Vol. XVII. No. 10 OCTOBER 1926

The Journal of the

TEXTILE INSTITUTE

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THE TEXTILE INSTITUTE
ST. MARY'S PARSONAGE, MANCHESTER

THE
TEXTILE INSTITUTE

NOTICES: INSTITUTE MEETINGS

Tuesday	9th November	*Manchester*—2.45 p.m. Meeting of Publications Committee, at the Institute.
Wednesday	17th November	*Manchester*—2.45 p.m. Meeting of Council, at the Institute.
		Lancashire Section
Friday	5th November	*Manchester*—12.45 p.m., Luncheon; 1.15 p.m., Lecture on "Impressions of Recent Visit to Italy," by Captain Sherston, at the Institute.
Friday	19th November	*Preston*—7.30 p.m. Lecture on "Artificial Silk; Relative Tensile Strengths and Tension during Winding &c.," by A. L. Wykes, B. Com., at the Harris Institute.
		Yorkshire Section
Thursday	11th November	*Bradford*—Lecture on "A Comparison between the Judgments of Individuals skilled in the Textile Trade and the Natural Judgments of Untrained Adults and Children," by Henry Binns, F.T.I.
		London Section
Wednesday	24th November	*London*—7 p.m. Informal Discussion on "Household Linen," by D. Anthony-Langsdale, at 38 Bloomsbury Square, W.C.1.
		Other Organisations
Bradford Textile Society—		
Monday	1st November	*Bradford*—7.30 p.m. Annual Address by the Rt. Hon. Arthur Michael Samuel, M.P., Vice-President of the Board of Trade Council, Department of Overseas Trade, at the King's Hall.
Monday	8th November	*Bradford*—7.30 p.m. Lecture on "Selling Problems," by Miss Gladys Burlton, B.A. (London), at the Midland Hotel.
Wednesday	17th November	Visit to the Branxholme Combing Co.'s Works, Bailiff Bridge (by kind permission of Sir William Bulmer).
Monday	22nd November	*Bradford*—7.30 p.m. Lecture on "Problems of Fine Cloth Weaving," by George Shackleton, A.T.I. (Queensbury), at the Midland Hotel.
Halifax Textile Society—		
Wednesday	10th November	*Halifax*—7.30 p.m. Lecture on "Carding—Its Function in the Making of Cotton Yarns," by J. Hanson (W. Hanson & Co. Ltd., Halifax), at the White Swan Hotel.
Wednesday	17th November	*Halifax*—7.30 p.m. Lecture on "Woollen Yarn Making," by T. Lawson (Huddersfield), at the White Swan Hotel.
Friday	19th November	*Halifax*—Whist Drive and Dance at the Cafe Royal.

Batley and District Textile Society—

Thursday	11th November	*Batley*—7.15 p.m. Lecture on "Wools for the Heavy Woollen Trade," by S. B. Hollings, F.T.I. (Bradford), in the Lecture Room of the Public Library.

Leigh Technical School Union—

Wednesday	17th November	*Leigh*—7.15 p.m. Lecture on "Ring Spinning Frame," by H. Lord (Platt Bros. & Co. Ltd.), in the Technical School, Railway Road.

Oldham Technical Association and Old Students' Union—

Saturday	6th November	*Oldham*—7 p.m. Lecture on "The Technics of Case Hardening," by John Riley, A.M.I.C.E., A.M.I.M.E., in the Municipal Technical School, Union Street.
Saturday	27th November	*Oldham*—7 p.m. Lecture on "Grinding Machinery," by Thos. R. Shaw (Churchill Machine Tool Co.), in the Municipal Technical School, Union Street.

Huddersfield Textile Society—

Monday	8th November	*Huddersfield*—7.30 p.m. Lecture on "Worsted Drawing and Spinning. Recent Investigations relating thereto," by S. Kershaw, F.T.I. (Bradford), in the Large Hall of the Technical College.
Monday	29th November	*Huddersfield*—7.30 p.m. Lecture on "Oleine and its Use in Cloth and Wool Oils," by David Allan, F.I.C. (Price's Patent Candle Co. Ltd.), in the Large Hall of the Technical College.

Nelson Textile Society—

Saturday	6th November	Visit to No. 2 D.R. Cotton Mills (Dunlop's), Rochdale.
Thursday	18th November	*Nelson*—7.30 p.m. Lecture on "Law as regards the Sale of Goods," by Coun. G. Roberts, LL.B.
Friday	19th November	*Burnley*—Joint Lecture with Burnley Textile Society and Burnley Managers' Association on "Some Factors in the Cotton Trade Depression," by S. Watson, F.T.I. (Hyde).
Saturday	20th November	*Nelson*—Annual Social in Oddie's Assembly Rooms, Scotland Road.

APPLICATION FOR MEMBERSHIP OF THE TEXTILE INSTITUTE

I hereby make application to the Council of the Textile Institute for admission to *Ordinary / *Junior Membership of the Institute. If elected, I undertake to observe and to be bound by the regulations (including the provision for three months' notice to terminate Membership) under the Charter and Bye-Laws of the Institute for the time being in force, and to endeavour to further the objects of the organisation.

* *Strike out word not required*

Name of Applicant, in full ....
(block capitals)

Usual Signature..............................

Date ....

Address (for all communications)..............................

Age, and Date of Birth..............................

Business or Profession, and Position..............................

University Degrees..............................

Diplomas or Certificates, other than University Degrees..............................

Membership of Scientific, Technical, or Educational Organisations..............................

Additional Information in support of application..............................

We, the undersigned, recommend the above-named applicant as a fit and proper person for election—

Proposer..............................*Member of the Textile Institute.*

Seconder..............................*Member of the Textile Institute.*

ANNUAL SUBSCRIPTION

The Annual Ordinary Membership Subscription is Two Guineas, and Junior Membership (over 18 and under 25 years of age) One Guinea, both payable in advance. Life Membership of the Institute may be secured, on election, by payment of a sum of not less than 20 Guineas.

