent composition was studied, and it is shown that benzyl alcohol as a solvent for cellulose acetate is deficient in OH groups. Partial replacement of benzyl alcohol by water resulted in a decrease in elasticity and an increase in solvation. On the other hand, partial replacement by xylene resulted in an increase in elasticity and decrease in solvation. —B.C.I.R.A.

Malt Amylase: Activity. W. Windisch. *Chem. Abs.*, 1926, **20**, 2386 (from *Wochschr. Brau.*, 1925, **42**, 276-278, 283-286, and 290-293).

The result of the action of malt amylase on starch is the production of maltose and achrodextrin. The latter has 10%-13% of the reducing power of maltose. Dextrin is thrown out in 70% alcohol, while maltose and achrodextrin are not. The conversion power is determined by iodine titration. Amylase activity changes with age, the saccharifying power decreasing and the dextrinising power increasing slightly during 24 hours. The rate of conversion is indèpendent of the concentration of the substrate. There is a definite relation between the concentration of enzyme and rate of reaction. The enzyme is inhibited by quantities of maltose. At a temperature of 56°-63° destruction occurs, and if the acidity is below *p*H 3·2 the activity is greatly decreased, and at *p*H 2·1 and 8·2 entirely destroyed. Amylase may consist of two enzymes, a liquefying, and a saccharifying. It has been possible to separate the saccharifying enzyme into a dextrinising and a saccharifying enzyme. Formaldehyde stimulates diastatic activity at a concentration of 0·016%. This may be due to formic acid produced. At high concentration formaldehyde inhibits. Caffeine has no action. —B.C.I.R.A.

Wool Analysis: Density Determinations. R. H. Burns. *Wool Record*, 1926, **29**, 555.

The Wyoming Experimental Station has developed a method of determining density of wool by calculating the number of fibres on a definite area of skin. . An half-inch square area of the wool is seaparated into a lock which is measured with a vernier caliper, clipped, and the area of skin exposed checked with the calipers. From these samples 100′ fibre diameters are measured with the micrometer and weighed and this weight compared against the weight of the remainder. By counting individual fibres of samples it was proved that the calculated density was correct within the probable error. A few density figures of shoulder samples are—

	Fibres per sq. in. of skin.
Hampshire	8,892 to 24,584
Rambouillets	17,604 to 55,936
Hampshire-Rambouillets crossbred	12,208 to 33,576

—B.R.A.W. & W.I.

Tungsten Arc Lamps: Application. F. Skaupy. *Z. Angew. Chem.*, 1926, **39**, 616.

The direct current tungsten arc lamp with nitrogen filling as a (cheaper) source of ultraviolet light is described. It is stated that tests by the Badische Co. show that for fading tests the tungsten arc makes the nearest approach to sunlight. —B.C.I.R.A.

Sodium Hydrosulphite: Estimation. H. Roth. *Z. Angew. Chem.*, 1926, **39**, 645-646.

Hydrosulphite, including the hydrosulphite in dye vats, is estimated by adding excess of a decinormal solution of ferric ammonium sulphate in the presence of acetic acid, excess of sodium acetate, and salicylic acid, in an atmosphere of carbon dioxide produced by the addition of sodium carbonate, and estimating the excess of iron by titration with a standard solution of sodium hydrosulphite preserved in the burette under petroleum ether. The solution before titration is a deep dark red colour which gradually fades to a rose and finally becomes colourless. The presence of thiosulphate has no effect on the accuracy of the titration. The results are lower than those obtained by the mercuric chloride method of Boshardt & Grob, but higher by several per cent. than by the methylene blue method of Knecht & Hibbert. If, in the latter method, the hydrosulphite is first dissolved instead of being added to the methylene blue solution in the solid form, the difference between the results by the two methods is only 0·2 to 0·5%. —B.C.I.R.A.

Tannins: Fluorescence. O. Gerngross. *Z. Angew. Chem.*, 1926, **39**, 696-697.

In a paper on the application of ultraviolet light for detecting and differentiating artificial and natural tannins, it was shown that a number of synthetic tannins exhibited strong fluorescence, while others were inactive. The fluorescence shown by natural tannin extracts under the influence of light from a Hanan analysis quartz lamp is described. The question of differentiating natural silk from artificial silks by ultraviolet light was raised in the discussion. —B.C.I.R.A.

Sulphur-black Dyed Yarns: Tendering. K. Brass. *Z. Angew. Chem.*, 1926, **39**, 697-698.

The author studied the course of sulphuric acid formation in American and Egyptian cotton yarns dyed similarly with sulphur black and chromed. The sulphuric acid was dissolved out with boiling water and precipitated as barium sulphate. The initial "acid value" was taken for all parts of the yarn. Egyptian cotton showed a continuous increase in acid value; after a period of 15 weeks the curve became less steep, and the maximum acid value was reached in 66 weeks. The author concludes that the oxidation of the sulphur is a catalytic process which is accelerated by the surface effect of the dyed cellulose fibre. Thus, with American cotton, there is frequently a discontinuous formation of sulphuric acid because the hairs possess a surface which is non-uniform, and therefore a catalytic power which is variable. The acid values indicate clearly the favourable effect of after-treatment with bichromate for they are considerably higher in unchromed than in chromed yarns. The bichromate thus removes by oxidation much of the easily oxidised sulphur. On the other hand, on soaping, the degree of dispersity of the dye, and therefore the active surface of the dyed fibre, appears to be unfavourably influenced, for the acid value rises more rapidly in a sulphur-black yarn which has been chromed and afterwards soaped than if the soaping were omitted. A sulphuric acid content of 0·2% damages the cotton hair. The hair resistance to acid formation is raised by treatment with sodium sulphide. The question of auto-oxidation *versus* catalysis was discussed. —B.C.I.R.A.

Permutites: Properties. V. Rothmund. *Z. Elektrochem.*, 1926, **32**, 367-371.

A summary of the literature dealing with the chemistry of the silicates including the zeolites of the soil and the amorphous permutites prepared for water purification, &c. The main properties discussed are water binding power and base exchange; the bibliography covers about 30 references. —B.C.I.R.A.

Dyed Collodion Films: Fading. A. Predwoditeleff and N. Netschajewa. *Z. Physik*, 1925, **32**, 226-235.

The results are given of spectrophotometric measurements of the initial velocity of bleaching of cyanine—and pinacyanol—collodion films containing the colouring matters in various concentrations. This velocity exhibits periodic variation, as the proportion of the dyestuff present is continuously increased. For films with high collodion content, however, the above deviation from the van 't Hoff-Lasarew law disappears. —B.C.I.R.A.

Lustre. H. Zocher and F. Reinicke. *Z. Physik*, 1925, **33**, 12-27.

The author discusses the cause of the impression of lustre and the method of producing it with suitably arranged surfaces. Physically, lustre indicates incomplete regular reflection and is always obtained if the impression of a surface and its mirror image is received by the eye. A distinction is drawn between mirror-reflection lustre and matt lustre. The lustre of diamond, glass, and water falls in the first class, that of mother-of-pearl and fat in the second. There is a third class in which the degree of reflection differs in different directions of the surface. This is silk lustre, or the lustre of ribbed surfaces. The different circumstances which lead to the impression of lustre, including the distribution of light, shade, and colour, are next discussed. The appearance of bright metallic surfaces is due to intensity of lustre, since a substance like barium sulphate may reflect nearly all the light incident on it without giving the impression of lustre. The perception of solidity and the effect of stereoscopic vision are discussed. In conclusion, a large number of ways of producing lustre effects with numerous paper, textile, or other surfaces are described; many are already in use in the textile industry, for example in "Schiller" or "changeant" fabrics, moiré fabrics, &c. —B.C.I.R.A.

Lustrous Surfaces: Brightness Distribution. P. Wolmeringer. *Z. Physik*, 1925, **34**, 184-215.