CONTENTS FOR OCTOBER 1926

THE TEXTILE INSTITUTE

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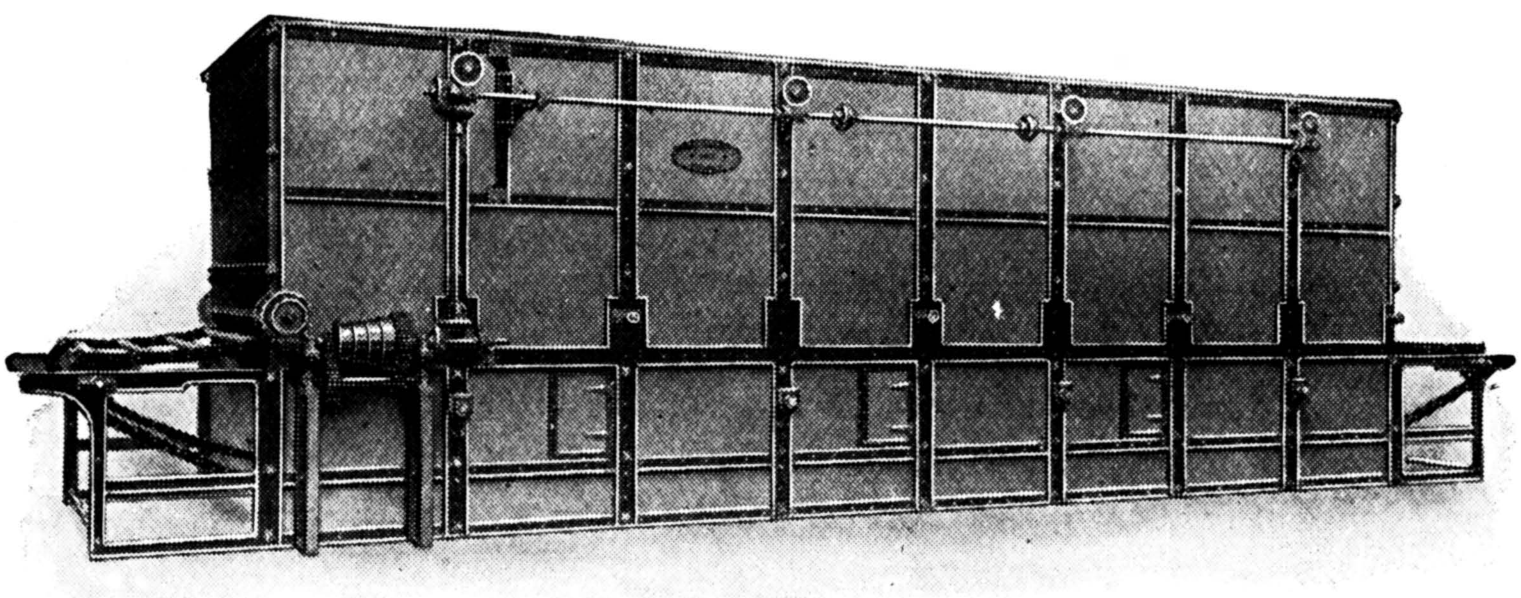


THE JOURNAL OF THE TEXTILE INSTITUTE

Vol. XVII OCTOBER 1926 No. 10

PROCEEDINGS

THE COTTON TEXTILE INDUSTRY IN THE U.S.A.

The first luncheon-hour meeting of the 1926-1927 session of the Lancashire Section of the Institute was held in the Council Room, Manchester, on Friday, 24th September, when Professor W. E. Morton and Mr. H. G. Greg delivered addresses upon the information and experiences they had gained during a recent visit to the U.S.A. Mr. Frank Nasmith presided, and there was a large attendance of members.

The Chairman, in introducing the speakers to the meeting, said that the Lancashire Section was endeavouring to arrange for the giving of a number of lectures dealing with methods of textile manufacture in various foreign countries. It was also hoped there would be a lecture, before the Christmas period, by a gentleman from Kettering upon the subject of "Price Forecasting," while prior to March next there would be one by the Chadwick Trust upon "Industrial Fatigue," and a third by Sir William Himbury entitled "Raw Cotton Supply." The Lancashire Section had tried to map out a very strong programme for the year, and, from the excellent attendance upon the present occasion, it certainly appeared as though they would have a thoroughly good session. The second lecture of the session would be delivered by Capt. Sherston, and was entitled "Impressions of a Recent Visit to Italy."

Professor W. E. Morton said—In planning out our effort for to-day Mr. Greg and I decided that the best thing would be to divide the proceedings into two sections, in the first of which I should deal with the technical details of interest and that he would follow on with points of more general industrial organisation. Obviously, in five weeks' touring one can pick up quite a considerable number of extremely interesting facts, but it is only the more important of these that I shall now be able to touch upon.

Commencing with the first operations of the spinning mills, the most notable feature was the difference in opening machinery compared with what we have in this country; not in the actual machines themselves but in the quantity. The Americans have nothing like the huge combinations of opening machinery one normally sees in spinning mills in this country. They are not very fond of up-stroke beaters. They have down-stroke beaters and a scutcher and laphead, and then only one finishing scutcher. Their mixing is done by the stack method for what they consider to be medium counts and for what we consider to be fairly low counts, 36's and 40's. They have their mixing bins in separate buildings from the blowing room, and the material is conveyed by pneumatic trunks. By that means, they avoid having to pay rather high insurance premiums. The reason for the small equipment in opening may possibly be found in the type of cotton used. We expected when we went there to find the same kind of cotton one uses in this country. We asked "What is this cotton ? " They said "That is Arkansas, Texas or Memphis cotton." In some cases we saw local cotton. But it never seemed to be the same as the "Arkansas," "Texas," or "Memphis" cotton that we use in this country. The difference is possibly rather hard to describe, but it has a rather harsher, harder, and more wiry "feel," and I should imagine it would be a much more easily cleaned cotton, which may account for the reduction possible in opening and cleaning apparatus. The "Crighton" opener was not much in favour, but we understand it is rather coming to the front. Also, we saw horizontal cleaners something like those used in the early days of cleaning machine development. Apparently, they were rather afraid to have splitting laps in the carding, because we saw in every case the cards were fitted with a device for avoiding this, which apparently overcame their difficulties. The only other point of interest in the opening and blowing was the supply of air to the fans for the scutchers Normally, they have to put a great deal of humidity into their atmosphere, and it costs them a good deal to do it, so they cannot afford in the more up-to-date mills to have this expensive humidified air drawn through the fans and out into the dust towers. In the case of two mills we found they have special ducts for drawing dust up from the scutchers and out through the fans agaih. In that way, they avoided withdrawing air from a mill which had been expensively humidified.

Generally speaking, the carding was good, light, and relatively slow, but the stripping devices were the "Saco-Lowell" type of stripping, which, by turning a handle, can be turned over either to the cylinder or the doffer. There is no dust thrown out into the room from the stripping processes; it is all drawn away by suction. On the whole, we do not consider it is a very effective method of stripping, though it has an advantage over the "Cook" system in that the waste is better for selling to the waste dealer. In regard to the draw frames, one very rarely observed more than two heads to the draw frames. They seem to run on the system there of cutting down the processes as much as possible, consistent with obtaining good work. I know many people think it will ruin work to cut out either a speed frame or a drawing frame, but for their purposes there must be something in it because they are eminently careful in investigating problems, in which respect they are very much more systematic than, I think, we are in this country. One point was raised by a mill engineer, I think in Greenville. He advocated the use of five ends up for drawings instead of six in order to get a better selvage. I do not know how it would apply in this country, but apparently it would have a use under their conditions. Combing we found extensively used for what we call medium counts, even as low as 30's, especially if used as hosiery yarns, although in one mill they admitted it was probably not as effective as a good carded yarn.

They have very little mule spinning as compared with ring spinning, and, on inquiry, we found that the reasons are two-fold. First, there is the difficulty in getting really skilled spinners, and, secondly, those that they had had strong unions and were causing them trouble. They will apparently sooner put up with spinning reasonably high counts on ring frames than have bother with the unions. The next thing, as I think most people know, is the saddle weighting for all top rollers of the spinning frames. Only in one mill that we saw had they middle top rollers. They are very chary of high drafts, and this particular mill were anxious to go as far as they possibly could with the existing roller arrangement. They were in the middle of their investigation, and I do not know how it worked out. Ordinarily the drafts we saw were fairly high—six to ten.