The distribution of brightness of wholly or partially diffuse reflecting spherical surfaces illuminated by a parallel beam of light was examined. The brightness distribution curve is obtained by calculation from Lambert's law, and from Lommel's law and also from experimental results previously obtained with plane surfaces. To measure the actual brightness ratios experimentally, photographic exposures were made of cylinders covered with magnesium oxide, drawing paper, aluminium and silk illuminated by parallel rays—by restriction to the equatorial zone cylinders may be used instead of spheres—and the blackening evaluated by comparison with a standard blackening wedge taken on a similar plate under the same conditions. The photometer used was constructed on the Moll principle. The results were not in satisfactory agreement with either of the laws, but were nearer to the Lambert law. The deviation is greatest in angular phases greater than 90°. Maximum brightness occurs near the

edge; this is in agreement with the results of Wiener and Messerschmidt.
—B.C.I.R.A.

Sized Paper: Effect of Humidity on Porosity. U. Albrecht. *Zellstoff ü Papier*, 1926, **6**, 396-397 (from a paper read before the Annual Meeting of the Vereins Finnischer Papier-Ingenieure).

A test for examining the strength of paper size is described in which the time taken for ink to soften and penetrate the size of a writing paper at a definite temperature is measured. It was found that the time increased with increasing air humidity from 10% to 30% relative humidity and then decreased from 30% to 70% relative humidity. Papers different in composition and in the kind of size used were exposed to the action of saturated air and their size strength in the damp condition determined from time to time. By such a "damp hardening" process (and subsequent drying) the time of ink penetration was greatly increased; test papers "damp-hardened" for seven days show no appreciable size penetration by the ink. It is shown that the change in size strength of "damp-hardened" paper with relative humidity follows the curve for the change in size strength of the same "unhardened" paper. Also that it is possible to restore by "damp-hardening" the size strength of a paper which has been tendered by sunlight.
—B.C.I.R.A.

Starch: Hydrolysis. H. Haehn and H. Berentzen. *J. Inst. Brewing*, 1926, **32**, 237 (from *Wochschr. Brau.*, 1926, **43**, 91-93 and 101-104).

The hydrolysis of soluble starch by solutions containing neutral salts, amino-acids, and peptones has been studied. A mixture of 1·5 cc. of a solution containing potassium, sodium, and calcium chlorides (M/90), alanine and leucine (M/60), and Witte's peptone (at 0·3% concentration) with 0·3 cc. of 1% starch solution and 8·3 cc. of water at *p*H 7·4 gave only a yellow colouration with iodine after 20 hours' incubation at 40° C. In starch paste the amylose only is attacked. Amylose solutions prepared by Biedermann's method are acted on much more rapidly than ordinary soluble starch. The presence of oxygen appears to be essential for the hydrolysis. Phosphates in acid or neutral solution accelerate it. In an experiment continued for 31 days, 12 grms. of starch yielded 1·34 grms. of maltose, 2·42 grms. of fermentable dextrin, and 8·28 grms. of unfermentable, non-reducing dextrin containing some traces of starch. The action appears to be a true hydrolysis.
—B.C.I.R.A.

Orifices; Flow from——. H. W. Swift. *Phil. Mag.*, 1926 [vii.], **2**, 852-875.

In a theoretical treatment of orifice flow, the author evaluates the coefficient of discharge C_d in the expression for volume rate of flow, $Q = C_d a\sqrt{2gH}$. The effect of surface tension and viscosity is treated in detail. The theory is confirmed by experiments with water and with oils.
—B.C.I.R.A.

Flowmeters. R. M. Archer. *J. Sci. Instr.*, 1926, **3**, 410-414.

A short description is given of several types of jet-and-vane flowmeter for measuring small rates of gas flow. The instruments are intended to be calibrated, but over the small angular working range used the square root law is approximately true. Alternative systems of control and methods of damping are described.
—B.C.I.R.A.

On the Use of v.d/y as a Parameter in the Practice of Hydraulics. E. Parry. *Engineering*, 1926, **122**, 474-475.

The author recommends the use of the expression $v.d/y$ (where v = mean velocity of flow in pipe, d = diameter of pipe, and y = kinematic viscosity of fluid) as a parameter in hydraulic practice instead of the empirical formulæ in general use on engineering problems of fluid friction in pipes. Taking the specific roughness into account, so that dynamic similarity applies, an equation is derived in which the above parameter appears. It is shown that a series of graphs may be obtained which would give a standard of reference for the coefficient of hydraulic friction, the terms of the equation for these graphs being determined experimentally. The series of graphs would represent conditions for all fluids, at temperatures for which density and viscosity are known. Suggestions are given for increasing the utility of the method.
—L.I.R.A.

Elasticity by Dynamical Methods; Determination of the Modulus of——. H. W. Swift. *Phil. Mag.*, 1926 [vii.], **2**, 351-368.

A dynamical method of determining the modulus of elasticity of metals is described. The theoretical basis of the method is given, and results obtained in this way are compared with those calculated from statical experiments. The deformation of a material is not determined by the existing stress system, but can be resolved into three components—(*a*) a reversible strain which develops with the change in stress, (*b*) a permanent and irreversible deformation which slowly approaches its final value, (*c*) a slow but reversible strain. So that the modulus of elasticity may be characteristic of the material it is here taken as the ratio of the stress to the instantaneous strain, i.e. the two kinds of "creep" (*b* and *c*) are eliminated. The methods whereby the value of this modulus were obtained are described; for wires the period of longitudinal vibrations was observed and the modulus calculated, while for rods of greater stiffness observations were made on the flexural vibrations using the rod as a cantilever and as a simply supported beam. The results show that the truly elastic strain is independent of the two types of creep and can be separated from them. They also suggest that elasticity is an inherent property of the material which is unaffected by mechanical treatment or by the elastic history or condition of the specimen. —L.I.R.A.

Elastic Properties of Wires; The Effect of Tension on Certain——. E. Edwards, I. Bowen, and S. Alty. *Phil. Mag.*, 1926 [vii.], **2**, 321-340.

The work described concerns a variation of torsional stiffness of metallic strips and wires with load. Following work by Pealing, the effect was considered to be anomalous, being caused by overstrain of some parts of the strip in the rolling process. Using dynamical methods, Bowen found that the effect was present in wires as well as strips, this indicating that it is a true variation. In all cases increase of load caused an increase of torsional stiffness. Bowen found that the increase is reduced in annealed strips, micro-photographs showing that the larger the crystals the smaller the variation. It was also observed that the rate of damping decreased with increase of load. The same effects were observed by Alty in experiments of a statical nature. In order to find the connection between the variation and the crystal structure of the metal, the latter method was used with tungsten wire in increasing stages of recrystallisation and with Pintsch single crystal tungsten wire. It was found that the variation decreased with the growth of the crystals and was absent in the case of the single crystal wire. The variation of hysteresis with load was also observed in the ordinary tungsten wire but was not detected in the single crystal wire. The effects were absent in fibres of drawn quartz. To account for the phenomena, a metal is considered to consist of small crystals each surrounded by a hard amorphous cement forming a three dimensional network. Increase of tension would cause the cement to bind more tightly on the crystals thereby stiffening the metal and reducing slipping in the crystals, which appears as hysteresis or damping. Growth of the crystals reduces the amount of binding material, making the network coarser so that the effects due to increase in tension would be less marked. —L.I.R.A.

Benzenediazonium Salt Solution: Stability. H. A. H. Pray. *J. Phys. Chem.*, 1926, **30**, 1417-1426.

The effect of a number of foreign substances on the velocity of the decomposition of diazobenzene chloride with water has been determined. A catalyst for the reaction has not been found. Evidence has been obtained in favour of the fact that diazobenzene molybdate solutions are much more stable than those of the chloride, nitrate, sulphate, &c. The effect of altering the viscosity of the medium in which the reaction takes place has been studied. There is no apparent relation between the viscosity of the medium and the velocity of the decomposition. The colloids gelatin, dextrin, starch, agar and egg albumin have been found to affect in no way either the velocity of the reaction or the rate at which gas evolution takes place from such solutions. —B.C.I.R.A.