The frames are nearly always band-driven which they find pays them as they get surer work. They admit it takes rather more power but it has the advantage of surer working in starting in the early morning. We found that the warp yarns were nearly always weft built; that is to say, they had not a straight build on their bobbins. They said this gave easier readying, and there is less likelihood of the unskilled operative pulling the bobbin to pieces, while they get more on the package. I cannot believe that, because if you have the threads crossing over, as one has to have in a weft build, it is inevitable that the package must be softer. They say they get less breakages. They were using large bobbins, up to 8 or 9 inches, bigger than we have in this country at any rate. Before leaving the spinning frames one cannot help mentoning the "Saco-Lowell" spinning frame. We saw one of these. The gearing is at the opposite end to the drive.

The main shaft runs through the tin roller, and the gearing is covered in by doors which can easily be opened; not heavy cast-iron plates which have to be lifted out without much room to do so. The gears are all helical cut, and they consider they get steadier and more regular running with them.

Turning to the sizing, we observed that a very light size is generally used; in no case did we find more than 10% and it is usually about 5% to 7%. Where they were winding on for a multi-coloured warp they wound on through a reed to facilitate drawing in. In their sizing rooms the lack of steam and water was very noticeable. Usually they had huge copper hoods for drawing-off the steam, and carefully designed ducts in the floors for water. On the whole, the rooms were much cleaner than I have seen them elsewhere.

The dyeing is rather interesting. We observed in one mill the complete spinning of dyed stock; that is to say, the material is brought in in the bale, opened, and cleaned with a small amount of opening machinery, and then dyed straight away in a huge cylinder. It is then dried, and spun in the dyed form in their various stock colours. By that means, they are able to get a very level colour, and, as far as weft is concerned, they can cut out one of the preparation processes in winding. We asked if they used oil for making the stuff work rather better but they said "No." Apparently they had tried it and found it did not do any better than mere water. They have a system of spray humidifiers spraying water on to the cotton in the hopper feeder. The next thing about dyeing is the use of "Franklin" dyed yarn for weft. They wind the yarn on to packages, and have it dyed in that form, and then pirn it and use it directly on the weft. The levelling of the dyeing is not good, and it will not do for large quantities of colour, but for pin stripes and narrow stripes the mill people find it quite satisfactory and rather cheaper. In wefts we found a prevalence of chain dyeing followed by pirning on quilling frames, that is, multiple-spindle winding frames.

In the weaving room, except for drop-box looms, dobbies, and jacquards all looms were automatics. We saw two-colour automatics for weaving ordinary two-coloured ginghams, and even in the exceptions to the automatics we never saw an over-pick loom. They were all under-pick, warp-stop motions, even on the non-automatic looms. For what they consider low counts, and below them, they have steel heddles as a rule, and for finer counts the ordinary cotton heald predominated. Another interesting thing in connection with looms appears to be a movement in the South towards the use of a deeper reed, deeper dents, so that they are stronger and less liable to be bent, and, of course, thus form cracks in the cloth. Finishing and making-up are all done in the same mill. Perhaps I should have mentioned before that in every case we saw the whole of the processes from raw cotton to the finished fabric ready for sale carried out either by one mill or by a group of mills working in conjunction.

I will now turn to more general things and deal with the lay-out. First of all, there is the large amount of space available for temporary storage and for rapid internal transport. The importance of this was stressed many times by the managers, and it was evident in every department, and, in particular, the slasher and sizing rooms where they have big gangways and plenty of room for moving things round. They have, in the up-to-date mills, automatic conveyers, and make as much use as possible of gravity feed; that is to say, they start the raw material on the top floor and work downwards. The material is put into suitable boxes, it is carried along to the end of the room along rollers, and then shoots down a spiral shoot on to the next floor ready for the next process. For moving warps to the sizing room, I think I am correct in saying in every case they had overhead mono-rails for taking the materials away, and not trucks on the floor.

The next point is the lay-out of the machines in the rooms. Generally speaking, instead of having the rows of machinery down the length of the room, as we usually find in this country, they have them the other way, across, with shorter and rather less diameter shafts than we have; that is to say, when they use overhead shafting at all. I should say in most cases the machines are individually driven, even the opening machinery and cards, and so on. Then they take very great care in the planning of their lighting systems. In nearly all cases they have the R.L.M. reflector. You can go into the rooms at night without experiencing any uncomfortable sensation due to glare. In one or two machine works or shops we observed the use of mercury-arc lamps. They gave a very good light, two or three feet long, and you can look at them without getting blinded, relatively speaking. Labour-saving devices are adopted practically everywhere. They endeavour to cut out human effort in all details. They avoid having a man whose job it is to do nothing else but push things about on the floor.

In one mill we saw a "Barber-Colman" bobbin winder and high-speed warper. The bobbin winder does all the piecing up. All the operative has to do is to bring along the spare bobbins and put them in the frame and the machine "does the rest" at a remarkably high speed. The high-speed warper runs at a speed of 500 yards per minute or little short of 20 miles an hour and makes an extraordinary good warp, a 31,000 yards of 29's complete, and, allowing for short stoppages, run in 80 minutes. Then we found there is a general use of weavers' knotters in order to save time. There is no hand knotting. There is no kissing of the shuttles. All shuttles have self-threading eyes, and cast-iron eyes are favoured more than the brass ones. There is an extensive use of compressed air for cleaning opening machinery, with nozzle-pressure of 40-60 lb. per square inch. Admittedly, they make a lot of dust in doing it but it does not settle back on the machines. They will go round with the compressed air nozzle for so long, and then sweep away the stuff on the floor. In that connection, there is a very interesting cleaning device used for ring frames; i.e., a blower—a small electric fan—travelling on a mono-rail over all the frames in one room. It consists of two arms down which air is propelled on either side of the frame. It simply moves along the frame blowing dust down. You might say that that stirs up a current of air and makes the dust fly, but it has the advantage that it does not allow the dust to collect, and you are not likely to have slubs and that kind of thing in the spinning, while the dust always collects on the floors.

I would like to mention one or two points concerning technical education. It is evident that America relies almost entirely on its technical development for keeping its place in competition, not only as between the North and South States, but with other countries. Consequently you find the mill men in America have a very much greater interest in the work of their technical schools. The specialisation of the operatives' job makes it such that they cannot draw on that class of people for their overlookers because they do not get sufficiently extended experience, consequenty they rely on the technical schools to turn out overlookers. They admittedly have to go through some sort of experience. They do not come straight from the school to take on the job. The mill superintendents and the executive class rise of course from the overlooker class. Also, the people who are determined to go straight into executive positions attend the technical schools very regularly. Technical education in textile matters is supported wholeheartedly. The Massachusetts Institute of Technology wanted to raise five million dollars for extensions to buildings, and they had four million dollars subscribed provided that they could raise another million dollars in six months. They did it in three months, and they got the five million dollars.

Another point might be worth mentioning; that is the overlookers there apparently take much greater care in the training of new operatives than one finds to be the case in this country; consequently the operations are carried out uniformly throughout the mill and not left entirely to the ingenuity of the operative himself.

Finally, the interchange of ideas is very free, and much freedom in allowing other men to come round their mills is permitted. That applies particularly in the South. Their attitude is this—You can get just as much out of the other man if he goes round your mill as he gets out of you, and it always helps you to discuss your problems with him, and you learn more by going round seeing other people's mills than you do in any other way. At the end of the trip a man asked me if we had had any difficulty in getting round the mills. I assured him that we had not and that we were shown everything, and that in many cases we were told things which were distinctly in confidence but they trusted us. He said, "Mr. Morton, when you get back to your country you might tell your people that; because I tried to get round a lot of mills in your country and I did not succeed in a single case."

Mr. H. G. Greg said—I should like to sketch the methods of production in America, as far as the personnel and their domestic difficulties are concerned. It is perhaps particularly interesting to look at this problem to-day because in America there are two distinct sources of production. You have the Northern mills, the New England Mills round Boston, some of which have been in existence for upwards of 50 years, and the Southern mills which extend practically throughout the cotton-growing belt in Texas, Oklahoma, Georgia, and North and South Carolina. The Southern mills have certain advantages as far as labour is concerned. In most cases their hours of employment are not controlled by any State Laws, whereas in the North they have their own laws, which would roughly correspond to city and urban district council bye-laws in this country, as opposed to Federal Laws, or what we term "laws of the land." There are no Federal laws covering hours of labour in America in the textile industry. The North is now beginning to feel competition from the South where the conditions are rather easier as far as labour is concerned. They have been faced with the problem we are facing at present of the tailing-off of markets and of difficulty in securing business. In one or two cases we heard it mentioned that during the war the capacity of the country to produce textiles had increased out of all proportion to necessity; the capacity of the country to absorb the goods being now much reduced. These people are really out to get business, and they have said "The business is there if we can get it. If our competitors can get it we can get it, and it is up to the best man to get the business, and we are going to be the best men." I will take one particular instance of a mill which they told us would have closed down in a couple of months if it was run on the lines it was two or three years ago. They were literally desperate. Their method of tackling the situation was to get scientists to study their scheme of production. The scientists realised to begin with that the essential thing was to get the work to run well. They realised that there are certain operations such as creeling, doffing, and warp-changing that are discontinuous since each involves periodic replenishment of bobbins, beams, &c. They realised also that if they could stop end breakages their whole scheme would go through more smoothly. The first point they dealt with was the humidity. They proved conclusively, as it had been proved in this country, of course, that cotton spins best under certain conditions of moisture and certain conditions of moisture are more pleasant to work under. In their climate they cannot guarantee humidity at all, and they go in very extensively for humidification and pay great attention to it. In most cases it is done on systems like the "carrier" system, whereby they have all the windows shielded. They keep the workrooms under slightly greater pressure than atmospheric pressure, and they push "doctored" air in; "doctored" to the right temperature and humidity. The air works out through the windows and doors and liftways, and so on. Roughly, I think their figures are about 62% relative humidity for spinning and 82% relative humidity for weaving.

The next point they considered was how best to apportion their labour. I would like to take a spinning frame as an example, because from that we may get their idea which we can then apply to cards and other machinery. The most important thing is the actual piecing up of an end; the most difficult operation to perform. They, therefore, took the number of frames they had, after they had satisfied themselves the work was running well. They discovered how many breakages there were per day, and how long it took a particular individual to piece up a particular end. They found out how many ends per diem an individual could piece up. They then worked out how many frames would give that individual just that number of ends to piece up. They realised it was a waste of time having that individual dusting, seeing to broken bands and tapes, and creeling, and that it was a less-skilled job which could be done by someone who was paid less wages. They found that all the subsidiary operations like creeling, oiling, and banding could be mapped out. Therefore, we get the extraordinary position of one spinner minding up to 24 ring frames, but we must realise that he or she only pieces up ends and does not do the whole operation.

Another way in which they have been able to economise is by grouping their mills together in big federations with a central clearing house for the receipt of orders, so that the various orders can go to the mills most fitted for their production. This enables individual mills to keep to very few counts of yarn and to plan out their production between their opening, cards, drawing frames, combs, down to ring frames and looms, so there was no bunching of roving in one place and no lack of intermediate bobbins in another place. In one intermediate frame the bobbins in a creel were dressed like a regiment of soldiers. At one end the bobbins were full, half way down part full, and at the other end empty. The creelers knew exactly at any minute of the day which particular frame they should be creeling and which particular frame would be next to creel. They were there with their barrels, and took the empty ones out and put full ones in. All frames had special doffers for the job—intermediate, jack frames, and spinning frames. All the organisation, of course, is based fundamentally on piece rates of wages. The spinner was paid on the production of the 25 frames minded, the doffers were based on the 20 or 30 frames they doffed, and creelers were on exactly the same basis. In every case where piece rates have been established the work has been split up so that the operative can produce more than before piece rates were established, and the operative has been given a very material benefit upon increased production. For instance, by the splitting up of labour one spinner, instead of minding two or three frames, doing creeling, piecing and everything, would turn out very much greater weight of yarn on 24 frames. She did not get the full advantage of the production of 24 frames as if she had creeled and cleaned them but she did get a very material advantage. This brings about a very curious point of view. When they start piece rates, first of all, they have to establish a basis of average earnings for a spinner. They then base the piece rate so that the spinners may get 10% or 20% more wages than on a day rate if they do a stated and reasonable amount of work. Whereas the day rate was 60s. a week, they are now earning 80s. a week. Any further piece rates will probably have to be based on the 80s. and they will probably get 120s. What will happen after two or three generations of that sort of thing having occurred I do not know, but that is one of their problems.

The present situation in America is interesting in most cases where automatic looms have been started, and where this entirely new method of splitting up work is concerned. There have been strikes, the workpeople saying that the mill owners are trying to get the better of them, and that the conditions meant starvation for them. A strike usually lasts from one month up to nine or ten months. In America if they have a strike they let it go on. They believe that after a time the strike will be over and the workpeople will come back on the owners' terms. But the mill managements are now going in more and more for the policy of educating their workpeople and of taking them into their confidence. They are finding it a tremendous advantage to do so. The managements are only too glad to have a quiet talk over the table in the evening with their workpeople while they all smoke their pipes. They explain their difficulties, how their production is too costly, and point out the mutual benefit of adopting a new system. The workpeople, nowadays, instead of being suspicious, appreciate the point of view of the management. They appreciate that the management are not altering the scheme of things purely for their own benefit, but that there is a very material benefit also to the workpeople. They are giving the management their wholehearted support in consequence.