Pentosans and Methylpentosans: Estimation. K. Oshima and K. Kondo. *Chem. Abs.*, 1926, **20**, 2803 (from *J. Coll. Agr. Hokkaido Imp. Univ.*, 1926, **16**, 1-71 [in German]).

The method consists essentially in distilling with hydrochloric acid and precipitating the distilled furfuraldehyde as phloroglucide. Formulæ are given for calculating the amounts of arabinose, xylose, &c., and the method is claimed to give values also for methyl pentosans which can be detected by spectrum analysis. —B.C.I.R.A.

Sodium Hypochlorite Solution: Autodecomposition. E. Chirnoaga. *J. Chem. Soc.*, 1926, 1693-1703.

The kinetics of the catalytic decomposition of sodium hypochlorite solutions in presence of finely divided metallic oxides were investigated. It was found that the stock solution of hypochlorite used diminished in strength at the ordinary laboratory temperature, and a table is given showing the course of this apparent auto-decomposition. —B.C.I.R.A.

Sodium Hypochlorite Solution: Autodecomposition. R. L. Wells. *Chem. Zentr.*, 1926, **ii.**, 2204 (from *Amer. J. Pharm.*, 1926, **98**, 404-406).

Concentrated solutions of sodium hypochlorite with 13·28 per cent. available chlorine and dilute solutions with 8·42 per cent. declined in strength over three months to about 6 per cent. available chlorine. No stabilising agent could be found. The presence of alcohol or aniline immediately caused almost complete decomposition, copper and aluminium gradual decomposition. Greater excess of alkali has no effect on stability. —B.C.I.R.A.

Dyes: Fastness. A. Crummett (British Silk Research Assoc.). *J. Soc. Dyers and Cols.*, 1926, **42**, 301-304.

Methods employed to determine the fastness of dyes (on silk) to light, water, washing, perspiration, &c., are described and a standard procedure suggested in the case of light exposure tests. —B.C.I.R.A.

Tests of Fastness of Dyestuffs. J. S. Heuthwaite. *Dyer and Cal. Printer*, 1926, **56**, 214-215.

A description of methods of testing the fastness of dyed materials to washing, alkalis, milling, acids, rubbing, and perspiration. —A.J.H.

Chromate Colour Standards: Application. A. Janke and S. Kropacsy. *Biochem. Z.*, 1926, **174**, 120-130.

The application of inorganic permanent series prepared from iron and cobalt salts

to match the colour scales obtained with two-colour indicators is not to be recommended, since the corresponding absorption spectra differ essentially from one another, and judgment of equal colour shade is accordingly subjective. Chromates and dichromates, on the other hand, are very convenient for the preparation of inorganic series serving for comparison with nitro-phenols and dinitro-phenols, since on standardising to the same depth of colour as the indicators named, they give absorption spectra sufficiently similar to those of the organic indicators when observed in a prism spectroscope.
—B.C.I.R.A.

"Slide Gauge" Colorimeter. A. L. Bernouilli. *Helv. Chim. Acta.*, 1926, **9**, 827-840.
The apparatus is characterised by the fact that the light serving for the analysis passes through two reflexion prisms, standing in a beaker or any other vessel, which can be moved relatively to one another in the way that the cheeks of a slide gauge are moved along their scale. The method of measurement by substitution, the effect of the colour on the optical film thickness, the independence of the constants on the concentration, the light sources and the degree of accuracy attainable are discussed. Results of analyses with the instrument given include lead as lead sulphide, dichromate, nitrite by the Griess reaction, and ammonia according to the hypochlorite phenol method. Nitrite-nitrogen even at the extreme dilution of $5 \cdot 10^{-5}$ mgr/cm.^{3} can be estimated with an accuracy of 1 per cent. An "inversion method" or micro-method can be carried out with the calorimeter on a volume of 2 c.c. of liquid without special vessels. With a "micro trough" an iron determination with pyrocatechol can be performed with 0·002 mgr. of substance dissolved in 0·1 c.c. with an accuracy of 4 per 1,000.
—B.C.I.R.A.

Spectral Filters: Data. K. S. Gibson. *J. Optical Soc. America*, 1926, **13**, 267-280.
A compilation of data relating to spectral filters for use in the ultra-violet, visible and infrared regions. The bibliography contains 45 references. —B.C.I.R.A.

Broken Yarn: Causes. H. H. Willis. *Cotton* (U.S.), 1926, **90**, 971-974.
In a discussion of the causes of end breakages, based on recent American official spinning tests, it is shown that end breakages may be largely avoided by the use of selected or line-bred cottons of good quality, by the use of a length of staple suited to the count of the yarn to be spun, and by proper mechanical conditions, adequate temperature and suitable humidity. —B.C.I.R.A.

Ancient Egyptian Linen: Disintegration. A. Lucas. *Analyst*, 1926, **51**, 446-447.
Ancient Egyptian linen burial fabrics are in some instances in as good condition when found as when made, whilst in others they are discoloured and rotted and may even be reduced to the condition of a black powder. The determining factors are damp and a certain amount of air, and it is suggested that the damage is caused largely or wholly by fungi, which induce a sort of slow spontaneous combustion.
—B.C.I.R.A.

How to Distinguish Rayon. *Chemicals* (N.Y.), 1926, **26**, No. 19, p. 21.
Acetate rayon is soluble in acetic acid and acetone, the other three kinds are not. Nitrocellulose rayon gives a characteristic blue colour in sulphuric acid and diphenylamine. If the rayon is either viscose or cupram, they may be identified by digesting in weak acetic acid for some hours in a vessel covered with a lead-acetate paper. A blackening of the paper shows that the sample is viscose. —F.G.P.

Sulphite Cellulose: Fluorescence. L. Meunier and A. Jamet. *Brit. Chem. Abs.*, 1926, B., 798 (from *J. Soc. Leather Trades Chem.*, 1926, **10**, 166-168, 212-213).
Work on the fluorescence of tanning materials is described in which the pale violet fluorescence of solutions of sulphite-cellulose extracts is used as a means for detecting adulteration in tannin extracts.
—B.C.I.R.A.

Cotton: Classification. T. Bühler. *Faserforschung*, 1926, **5**, 206-226.
In a further contribution to the subject of grading raw cotton the author enumerates the factors to be tested under the headings "class" and "staple." Class as defined includes, in addition to the ordinary properties such as colour, impurity, &c., "rendement" (spinning quality), which is governed by tensile strength and elasticity of the hair, hair dimensions and convolutions, coefficient of friction, ratio of undamaged to damaged hairs, hair moisture and fat content. The results of applying the tests to a series of American staples are recorded and show that many sources of error are inherent in the subjective classification methods hitherto in use, which are based on hair length and general character of the cotton. A displacement of the character index in the class itself results according to the date of gathering the crop; thus, for example, the intrinsic spinning value of the "staple" changes with the class (apart from change of staple length) and the spinning value of the class with the staple indication. —B.C.I.R.A.

American Cotton Linters: Grading. *U.S. Dept. Agric. Service and Regulatory Announcements* No. 94, 1925, 9 pp.
The grades adopted as the official standards of the United States for American cotton linters are described. They comprise seven basic grades ranging from the highest first cuts to the shortest second cuts. Linters below that of Grade 7 are to be

designated hull fibre. The pamphlet also contains notes on the character, "cutting" and uses of linters. —B.C.I.R.A.

Improved Indian Cottons: Spinning Tests. *Emp. Cotton Grow. Rev.*, 1926, **3**, 374-381.

Results of the Oldham tests on 1925-26 samples of improved Indian cottons, namely, Gadag No. 1, 285F. Punjab American, 1027ALF (Surat), Sircar 14, Sircar 25, Cambodia No. 1, Dharwar No. 1 and 289F. —B.C.I.R.A.

The Distortion of Iron Crystals. G. I. Taylor and C. F. Elam. *Proc. Roy. Soc.*, 1926, Ser. A, **112**, 337-361.

This work shows that the mechanism of distortion in iron crystals is quite different from that in crystals of other metals. The plane of slip has no direct relationship with the crystal axis. From a study of the slip lines it is found that the particles of the metal stick together along a certain crystallographic direction and the resulting distortion is similar to that of a large bundle of rods which slide on one another. The rods stick together in groups and the slip lines are the traces of these groups. The work was carried out on large single crystals and it was found to be essential to subject the crystal to a uniform distribution of stress. —L.I.R.A.

Filter Cloths: Properties. H. I. Waterman and J. P. M. van Gilse, and H. I. Waterman and A. Dauvillier. *Rec. Trav. Chim.*, 1924, **43**, 757-767, and 1926, **45**, 628-632.

In experiments on charcoal filtration a method was worked out for determining the time needed for filtration through the filter cloth independently of that for filtration through the filter cake the volume of which continually increases. New filter cloths did not give constant values at once. After use the charcoal layer was always carefully washed off, and constant values were only obtained after this operation had been repeated several times. The observed behaviour of the cloth is due to fine particles of charcoal being pressed into the pores of the cloth and not being removed by surface washing. If a used filter cloth is boiled and stirred in water the carbon particles are removed. If such a boiled cloth is used a much smaller time of flow is again first found, which after repeated use becomes larger and finally approaches a constant value. —B.C.I.R.A.

Paper Machine Drying Felts: Tendering. H. Postl. *Papier-Fabr.* (Verein Zellstoff Ingenieure Section), 1926, **24**, 582-584.

The author discusses drying felts, i.e., the conveyer belts passing round the drying, &c., cylinders in paper making machinery and shows that the tendering of these is caused by excessive water absorption from the saturated air surrounding the plant. Many of the better cotton felts are now impregnated or lined with asbestos on the side in contact with the hot cylinder. —B.C.I.R.A.

Auramine and Indigosol Dyes: Analysis. A. Noll. *Papier-Fabr.* (Verein Zellstoff Ingenieure Section), 1926, **24**, 593-595.

Commercial auramines may be examined by (1) quantitative extraction of pure auramine, (2) preparation quantitatively of tetra-methyl-*p*-diamino-benzophenone, (3) qualitative examination of the various makes of auramine by identifying the ketones obtained on hydrolysis, (4) estimation of the dye strength from the weight of the ketones obtained. Commercial indigosols may be determined by preparing quantitatively tetra-bromo-indigo by the method described. —B.C.I.R.A.

Cellulose Compounds; Adsorption Properties of——. J. Duclaux. *J. Soc. Dyers and Col.*, 1926, **42**, 317 (from *Rev. gen. Colloid*, 1926, **4**, 137-142).

It is possible theoretically to separate two substances which are adsorbed unequally by a third substance. Owing to its powerful selective adsorption properties cellulose nitrate is particularly useful, and is superior to carbon and alumina in the analysis of solutions and separation of the dissolved substances. The cellulose nitrate must be used in a porous form for dialysis or ultrafiltration, and is equally suitable for the isolation of substances from concentrated or dilute solutions. Investigations in this direction have been confined up to the present to colouring matters, but in view of the adsorptive properties of collodion and cellulose for certain enzymes and toxins, there is little doubt that systematic study would reveal similar results with these substances. Experiments with other cellulose derivatives show that their affinities vary considerably. —L.I.R.A.

Paper Sheets: Tensile Strength; and Sulphite Cellulose: Bleaching. *Papier-Fabr.* (Verein Zellstoff Ingenieure Section), 1926, **24**, 465-468 and 481-483.

The author describes a standard method of testing the tensile strength and felting qualities of half-stuffs. The tests are carried out on paper sheets, 60 lb. in weight, manufactured in the way described from the raw stock under test; and the favourable effect of pressures varying from 0 to 200 lb. per sq. in. on the strengths of the corresponding papers is shown for wood pulp and for sulphite pulp unbeaten and unbleached, beaten and unbleached, unbeaten and bleached, &c. The results of a number of works scale tests showing the effect of different bleaching processes on the strength of different sulphite pulps are recorded. —B.C.I.R.A.

Cotton Staple Standards: Objections. *Cotton* (M/cr.), 1926, **32**, No. 1543.

A meeting of representatives of British and European Cotton Associations and Exchanges gave, in a memorandum presented to the United States Department of Agriculture, the following reasons for rejecting the proposal for universal standards for staple length—(1) There is no general desire amongst buyers and users of cotton to accept the principle of universal standards for staple lengths. (2) Such standards are not practicable either in formulation or maintenance. (3) Such standards would not be acceptable as they only express one of the many characteristics required by the cotton trade. These headings are further discussed. —B.C.I.R.A.

Stressed Rubber: Structure. E. A. Hauser and H. Mark. *Kolloidchem. Beih.*, 1926, **23**, 64-78.
The authors review the changed physical properties of rubber subjected to stress including optical properties, Joule heating effect, dielectric constant, specific gravity, &c., and discuss current theories of the structure of stressed rubber, notably the "two-phase" theory supported by several writers. It is pointed out that one of the difficulties in explaining the processes accompanying stress is the appearance of Röntgen interference bands, and the point is emphasised that such interferences are not necessarily conclusive evidence of crystal structure, nor does the absence of crystal interference always denote the absence of crystal structure. The authors advance the view that unstressed raw rubber resembles in structure a framework with rigid supports such as is used in bridge building. The supports consist of groups of atoms more or less firmly joined in chain or other formation, these chains being linked to one another by weaker links. Unstressed rubber in the normally dry state resembles a telescoped framework taking up little room. On bringing it into a solvent the same change occurs as in opening the framework. The rigid supports separate as far as possible until an equilibrium position is reached. In mastication, the links between the chains are broken down, and the rigid structure gives way to unarranged detached chain fragments. —B.C.I.R.A.

Suspensions: Viscosity. E. Hatschek and R. S. Jane. *Kolloid Z.*, 1926, **40**, 53-58.
It is shown that the viscosity of suspensions of rigid microscopic particles (rice starch grains) in a neutral liquid, at volume concentrations of 2, 4, 6, and 8 per cent., increases with decreasing shear gradient, as is the case with emulsoid sols. The increase is more pronounced as the concentration increases. Excluding the possibility that the suspensions possess shear elasticity, the variability of the viscosity may be explained by assuming that the virtual volume of the disperse phase is augmented either by liquid sheaths or "dead space" in the sense of W. R. Hess, and that the increase is lessened with rising shear gradient. —B.C.I.R.A.

Faulty Fabrics: Bleaching, Dyeing, and Mercerising. —. Flemming. *Leipziger Monats. Text.-Ind.*, 1926, **41**, 354-356 and 390-391.
The article is a summary of the faults occurring in bleached and dyed cotton goods with a discussion of the causes of each. —B.C.I.R.A.

Prevention of Damages in Textiles: Lousy Silk. J. Chittick. *Text. Amer.*, 1926, **45**, No. 6, p. 11.
This defect has the appearance of an unremovable dust and is seen after the yarn or fabric has been dyed; it may be described as being ravellings of the silk thread; the light colour is due to their exceeding fineness. Lousy silk is that in which the boin has separated in the bave during working, and even the best qualities are not always free; the presence of this defect varies from crop to crop of silk from the same locality and is probably due to climatic conditions. Severe treatment during dyeing will often produce it, and this end should be tackled first with a view to eliminating or at least minimising to commercial limits. Silk liable to lousiness cannot be used for satins. The raw silk dealer, it is said, cannot be held responsible, but he should be notified in order that he may get silk from other crops. —F.G.P.

Absorption of Water by Colloidal Fibres. J. J. Hedger. *Brit. Chem. Abs.* (A), 1926, 1091 (from *Trans. Faraday Soc.*, 1926, **22**, 178).
The moisture contents of wool in atmospheres of varying humidities at 17-29 degrees, and the heats of wetting of wool of different moisture contents at 22 degrees determined. Heats of absorption calculated therefrom are in rough agreement with Shorter's values (B, 1924, 628). Similarly for silk. —B.L.R.A.