In the Northern States the workpeople are of many races, comprising practically every nationality. You can go into some mills and see notices posted up in from four to ten different languages. There is not the same solidarity of labour by any manner of means that there is in this country. If one mill goes on strike the mill next to it has not the least compunction in taking in their workpeople or doing all their trade. They look upon the situation in this way—"Well, these people are more stupid than we believe ourselves to be. We treat our workpeople well. They will stand by us. If they are unlucky, and cannot go on without a strike, and it is any benefit to us, we shall take the benefit."

Another point about the labour situation is the extraordinary fluidity of labour. If a man has been a cabinet maker, and he finds that from some cause or other cabinet making work is not available, he will turn his hand to something else. He may go for a short time to a technical school during the daytime, and he will keep himself by taking a night watchman's job or working an elevator during the night, which seems to be the stock job for anyone who gets the "sack." Then he goes to a mill. He will go through the hands of the overlooker, who will go to great pains to teach him the proper way to do things. If they can make him do things they will keep him; if they cannot then they have not the least compunction in dismissing him. Their method of determining a man to be what he claims to be is to see him at it. If there is a blockage through one operative being slow, they will go to considerable pains to investigate the case and to see if the work is right, if the frames are most convenient for the height of the worker, or if the light is wrong. Then if they are satisfied that they cannot increase the production of the operative through mechanical means they resort to dismissal. Owing to the relative scarcity of labour anyone who is "sacked" from one job can get another job without difficulty if they have really the will to work.

Another point to which they pay great attention is advertising. They like to produce what is most suitable to them, and they plan out their mills to produce it easily and very cheaply. They go to great pains in advertising their products in order to get buyers to say "The stuff you are making is just what I have been looking for."

It has already been mentioned that a mill likes to do all its blowing, spinning, dyeing, weaving, bleaching, and finishing under one roof. That enables the management to secure a balanced working and to retain the profits from the intermediate processes. It enables the spinner to appreciate the weavers' difficulties with their yarns, and the spinner is able to rectify any faults and make the weavers' work easier. The finisher gives advice to the spinner. The whole thing is very much quicker in its cycle. If you have the whole thing under one roof you can push the spinning and weaving through quickly and get on to the finishing, whereas if it is split up the finisher may have a lot of work in from somewhere else and there is a stoppage. They have recently adopted a system of "selling houses" by means of which they are enabled to get in direct touch with the customer, and thus enable the manufacturer practically to have his own finger on the market's pulse. That is almost as big a development as any that they are going in for.

The conditions in the South both in respect of results or methods of production differ greatly from those in the New England mills. There are no mill towns in the South. There are no "Stockports" or "Boltons" there. When people build a mill they also build a town for their operatives. Not only do they build the houses that the operatives live in but they build a school, a church, and very likely a technical college; there is nothing in the village except the mill and the operatives. The mill runs its own baseball team, its own cinema, and they rent their houses approximately at a rate of one shilling per week per room. Therefore, they have a pretty good control over their workpeople. The workpeople cannot move into another town or into another house because it is all controlled by the management and there they have to stay. The management are complete despots but they are most philanthropic. In every case that we saw the mill villages were clean, the houses were in good condition, the operatives were happy and contented, and were being looked after by the management as well, and probably better, than they could have looked after themselves. In the mills the scheme of production is following fairly rapidly that of the New England mills; in fact there is a great tendency for the New England mill owners to build a mill in the South and overcome the difficulties of mixed labour that they have in the North. We were told that we would see negroes and children working in the Southern mills but that is a big mistake. A white man will not associate with a negro at all in the South, and the control of child labour, not by any Statutes, I think, but by mutual consent, is such that there are no young persons employed at all. Their production costs are considerably less in the South owing to the simpler life the operatives lead. They do not, of course, earn such high wages, because they have not increased their efficiency by piece rates and splitting up of production to the extent as the North has done, but they are a considerable source of competition to the North.

In conclusion, I wish to endorse what Professor Morton has said. The kind way in which we were received almost made us blush. You had practically only to turn up on a doorstep and they would greet you, invite you in and put you up for the night. The people there are always having conventions, and they go to great pains to attend them all, and they discuss their views with great freedom. As soon as a man has a new idea he goes and tells his neighbours about it at a convention, while he himself receives perhaps a dozen new ideas from other speakers, so that the exchange is a profitable one from his point of view.

Mr. John Crompton, in proposing a vote of thanks to the lecturers, said that what had been told them brought vividly to mind things that he himself saw in the States some years ago in company with Mr. Greg, Senr. There was ample food for thought in what had been told them. With regard to the exchanging of ideas at conventions which had been referred to, this was a system which the Textile Institute were really endeavouring to adopt by the holding of their luncheon-hour meetings. If there was a free interchange of opinions at such meetings then some of the objects for which the Institute was established would be achieved. It was very interesting to learn that their American friends went to the colleges for their foremen. It was quite correct to state that the trade unions in America were not so strongly established as those in Great Britain. It was necessary for both employers and trade unions to work together in harmony for mutual benefit, and then the workmen would receive the full measure of reward for their labour.

Mr. Fielden briefly seconded the vote of thanks, and it was carried by acclamation.

Yorkshire Section

Meeting held in the Council Chamber, Town Hall, Bradford, 7th October 1926, *The Mayor of Bradford (Alderman Joseph Stringer) presiding.*

ADDRESS ON SOME MODERN ASPECTS OF TRADE AND INDUSTRY

By the Rt. Hon. PHILIP SNOWDEN, P.C., M.P.

Having been introduced by the Chairman, Mr. Snowden said he proposed to speak on some of the wider aspects of trade and industry. He did not bring them a panacea, the immediate application of which would restore trade and ensure prosperity. It might be profitable, however, to consider the principles upon which rested industrial prosperity. There was a feature of the present industrial and economic situation which was perplexing students of the subject. There had been for some years a registered number of unemployed never below

1,000,000; wages had declined in the aggregate by £500,000,000 a year from the peak figure of 1920; the export trade was only three-quarters of the pre-war figure. Yet, in spite of this, the general standard of living was probably never higher, except during a brief period of the war. The amount of money spent in amusements and upon holidays was increasing; 30,000,000 people attended cinemas every week; there were over 2,000,000 homes with wireless installations. These expenditures were recent developments. The figures of savings banks, building societies, sales and membership of co-operative societies were expanding. The profits of retail stores were never higher than to-day. One firm manufacturing cheap motor cars was turning out a new car every two minutes of the working day. The country was being covered by a network of motor 'buses, and tens of millions of people were patronising that means of locomotion. The amount of expenditure on drink, though the amount of liquor consumed was less, was twice the 1914 figure. What was the explanation of the paradox? Unemployment was confined in the main to three or four of the great export trades. He did not think the unemployment figure was very greatly in excess of the actual number of unemployed at times of severe depression in pre-war days. The cost of living had fallen from the peak figure of 325 points to 74 points, and if they took industry as a whole they would find that the reduction in wages had approximated very closely to the reduction in the cost of living. That applied in particular to the two classes of unemployment known as sheltered industries and unskilled labour. What was the explanation of this obvious higher and better standard of living? It was to be found in the fact that in recent years there had been large grants from public sources towards certain social services. The working class was being helped in this way to the extent of £164,000,000 a year.