Wool and Sulphuric Acid. Ristenpart and Petzold. *Leipziger Monats. Textilind.*, 1926, **41**, 242-243 (from *Soc. Dyers and Col.*, 1926, p. 294).
The extensibility and breaking strength of woollen yarn after boiling for one hour in 20 times its weight of water and of sulphuric acids of different concentrations have been determined. The results show that using up to about 9 per cent. of the weight of wool, the acid has a protective action. Subsequent heating to 120° C. does not cause weakening, nor does storage of the treated yarn for six months with exclusion of light. When 9 per cent. of acid has been used, the treated wool contains about 4·3 per cent. of acid, and if these figures be not exceeded, it is not necessary to use a weaker acid in dyeing than sulphuric, as has been recommended. For determining the amount of acid in the wool, the authors recommend a colorimetric method, in which the colours produced by the wool on litmus and Congo Red papers are compared with the colours produced by

wool containing a known percentage of acid. B.R.A.W. & W.I.

Recognition and Estimation of Constituents of Fats and Soaps. *Siefenseider Ztg.*, 1926, **53**, 708.
German Commission for the provision of simple methods of examination of materials used in the fat industry.

Vol. 53, No. 41.		Estimation of fats in seeds and fruit.
,,	,, 42.	Qualitative determination of fats.
,,	,, 43.	Chemical and physical tests of fats.
,,	,, 44.	Detailed description of methods of soap analysis.
,,	,, 45.	Analysis of soap powders —glycerine estimation.

—B.L.R.A.

7—BUILDING AND POWER

(C)—Power

Water: Softening. *Mech. Eng.*, 1926, **48**, 748-750.
In the discussion following a paper on water purification the problems of organic matter, iron, and oil removal from waters were further discussed. —B.C.I.R.A.

Rope Driving [of Textile Machinery]. E. L. Parry. *Dyer and Cal. Printer*, 1927, **57**, 18-19.
A theoretical treatment of practical problems. —A.J.H.

Leather Belting. J. F. Springer. *Silk* (N.Y.), 1926, **19**, No. 5, p. 41.
Waterproofed leather, it is said, is not so widely used as it should be; price, not quality, is the main consideration. The same sort of belting is used for all purposes. Most belts fail because of improper selection and installation or lack of attention. Purchasers frequently understate the horse-power in order to get a cheaper belt. Belts should be under the care of a skilled attendant. Dressings should be bought from the supplier of the belting. Various types of belt drives are described.
—F.G.P.

(D)—Lubrication

"Liquide S" Lubricant: Application. *J. Sci. Instr.*, 1926, **3**, 352-353.
"Liquide S" is a 1 per cent. solution of stearic acid in toluene manufactured by Wisner, of Clichy, and intended for the treatment of fine mechanisms which are to be lubricated by one of their oils. Instructions are given for its use. Photographs are reproduced of a flat surface of polished steel of which one half had been treated by the stearic acid in toluene process, showing the spread of small drops of mineral oil on the untreated surface after 5, 15, and 90 minutes. The drops on the treated surface show no sign of spreading. —B.C.I.R.A.

(F)—Lighting

Quartz Mercury Lamp: Energy Distribution. P. W. Cunliffe, R. G. Franklin, R. E. W. Maddison, and L. Reeve. *J. Phys. Chem.*, 1926, **30**, 1427-1431.
Experimental data are presented to give a general idea of the magnitude to be expected in the energy values of definite wave lengths in the radiation from the quartz mercury arc lamp. The individuality of the lamps and the importance for quantitative photochemical work of accurately determining in absolute units (ergs per sq. cm. per sec.) the intensity of a given wave length with the lamp burning under well defined conditions was emphasised. —B.C.I.R.A.

Anti-hygron Insulated Wire: Application. O. Bodemann. *Papier-Fabr.* (Verein Zellstoff Ingenieure Section), 1926, **24**, 655-656.
Electric light installations suitable for rooms with humid or fume-contaminated atmospheres are described. A special feature is the "anti-hygron" wiring (made by the Siemens Schuckert Co.). The wire is encased by numerous impregnated fabric or rubber sheaths which are specially resistant to water, ammonia, or other gases or vapours. —B.C.I.R.A.

Light Ray Protective Glass. A. Kühl. *Chem. Zentr.*, 1926, **ii.**, 2099 (from *Zentral-Ztg. Opt. ü Mech.*, 1925, **46**, 333-335 and 350-353).
Curves constructed on optical and physiological principles are given from which the adsorption properties necessary in eye protective glasses and their application in practice can be read off. The yellow-green enixanthor and the blue-green heat protective glasses of Vogt are recommended; the former are claimed to give nearly ideal protection from sunlight and the latter against red and infra-red radiation.
—B.C.I.R.A.

(H)—Humidification

Humidifiers: Application. J. W. Cooling. *Paper read before the Institution of Heating and Ventilating Engineers*, Summer Meeting, 22nd June 1926, 28 pp.
The principles of air-conditioning and air-conditioning apparatus are discussed, and a typical humidifier of the "mist" type of air washer is described with a detailed description of the automatic thermostat controls. A code of minimum requirements for air washers drawn up by the American Society of Heating and Ventilating Engineers is quoted. The calculation involved for adjusting the different parts of the system to give the required temperature and humidity conditions in a factory in summer and in winter is explained. —B.C.I.R.A.

Cotton Mills: Humidification. D. M. Amalsad. *Indian Text. J.*, 1926, **36**, 341-343.
The principles underlying humidification are explained in simple language and

practical methods of humidifying the air of a mill are outlined. —B.C.I.R.A.

Warmed Hair Hygrometer: Application of, for Water Content Mist. F. Albrecht. *Physikal. Ber.*, 1926, **7**, 1187 (from *Meteorol Z.*, 1925, **42**, 468-477).
A hair hygrometer suitable for measuring the water content of clouds and mists consists of a hair wound with a thin platinum wire so that it can be heated electrically. The temperature reached depends on the wind velocity and the strength of the heating current. The effective air humidity at the surface of the heated air may be ascertained experimentally by measurements in a wind channel with different wind velocities and degrees of heating. In misty air the heated hair, however, indicates a higher humidity than is to be expected according to wind velocity and heat. It follows from theoretical considerations that the water content of the air in liquid water is proportional to the difference of the relative humidity indicated by the heated hygrometer and that which the hair would give in mist-free air under the same heating and ventilating conditions. —B.C.I.R.A.

8—DESIGN

Colours in Modern Decoration. *Silk* (N.Y.), 1926, **19**, No. 6, p. 43.
Since the 15th century France has led the world in beauty of design of silk. Notes are given of the encouragement the artists received from the kings. At the present day the attention paid to decoration is the same. The artist, Benedictus, who produces fabrics of all kinds, has created masterpieces with rayon by making it supple like silk. Purple violets with motifs of metal or graded shades of strong colours are popular. —F.G.P.

9—COMMERCE, ECONOMICS, LABOUR &c.

Cotton Production in the British Empire. *Cotton* (M/cr), 1926, **32**, No. 1543, p. 17.
A table showing the area, population, suitability of soil, climatic conditions, methods of transport, approximate cotton produced in 1925, quality, approximate total value, and possibilities of increase for each of the colonies and protectorates of the British Empire is reproduced. The table has been compiled by the British Cotton Growing Association. —B.C.I.R.A.

Cotton Cultivation in Nyasaland. C. Ponsonby. *Emp. Cotton Grow. Rev.*, 1926, **3**, 322-330.
A general account of cotton growing in Nyasaland with particular reference to the British East Africa Company. On an average of 120 lb. lint yield per acre the cost of growing, baling, and barging 50 mills should be from 6d. to 8d. a lb. Freightage costs 1½d. a lb. to the Liverpool market where Nyasaland cotton brings 150 to 200 points on American fully middling. With improved methods of cultivation, including especially the growing of cotton on the flat instead of on ridges, higher yields than 120 lb. lint per acre have been reached. This figure contrasts greatly with the usual European crop that barely reaches 60 lb. The development of cotton growing is still largely dependent on European enterprise, whilst nothing could have been done without the system of guaranteed prices. The importance of improved communications by means of the bridge over the Zambesi is emphasised. —B.C.I.R.A.