Proceeding, he said the huge sum of £308,000,000 per year was being paid in interest in War Debts, and this was, in fact, a transference of purchasing power. It was robbing Peter to pay Paul, but the fact remained that the Peters and the Pauls were to a very large extent the same people. There were two powerful and serious economic arguments against the interest on the War Debt. The first was that the interest on this debt went in the main to the people who would not spend it on the patronage of the staple industries of the country—it went mostly to the luxury trades. The other argument was that the War Debt lowered national credit, kept up the price of new capital, and was a detriment to trade and industry. Anything that could be done to increase the purchasing power of the people of this country was a direct encouragement and stimulus to trade.

Turning to the depression in the export trade, Mr. Snowden said that for the last eight years it had been a matter of constant surprise to him that, bad as our foreign trade had been, it had not been infinitely worse. The four main causes of the depression were—(1) the decreased purchasing power of the countries that were formerly the customers of the manufacturing nations; (2) the political instability which had followed the war; (3) the exchanges; and (4) the want of capital. Alluding to the return of the gold standard, he said he thought it was done too hastily, and this was not good for a country. The deflation was carried out too rapidly. These were some of the temporary and, he hoped, passing influences which were preventing the recovery of world trade. Dealing with what he described as influences of a more permanent character, Mr. Snowden said we could no longer hope or expect that Great Britain would have a monopoly of the world's trade. Other countries were becoming industrialists, and were dealing with the manufactures that needed no great amount of technical skill. Great Britain would have to rely very largely for its foreign trade on devoting energy and enterprise to the production of high-class goods. An examination of the table giving the exports per head from the United Kingdom to the countries of the world showed a striking disparity between the volume of goods purchased by these countries. It was the countries with a high standard of living which were our best customers. The fact that the British Colonies were our best customers was not alone due to the fact that they were our own kith and kin. Two other reasons were that they had borrowed largely from the home country, and their exports were to a considerable extent the payment of interest on these loans; and that they had a high standard of living.

Mr. Snowden went on to point out the increase in the volume of world trade that would result from the raising of the standard of living in such countries as India, China, and Africa. In regard to India, he said that the exports were 5s. 3d. per head of the population. If the purchasing power of the nation were raised by a penny per week, India would take £60,000,000 more than she did at the present time. They must look to the countries where the standard of living was still low for the expansion of world trade. They were hardly yet at the beginning of the world trade; it was in its infancy. The development would be comparatively slow, but it could be done. One of the most serious barriers was the tariff. In the last few years, 25 countries had modified their tariff rates and in practically every instance the alteration had been an increase. This was due to the ineffectiveness of tariff barriers to protect the home industry, and to the idea that it was a good thing to make the country into an independent economic unit. The country with a tariff constantly needed to raise the amount of the tariff and that was itself conclusive evidence of its ineffectiveness to attain its object. Tariffs stimulated the competition of world-rivals. The desire to make the country an independent economic unit arose from a delusion. They did not realise that trade was an exchange of commodities. The same delusion was behind the slogan, "Buy British Goods." There was no country in the world where the uttering of a slogan like that was likely to be so disastrous to trade. A statement was made by the President of the Board of Trade recently that every time one bought a foreign article one deprived a British workman of a job. No statement could be more foolish or more grotesque. Suppose the foreigner took up that position, where would the British export trade be? He did not think the Governments of this country had done all they might have done in the way of bringing pressure to bear upon other countries to reduce their tariffs. He thought Government action ought to be taken to refuse to let London be an open market for the raising of capital for foreign countries unless some reciprocal advantage was given in the way of a reduction of tariffs. He thought much could be done through the League of Nations and the International Chamber of Commerce to bring about an international reduction of tariffs. The greatest of all the barriers to international intercourse was war. He believed there was going to be trade enough for everybody, but peace at home was vital and essential. "If we are going to have a succession of industrial disputes, there is little hope or prospect of the progress I believe it is possible to realise. The obligation to avoid industrial trouble is not imposed on one side or the other. It is an obligation on both sides. I hope there is a growing appreciation, both amongst workers and employers, for the maintenance of industrial peace, and this can only be done by doing justice all round. The employer must realise that there must be a progressive improvement in the standard of life of the workers, and that it is fatal to try and reduce costs by attacking wages. That is the worst policy that could be adopted.

In conclusion, Mr Snowden said the present coal dispute was due to the inefficient handling and use of coal. We could not have a satisfactory settlement of the coal problem unless we eliminated the waste involved in our present methods of dealing with coal. (Applause.)

On the motion of Mr. John Emsley, seconded by Ald. W. Turner, a hearty vote of thanks was accorded to Mr. Snowden.

Joint Meeting with the Batley and District Textile Society in the Batley Public Library, 30th September 1926: Mr. T. C. Taylor, J.P., being in the chair.

Opening the proceedings, Mr. Taylor said that upon the head of a woollen manufacturer's business rested the responsibility of seeing that a very great variety of processes were competently managed. In their trade, at least, there was never a piece of cloth which had not to pass through the hands of at least twenty different persons before it got to the merchant. He could not imagine any business in which the team spirit was so necessary as in theirs. The securing of competent managers and foremen for such a variety of departments was itself no easy matter for the head of the concern, and the two qualities necessary in every manager were personal fitness to manage men and technical knowledge. Some men possessed the first of these qualities and others the second, but very few possessed both. While not everyone agreed with him, continued Mr. Taylor, that the profit receivers should share their profits with the workers, there were many firms who took a real interest in their workers, and if they did so the workers knew it. Only if the employer did his best for his workpeople, could he expect them to do their best for him. Employers must make those under them see that it was in their interest to do their duty, and should try to make it their pleasure too. They must employ the heads and hearts of their workers as well as the hands. Recent observers from this country of industrial relationships in the United States appeared to agree on the absence of "ca-canny" in American industry. Employer and employed appeared to co-operate in securing the largest possible amount of production. Real wages were high and there was an absence of "that ignorant and mischievous doctrine that we can get more by producing less." He then asked Mr. G. Garnett, a Vice-President of the Textile Institute, to deliver his address.

After thanking the Yorkshire Section of the Institute for the invitation to speak before this meeting, Mr. Garnett said that in his opinion, and in the opinion of others, we have rested too long on our laurels, and that apart from economic factors, which are more or less international in their effect and, therefore, less controllable by ourselves, other nations were successfully competing with us in securing a much greater proportion of the world's markets than formerly. He therefore proposed for a short while to attempt a brief survey of what was being done at home to meet these external competitive conditions. He first wished to deal with advances in the scientific investigation of industrial problems from, of course, the aspect of the wool textile industry. The underlying principles of technical processes were to a considerable extent known and understood by our forefathers, and a measure of the success they achieved is to be found in the number of people normally employed in the industry, namely, 300,000. Natural facilities, as well as inherent aptitude, had helped them to be first in the field, and though to a great extent these advantages are still our inheritance, they are not in themselves sufficient to keep us in the premier position. In 1918, under the guidance of the Department of Scientific and Industrial Research, the British Research Association for the Woollen and Worsted Industries was formed to deal with pure research, with investigation of specific problems, and to give technical and scientific assistance to members of the Association. Such work had been needed for some time, but it was only by the formation of an association of firms that it was possible to meet the cost. He had no hesitation in saying that the Association had justified its creation and had only to refer to such investigations as "Electricity in Wool," "Causes of Colour Fading," "Standards of Regain," and "Migration of Alkali in Damp Scoured Cloth," to illustrate the important character of the work done and of the information given to subscribing firms. On the mechanical side, the Stroboscope had revealed the irregular speed of spindles, a contributory cause of yarn imperfections, and thrown thereby much light on the causes of faults previously unknown. He felt, too, that of particular interest to the Batley district, would be the experimental carding set now running at Leeds on various types of blends. From this set, mechanical improvements which should have far-reaching results were confidently expected. All this, said Mr. Garnett, involves much work, time, and patience, and could only be continued if it had the whole-hearted support of the trade. The income of the Association would have to be considerably increased in order to comply with the conditions upon which the Government grant was now being given.

To let the work of the Association diminish or die of starvation would be sheer madness, and would be equivalent to leaving the field to our competitors.

Mr. Garnett, proceeding, said that he was confident that an *esprit de corps* was now definitely discernible in industrial life. It was eminently desirable that those engaged in industry should be imbued with a sense of fair play, should recognise the rights and privileges of others, and should believe firmly in joint action for the common weal. Such a spirit he felt now definitely animated industrial life and found practical expression in the welfare schemes with which all would be familiar. The establishment of dining rooms, sports grounds, savings clubs, and pension schemes, all served to prove that those in control of our big industries realised the value of anything that might bring into closer contact all sections of masters and men. Such movements as those of the boy scouts and girl guides played their part both in industrial and in civil life in helping those concerned to realise the value of team work. Not only did these considerations make for greater personal efficiency and better quality of work, but they resulted in a fuller knowledge of others, coupled with a sense of interdependence and a recognition of the value of co-operation. Speaking of the development of trade unionism in industry, Mr. Garnett said that though the trade union must be recognised as an integral part of the constitution of industry, he was afraid that trade unionism had developed upon lines destructive rather than constructive. It cherished prejudices directly contrary to that spirit of fair play and mutual confidence for which he was pleading. Both Capital and Labour appeared to wish to divert attention from their own faults by overemphasising the faults of the other side, and it was not until both sides would look their own faults plainly in the face that industry would be relieved of the dead weight of mutual suspicion and mistrust. He referred to the different state of affairs in the United States, but said that he hoped in this country we should go further—as was, he thought, our habit—and achieve a wider perfection.

The grant of a Royal Charter of Incorporation to the Textile Institute, said Mr. Garnett, may be said to have marked the beginning of a new era in textile technological qualification. Under the Charter, a diploma scheme was in course of establishment and members of the Institute whose qualifications were accepted as satisfying the requirements of the Institute's bye-laws might receive Diplomas of Associateship or Fellowship of the Textile Institute. In brief, this meant the creation of a new post-graduate qualification and distinction. This should prove a powerful incentive to young men in the industry to continue their training and not to mark time in relation to textile technology during their early years in the textile industry. He was pleased to say that Mr. J. H. Lester, Chairman of the Selection (Diplomas) Committee of the Institute, was present, and would deal at greater length with the scheme. In conclusion, he wished to re-emphasise that in his belief the lines of development along which the industry should make every effort to progress were those of scientific research, of closer co-operation and mutual goodwill between all concerned, and of higher technological qualification.

Mr. Lester, being called upon to address the meeting, described in detail the methods by which the diplomas of the Textile Institute could be obtained and paid a tribute to the work of Mr. John Emsley in obtaining the Royal Charter for the Institute. The textile technologist, he said, was someone acquainted not only with the science but with the art of textile manufacture. It was a case of the combination of theory and practice, and they did not say the one or the other was supreme. The industry in the past had been built up, not on science, but on art, on rule-of-thumb, on the cleverness of their forefathers. They would be unwise to abandon that heritage and to submit to the dominance of science. Describing the "royal road" to Associateship of the Institute by way of the universities, Mr. Lester said that unfortunately few of their students could enter the door to the university even after passing the matriculation examination. Though they might obtain a County Council grant which would provide for their fees, they had not always the means of obtaining the necessary money for their maintenance. It was, he thought, a disgrace to the country that so small a proportion of the poorer members of the community could possibly obtain scholarship and maintenance grants to enable them to go forward to the universities. He felt that the textile industry to-day was not in a healthy condition and he was not inclined to be optimistic for the future. The student of to-day by no means utilised, as he might, the facilities that were provided for him and that enabled him to lift himself above the common level. Moreover, with many notable exceptions, it must be admitted that as regards the directorate and management of by far the larger part of the mills, the training which the heads of the concerns had received was not such as they should really have had.

Mr. John Emsley, referring to his own work for the Textile Institute, said that any man who had benefited by his industry ought to put something back into the industry. It had been a privilege to him to have been able to take part in the securing of the Charter. Unlike Mr. Lester, he was rather optimistic. We had had what was really a revolution in this country; we had had to decide whether we should be ruled by order or by mob law, but when we got over these troubles there was a great future for this country. The spirit between man and man would be better, and both employers and employed would benefit.

The interesting discussion which followed was terminated by a vote of thanks to the speakers, proposed by Mr. C. Varley and seconded by Mr. N. B. Radcliffe.

South of Scotland Section

Meeting at the Technical College, Galashiels, on Thursday, 30th September 1926.

ARTIFICIAL SILKS—PREPARATION AND PROPERTIES

At this meeting, Mr. Ninian Kemp occupied the chair, and there was an excellent attendance, considerable interest being evinced in the special display of yarns and fabrics which had been secured by the Institute. Exhibits had been kindly lent by Mesrs. Courtaulds, Ltd., and the Celanese Company, whilst a general collection was forwarded by Mr. P. E. King, of the Department of Dyeing, Leeds University. Exhibits of fabrics showing cross-dyeing effects were supplied by the Research Department of the Bleachers' Association. The interest in the display was so marked that the collection was allowed to remain available for inspection for a few days.

The Chairman, introducing the lecturer, Dr. J. C. Withers, of the British Cotton Industry Research Association, said he was sure everyone there would be anxious to hear what Dr. Withers had to say in regard to this important development in the textile industry. He than asked Dr. Withers to address the meeting.

The Lecturer explained that whilst most of the many valuable papers which had been read before audiences of textile workers during the past few years dealt exclusively with dyeing or emphasised the merits of the products of a particular firm, he would attempt to give a review of the whole field and discuss such ascertained properties of the various artificial silks as were important in their application or would serve to distinguish one from another. After a short historical introduction, he gave an outline of the processes underlying the manufacture of the four main types, namely, Chardonnet, cuprammonium, viscose, and cellulose acetate silks, pointing out those stages which require careful control and which profoundly affect the quality of the final product. He explained that the first three types are really cellulose, differing considerably in physical properties, but only slightly in chemical properties, from cellulose as found in well-scoured cotton, whereas cellulose acetate silk is chemically quite distinct, being a compound.