Cotton Cultivation in the Sudan (Rain Areas). R. A. Wardle. *Internat. Cotton Bull.*, 1926, **4**, 498.
Cotton is grown roughly between the parallels of 12° and 4° of latitude, with rainfall ranging from 500 mm. in the north to 1,200 mm. in the south. In the provinces of Kassala Blue Nile, Fung, and White Nile, the authorities have been concerned with replacing native cottons with exportable varieties, with improvements in cultural methods and with ginning and transport organisation. Cotton growing is, however, practically a new industry in the Upper Nile, Nuba Mountains, Kordofan, Bahr-el-Ghazal, and Mongalla, and time has been largely spent in testing varieties and with devising the appropriate methods of cultivation. Abnormally low rainfall reduced the 1925-26 crop as compared with the previous crop from 12,240 bales to 5,600 bales. The South Sudan crop, however, increased from 360 bales to 3,100 bales and Bahr-el-Ghazal and Mongalla which produced none in 1924-25 raised 1,100 bales. —B.C.I.R.A.

Cotton Bales: Marking in India. *Internat. Cotton Bull.*, 1926, **5**, 72-77.
A table showing the key to the marks and numbers as allocated to the pressing factories in the Bombay Presidency, Sind, the United Provinces, and in the Madras Presidency, allows the spinner to learn by name the ginner and packer responsible for his cotton purchases. The new system will be the means of compelling the Indian ginners and packers to maintain a higher standard than formerly. —B.C.I.R.A.

Cotton Cultivation in India (Punjab). *Rept. Dept. Agric. Punjab*, 1925, Part 1.
High cotton prices in 1923-24 led to a 33 per cent. increase in acreage up to 2,320,000 acres or 58 per cent. higher than the decennial average. Nearly 1,000,000 acres were under American, of which 285F covered 14,300 acres, and 289F 2,070 acres. The remainder was sown down to 4F. Owing to the general fall in cotton prices and to the loss in confidence caused by wholesale mixing the previous year, prices fell from 18-28 maunds per candy to 15-19 maunds. Late varieties fared better than early varieties because of bad rainfall distribution early in the season and of the late frosts. Both 289F and 4F gave greater yields than 285F, which is an early variety.

Details of seed distribution, relative prices for the different qualities grown and detailed accounts of the crop progress both with American and Desi varieties during the growing season are given.

—B.C.I.R.A.

Cotton Cultivation and Spinning in India (Madras). *Indian Text. J.*, 1925, **35**, 277-280.

While in the Bombay Presidency there are 250 cotton mills not more than 16 exist in the Madras Presidency. In order to attract financial interests an account is given of the natural resources, labour, and transport facilities on which industrial development may draw. Of the cotton districts, which together grow 2½ million acres of cotton annually, Cuddapah, Kurnool, Bellary, Anantapur, Guntur, Coimbatore, Madura, Ramnad, and Tinnevelly are the most important. Next in importance are Vizagapatam, Krishna, Nellore, Salem, and Trichinopoly. About 450,000 bales of 400 lb. are produced annually, of which two-thirds is exported. The remaining third is used by the local mills to which cotton is frequently sold direct by the producers. The article proceeds to outline the considerations necessary to be taken into account by the prospective builder of a new mill, and draws attention to the facilities afforded by the State Aid to Industries Act. A list of mills showing the district, station, name of mill, number of spindles, and number of looms is given. The total Madras spindleage is 543,000 spindles and there are about 4,000 looms in operation.

—B.C.I.R.A.

Cotton Cultivation in Greece. *Internat. Cotton Bull.*, 1926, **4**, 479-480.

Production for each of the last four years is as follows in bales of 478 lb., 5,983 bales, 9,868 bales, 18,325 bales, and 14,812 bales. The outlook for the 1926 crop is favourable. Almost all kinds of cotton are cultivated, but Egyptian has not proved successful because its ripening is slow. "Ghierli" is the local and most successful variety and is chiefly grown in the Livadia and the Serres districts of Continental Greece. The cultivation of cotton has been materially increased by the refugees from Asia Minor. —B.C.I.R.A.

Cotton Cultivation in Egypt. *Internat. Cotton Bull.*, 1926, **5**, 69.

The following are considered reliable figures for the acreages of the different varieties sown in 1925 and 1926.

Variety	1925-26 Feddans	1924-25 Feddans
Sakellaridis	981,783	1,128,946
Ashmouni and Zagora	667,474	659,420
Pilion	102,394	72,799
Afifi and Assili	4,234	8,384
Other Varieties	29,817	54,833
Total	1,785,702	1,924,382

—B.C.I.R.A.

Kanegafuchi Spinning Mill: Japan. B. Crane. *Cotton* (U.S.), 1926, **90**, 963-969.

An illustrated account is given of a visit to the Tokyo mill of the Kanegafuchi Spinning Company, dealing mainly with factory organisation and welfare work. The output figures of the Company's various mills for 1925 having about 520,000 spindles and 8,000 looms, are furnished.

—B.C.I.R.A.

Cotton Cultivation in the Portuguese Colonies. *Internat. Cotton Bull.*, 1926, **5**, 33-42.

Cotton growing in Portuguese Colonies is now subject to a decree that came into force on 28th July 1926. This legislation is designed to protect the cotton growing industry against insect pests, diseases, and frauds and to give security to foreign enterprise. Cultivation, education of natives, seed supply, prices, market location and organisation, ginning installations and numerous general regulations are imposed; and for any contravention of these laws the penalties are heavy. This decree is suggested as a model for other cotton growing countries, especially in South America and Africa. —B.C.I.R.A.

Cotton Cultivation in the Belgian Congo (Uélé). *Internat. Cotton Bull.*, 1926, **4**, 475-477.

The Uélé district in the Eastern Congo has been rapidly opened up by an extensive road system, and the cotton growing industry is benefiting greatly. From this and other Eastern Congo areas the aggregate crop has increased from 1,300 tons in 1920 to 13,000 tons in 1926. During the period of high cotton values the prices paid to the natives were kept relatively low and bonuses in the form of implements were given. Five seed farms are established and at Bambesa yields of 1,010 lb. per acre of seed cotton have been reached. Neighbouring lands under native cultivation obtain 882 lb. per acre of seed cotton.

—B.C.I.R.A.

Staple Cotton Production in U.S.A. (Texas). *Internat. Cotton Bull.*, 1926, **4**, 539.

The "More Cotton on Fewer Acres" movement is having a useful effect in stimulating the growth of better staples, for, in the competitions that have been inaugurated in connection with this movement, cotton above 1 inch is specified. Current estimates of the plantings of inch cotton in Texas amount to 7,000,000 acres out of 18,000,000 acres. —B.C.I.R.A.

Cotton Cultivation in Bolivia. *Mcr. Guard. Comm.*, 21/x/1926, p. 489.

A British Syndicate has secured a large concession in the Gaiba district of Bolivia; and it is intended to develop 200,000 acres for cotton. Preparations are being made to take 3,000 families of settlers from Europe and already 600 acres have been cleared and planted. Railway construction has commenced and a steamship service between Gaiba and Buenos Ayres has been instituted. —B.C.I.R.A.

Cotton Statistics: Brazil. *Internat. Cotton Bull.*, 1926, **5**, pp. 82-84.
Cotton production by states for the year 1925-26 and the preceding five years are given, together with exports by ports of shipment and by countries of destination for the last eight years; Brazilian cotton mill statistics; imports of cotton goods into Brazil for the last five years; and the exports of woven goods from Brazil in the years 1923, 1924, and 1925. —B.C.I.R.A.

Cotton Exports: Brazil. *Internat. Cotton Bull.*, 1926, **4**, 473.
Exports of Brazilian cotton in 1925 amounted to 153,175 bales, of which England took 107,025 bales, France 21,205, Portugal 15,140, Germany 6,020, Holland 2,350, Belgium 1,320, Denmark 110, and Italy 5. S. Paulo and Minas Geraes exported 48,505 bales, the North-east exported *via* Pernambuco, &c., 101,580 bales, and 3,090 bales were exported from Para. —B.C.I.R.A.

Cotton: Staple Standards. *Internat. Cotton Bull.*, 1926, **5**, pp. 57-65.
A statement in favour of universal standards, made by a representative of the U.S. Department of Agriculture is given. Looking at the matter from the standpoint of principle, practicability and desirability the Department considered the time opportune for the adoption of such standards. However, representatives of the European Cotton Exchange and of the English Federation of Master Cotton Spinners and Manufacturers condemned the proposal as unwanted and impracticable. The Italian Cotton Association disagrees with the latter opinion. An interesting table shows the anomalies existing among the American, Liverpool, Bremen, and Havre standards of length. —B.C.I.R.A.

Blow Room Costs in the U.S.A.: Reduction. J. O. Corn. *Cotton* (U.S.), 1926, **90**, 978.
The author indicates the most economic opening, drawing and spinning conditions for producing 30's to 40's yarns, based on comparative costs of the several operations at different speeds of working, &c. The cost figures are reproduced. —B.C.I.R.A.

Cotton Prices. J. A. Todd. *Emp. Cotton Grow. Rev.*, 1926, **3**, 382-386.
The course of prices for principal types of cotton in the Liverpool markets are brought up to August 1926-27. —B.C.I.R.A.

Seed Industry in Denmark; Co-operative Organisation and the Development of the——. W. J. Jenkins. *Agric. J. India*, 1926, **21**, 371-376.
The author gives a general account of the building up and organisation of the farm seed producing industry in Denmark. The normal acreage allotted to seed production is about 40,000 acres, some 75 per cent. of which is used for the production of grass seed. The organisation of the industry dated from the formation of the State Seed Testing Station in 1891 and the Co-operative Wholesale Society of Denmark in 1896. The success of this latter Society in the distribution of pure seeds led to the formation of the Danish Farmers' Co-operative Association for Seed Growing in 1906. Strict rules govern the admission of members to this Association. It supplies its seed growers with selected stock seed and the fields of seed growing members are carefully supervised during growth. The members have to provide a guarantee of 100 kroner per hectare and bind themselves to grow only selected stock seed. They sell their seed to the Association and are also paid a percentage of their share in the funds of the Association. All seed is sold under a guarantee of germination and purity and only such seeds are used as have been classified as first class by the State experimental stations. Distribution is effected through 1,850 local co-operative distributive societies. About two-thirds of all seed sold in Denmark comes under the "automatic control" system, whereby the seed grower agrees with the Seed Testing Station that if, on the result of tests made by the Testing Station on samples taken from consignments and shipments under delivery, his seed is found not to reach the agreed standard, he pays compensation to the purchaser in accordance with the regulations of the Association. —L.I.R.A.

Cotton Industry in the U.S.A.; The Economics of——. C. T. Main and F. M. Gunby. *Mech. Eng.*, 1926, **48**, 999-1004.
A broad economic analysis of the problems of the cotton industry in the northern and southern states, dealing with cotton consumption, output, hours of operation, wages and efficiency of operatives, supply of operatives, exports and imports, cost of manufacture, conditions adversely affecting the industry in the recent past and available remedies. —B.C.I.R.A.

Bivariate Population: Sampling. K. Pearson. *Proc. Roy. Soc.*, 1926, **A112**, 1-14.
Researches on the mode of distribution of the constants of samples taken at random from a bivariate normal population are communicated. It is indicated how regression lines far from straight, and correlation surfaces far from normal, may arise in the case of compound characters even on sampling from a normal population, and it is evident how readily the theory of "probable errors" may mislead. —B.C.I.R.A.

Standardisation of Quills, Bobbins, and Shuttles. J. F. Springer. *Silk* (N.Y.), 1926, **19**, No. 5, p. 43.
If this were brought about it would reduce costs and delays in delivery. Manufacturers are considering its desirability. —F.G.P.

The Experimental Silkworm Station at Padua. *Silk* (N.Y.), 1926, **19**, No. 5, p. 76.

The sale of seed by travelling salesmen is forbidden. All authorised seed is sold in carefully marked packets. The station tests samples of seed sent in by silk growers. —F.G.P.

Scientific Buying of Raw Silk. L. Duran. *Silk* (N.Y.), 1926, **19**, No. 6, p. 31.

To-day, practically all American women wear stockings of silk, pure or mixed with rayon, wool, or cotton. Japan has developed her production with the increased American demand and now exports about 65 million pounds yearly; but the filatures are growing in carelessness, and where one hundred bales of double extra were made formerly, now 105 bales are produced from the same number of basins, which are said to be of the same chop. Much blame is attached to American buyers who purchase, not according to quality but according to price. Silk should be thoroughly tested by cohesion machines and seriplane and quality insisted upon. Grades and chops should be eliminated. Silk inspection should be moved from Japan to New York. —F.G.P.

Rayon Output in Japan to be Increased. A. Perl. *Silk* (N.Y.), 1926, **19**, No. 6, p. 91.

The quantity produced is to be doubled and will replace the finer counts of cotton. It will be largely used in mixtures. The raw materials will be home products. With the cheaper production costs Japan will compete with the world successfully, and will make up the time lost by her slower start. —F.G.P.

Lyons Silk Industry in 1925. M. Fougère. *Silk* (N.Y.), 1926, **19**, No. 5, p. 30.

Production increased 24 per cent. on 1924, and exports 16 per cent. The silk harvest in Europe generally was lower, for France it was nearly a million kilos. less. The French output of rayon was about the same as in 1924, but is likely to increase. England continues, more than any other country, her self-centred policy of slightly protecting home manufacturers. This unpleasantness causes the French exporters to try to find other markets. The fall of the franc value has caused much embarrassment to the industry. —F.G.P.

International Wool Statistics; Standardisation of Wool in the Preparation of——. See Section 1B.

10—MISCELLANEOUS

Hydrostatic Compensating Balance. M. Guichard. *Bull. Soc. Chim.*, 1926, **39**, 1113-1115.

A hydrostatic compensating balance designed originally for studying the dehydration of precipitated alumina, is described. The substance to be weighed is suspended by a long filament from one end of the beam while the other end supports a shorter plunger which dips into a vessel containing vaseline oil introduced from a graduated burette fixed outside the balance case. The specimen to be weighed is surrounded by a vessel through which a gas can be passed and which stands in a thermostat. In making weighings the volume changes in the oil are read off on the burette which has been previously calibrated with known weights. The balance could be used for following any process involving fluctuations in weight. —B.C.I.R.A.

Surface Pyrometer. F. W. Adams and R. H. Kean. *Ind. Eng. Chem.*, 1926, **18**, 856-857.

The results obtained in measuring the temperature of a metal surface between 100° and 150° by the use of a mercury thermometer, of thermo-couples of different types and of a thermo-couple compensated for heat losses are presented and discussed. The compensated couple was found to be the most useful instrument and was applied successfully to temperature measurements of metallic and non-metallic surfaces over a temperature range of 25° to 150°. —B.C.I.R.A.

Sulphur Dioxide: Manufacture and Properties. C. W. Johnson (Virginia Smelting Co.). *Amer. Dyestuff Rep.*, 1926, **15**, 682-689.

The paper is an account of the manufacture of liquid sulphur dioxide from smelting works gases, its properties, and its uses in the textile industry as an antichlor and for the preparation of hydrosulphites and sulphoxylates. —B.C.I.R.A.

Phenol Resins: Properties and Application. *Chem. and Met. Eng.*, 1926, **33**, 647-649.

These products are infusible and withstand continuously temperatures up to 300° F. They are insoluble in the ordinary solvents, practically impervious to oils, absorb little water and are affected little or not at all by organic and dilute mineral acids. Unusual applications include transparent Bakelite bottles and measuring cylinders for hydrofluoric acid, use as protective coatings and as a lining for kettles and other chemical equipment. A table is given comparing the properties of hard rubber, vulcanised fibre, and phenol resins. —B.C.I.R.A.

Rubber: Erosion; and Ball Bearings: Application. *Chem. and Met. Eng.*, 1926, **33**, 638-641.

Several articles on the subject of resistance to abrasion are presented of which the chief deal with the use of rubber in overcoming abrasion in many types of equipment and the reduction of wear in bearings by correct design and application. —B.C.I.R.A.

Metals and Alloys: Corrosion. *Chem. and Met. Eng.*, 1926, **33**, 604-636.

An extensive series of papers among which are the following—Boiler corrosion and

possible combative measures; Chromium alloys in chemical plant equipment; Resistance of special metals to sulphuric and acetic acids; Aluminium alloy for ammonia stills; High-chromium irons and steels for severe service; Resistance of metals to nitric acid; Subsoil corrosion of oil pipe lines; Rubber-lined tanks for acids; Non-ferrous alloys for severe service in chemical industries; Materials for dye-house machinery; Centrifugals for handling corrosive materials; Protective paint for water tanks; Concrete as a chemically resistant material of construction; Some static duration tests on metals and alloys; A table showing the comparative resistance of mild steel, chromium steel, and chromium nickel steel to various reagents.
—B.C.I.R.A.

Nickel Alloy Singe Rollers: Corrosion. J. T. Travis. *Amer. Dyestuffs Rep.*, 1926, **15**, 601-605.

Instances of corrosion of nickel alloy singe rollers have been traced to the action of zinc chloride present as a size ingredient. The corrosion is facilitated by. the higher temperature at which the rotary singers can be run. —B.C.I.R.A.

Oil Extraction Solvents: Properties. L. C. Whiton. *J. Oil and Fat Ind.*, 1926, **3**, 336-342.

The properties of petroleum ether, gasoline (motor fuel), refined gasoline, ether, benzol, ethylene dichloride, a mixture of 75 per cent. of trichlorethylene, and 25 per cent. of benzol, a mixture of 30 per cent. of carbon tetrachloride, and 70 per cent. of refined gasoline, trichlorethylene, and carbon tetrachloride are discussed from the point of view of their value as solvents in the commercial extraction of oil seeds.
—B.C.I.R.A.

Moscow Textile Institute. F. Tobler. *Faserforschung*, 1926, **5**, 269-270.

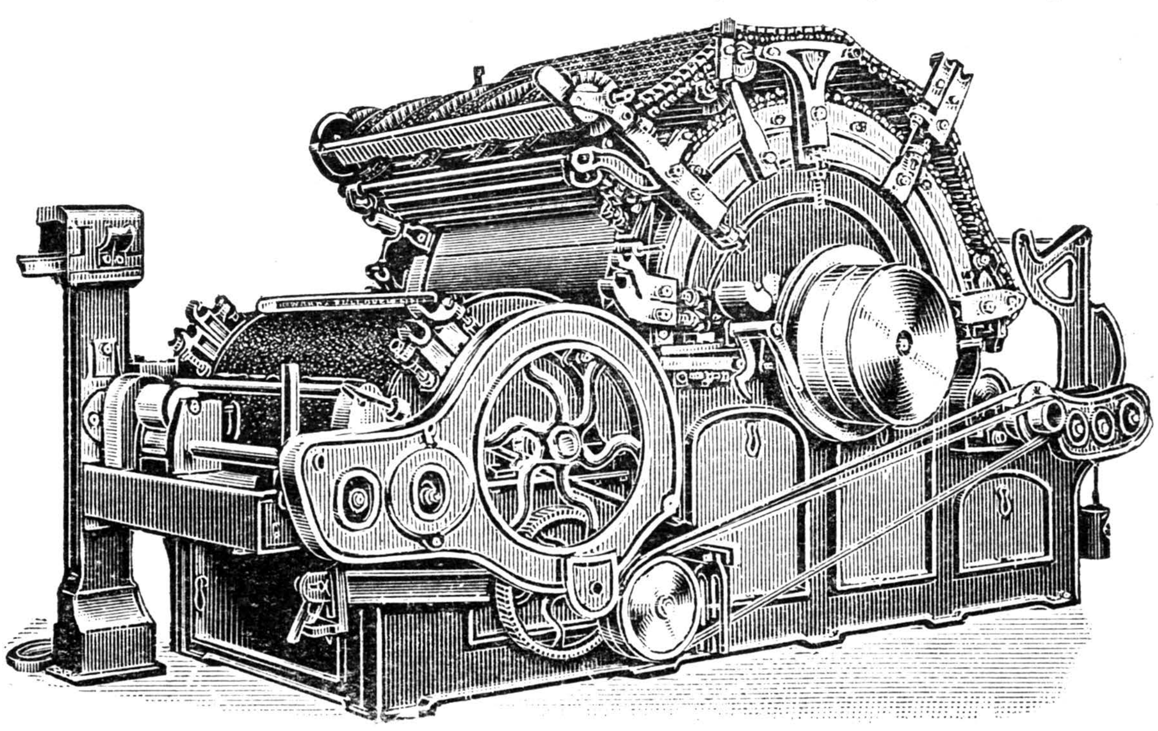
The curriculum of the Moscow Textile Institute as described covers all branches of science and textile technology.
—B.C.I.R.A.

Research and the Merchant. W. H. Gibson. *Belfast Ch. of C. J.*, 1926, **4**, No. 7, pp. 102-105.

In this article the writer points out that although it is quite logical when forming a programme of research on linen to begin with the raw material and follow it through all the processes of manufacture and to endeavour to bring quality up and cost of production down, it is equally logical to begin with the human needs on which the existence of the linen trade depends and to work back from these to the raw material used to satisfy them. If the problems of the linen trade were looked at from the latter point of view, the interest of the merchant in research is as direct and vital as that of the farmer, spinner, weaver, or bleacher. The supreme problem, in the linen as in any other trade is to give the consumer what he wants. In order to put in hand research work to meet the demands of the markets, these should be studied by the researchers themselves. A survey of the present position should be taken in order to discover what the consumer is buying and, if possible, what he has bought in the past few years. The information would tell us what the consumer has chosen out of the selection of linen goods submitted to him. As a result of research work standardisation of goods could be effected and then the next step would be to educate the public regarding the merit of the goods and thus concentrate demand on these goods. In order to make research work on merchanting really effective it must be carried out on a co-operative basis and data taken from the trade as a whole so that sound conclusions may be drawn. The study of the requirements of the market is really the controlling factor in all industrial research, since consideration arising between the salesman and his customer leads to modification of other portions of research programme. Scientific research can assist the merchant directly by enabling him to give the customer the maximum of service for his money. This can be accomplished by establishing what are the valuable and the desirable qualities to be supplied in each particular class of goods and indicating the simplest way to provide these qualities. The article is illustrated by two diagrams, one showing the record of monthly export of linen goods, bleached and unbleached, from the United Kingdom for a period of five years. The second curve shows that linen stands alone among textiles in becoming markedly stronger when wet or damp, which means that linen alone acquires strength to enable it to endure the trials of the modern laundry.
—L.I.R.A.

Psychrometers: Study. A. Svensson. *Sci. Abstr.*, 1926, **29A**, 539 (from *Meteorolog. Z.*, 1926, **43**, 140-146).

The author gives a formula for the ventilated psychrometer, indicating the range of wet and dry bulb temperatures, of temperature difference and of relative humidity over which it holds. The mean limits of error of observation are $\pm 0{\cdot}12$ mm. Examination of several kinds of material surrounding the wet bulb indicates that the thickness, texture, flexibility, and previous treatment of the substance are important. A stocking-shaped cover is recommended for the thermometer bulb of the Assmann psychrometer, to be supplied by the maker to secure uniformity. Allowance has been made in the formula for radiation and ventilation. The Sondén's hygrometer is especially recommended for use as it is based on the physical laws of mixed gases and gives results agreeing well with Regnault's historical values for vapour pressures. —B.C.I.R.A.

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