Dr. Withers then explained the denier system of counts and gave examples of the wide range in the number and dimensions of single filaments in threads of about the same counts, showing that the appearance and feel of real silk are more nearly approached by threads composed of very many slender filaments. He then reviewed what was known of the microscopic appearance, tensile, optical, and other properties, quoting largely from the published researches of the Forschungs Institut für die Textilindustrie, Dresden. It was explained that certain measurements made on cross-sections can be used as a distinguishing test between artificial silks, whilst the actual outlines of the sections often afford a clue to the nature of the spinning baths used in their manufacture. More simple chemical and physical tests were summarised. Moisture regain and the serious effect of moisture on the tensile properties of artificial silk were also discussed.

Difficulties in sizing, winding, and weaving were briefly mentioned, and it was explained that defects due to variable tension are magnified enormously with such lustrous materials. Actual examples of lustre faults in fabrics were exhibited, and the use of photography and the microscope in examining them was described. Finally, brief references were made to the dye affinities of the various types.

On the motion of Mr. R. S. Hayward, Dr. Withers was heartily thanked for his services.

The General Secretary of the Institute contributed a short statement in reference to the Institute's Diploma scheme, and moved a vote of thanks to the Chairman, which was carried by acclamation.

CONFERENCE OF REPRESENTATIVES OF TEXTILE SOCIETIES AND KINDRED ORGANISATIONS

Visit to Blackburn Technical College

A conference of representatives of Textile Societies and Kindred Organisations of Lancashire, Yorkshire, and the Midlands, took place at Blackburn Technical College on the afternoon of Saturday, 9th October. Over fifty delegates were present and were welcomed by Mr. J. W. Marsden, J.P., Chairman of Blackburn Higher Education Committee, by Mr. Charles Tate, President of Blackburn Textile Society, and by Mr. J. H. Dawson, President of Federation of Textile Works Managers' Associations.

Introducing the discussion on "The Work of Textile Societies and its relation to Technical Education generally," Mr. J. H. Dawson, of Brierfield, said that the public spirited organisations represented at that conference exerted a wonderful influence on technical education in regard to the textile industries. The whole atmosphere of textile societies was one of technical education. There were 33 societies represented and the total membership was over 10,000, which certainly indicated the potentialities of the movement. Some of the societies had prepared the soil for to-day's technical education, starting as mutual improvement societies, and leading up to the mechanics' institutions, long before municipalities and Governments thought about the importance of the subject. The ideal remained with these societies and, in nearly every case, their first aim and object was "to further the interests of the textile industry by educational and other means." There was still great opportunity for the societies, and the unselfish character of their work was probably not fully realised by themselves. He believed it was still possible for these organisations to mould the tendencies of technical education of the future. Their endeavour was in the direction of making occupation intelligent and interesting without drift into drudgery. This was what some of the old Textile Craft Guilds engaged in, and he thought some endeavour might be made to resuscitate the spirit of those Guilds and apply it to modern industrialism. A good many young men in the industry were liable, apparently, to reach the state commonly described as "fed-up," whilst at the other end of the scale there were individuals who erroneously considered their knowledge all-sufficient. If textile societies could remove either of these defects, the achievement would be great. As a matter of fact, the real benefit and interest of technical education only accrued subsequent to class or course instruction. The textile societies provided for continuance of technical education, and since the Textile Institute had set up its post-graduate qualifications, the whole movement was carried forward and achievement in continued technical education could be properly recognised.

Mr. W. Wilkinson (Head of the College) said the textile societies afforded a very necessary meeting ground for those who had received technical training. It was perfectly true that the student who completed the usual courses of training was not even then fully trained. The textile societies, and after that the Textile Institute, provided the avenue of progress.

Mr. W. P. Crankshaw (Bolton) expressed the view that it was not the business of the College to teach a man his job, this being the function of the industry.

The delegates spent a couple of hours inspecting the various departments of the College and their equipment, and on the motion of Mr. Henry Binns (Bradford), seconded by Mr. J. Chamberlain (Leicester), a hearty vote of thanks was accorded to the officials of the College, the Blackburn Textile Society, and the Federation of Works Managers' Associations.

It was decided that the next annual conference should take place in October 1927, and representatives were asked to give their organisations opportunity to offer an invitation to the conference as Blackburn had done on this occasion. Any such invitation should be forwarded to the General Secretary of the Textile Institute, Mr. J. D. Athey.

Some discussion took place regarding framing of syllabuses of lectures, and several representatives alluded to difficulty experienced in securing contributors. Mr. G. S. Leeson (Bradford) urged formation of "Syllabus Committees" definitely responsible for securing the programmes of lectures. The Secretary (Mr. Athey) pleaded for more frequent requests to members of societies to prepare papers, and interchange of services in this connection. Messrs. N. Collinson (Batley), J. Burgess (Ashton), and C. Barnshaw (Blackburn), also took part in discussion, and the proceedings ended with a hearty vote of thanks to the Chairman.

CIVIC WEEK CELEBRATIONS IN MANCHESTER

Manchester engaged in Civic Week celebrations—from 2nd to 9th October—when various institutions contributed in a variety of ways to the programme. In response to request, the Council of the Textile Institute agreed to arrange for a contribution by wireless in reference to the city and the cotton textile industry. Accordingly, on the evening of the 7th October, the President of the Institute, William Howarth, Esq., J.P., broadcast the following statement from the B.B.C. Station—

MANCHESTER AND THE COTTON INDUSTRY

Manchester is the centre of the British cotton manufacturing industry—the largest in the world and, in relation to our export trade, the most important of all British manufacturing industries. The complex commercial activities of this vast industry, and the warehousing, packing, and distribution arrangements are all concentrated here. Raw cotton is brought overseas direct to Manchester via the Ship Canal, and the fabrics manufactured therefrom are shipped to all parts of the world. Lancashire's consignments of fabrics stream out so that the location of the consumer may range from the proverbial "China to Peru." Native races in many climes are abundantly familiar with textiles from Manchester, but they know them by descriptions not commonly known throughout England (Dhooties, Sarongs, &c.). In exceptional cases, goods which are not usually seen in this country except in the process of manufacture, are sent regularly to a particular country where they are traditionally regarded by the natives as of exclusive character, and the demand for them would be imperilled if the exclusiveness were seriously doubted. Manchester is undoubtedly the leading textile market of the world.

The organisation of the industry may be divided into three main sections—Manufacturing (which comprises spinning and weaving); Finishing (which includes bleaching, dyeing, and printing); and Marketing (at home and abroad). Spinning is mainly concentrated in South Lancashire and adjoining parts of Cheshire and Yorkshire, the fine spinning being centred in the Bolton and Manchester districts, and the spinning of the coarser yarns in Oldham, Rochdale, Wigan, and Stockport areas. The weaving centres are largely in North and East Lancashire—Blackburn, Burnley, and Preston being important districts. Finishing is to some extent a specialised industry in Lancashire, but is also usually combined with the bleaching, dyeing, and calico-printing industries. Enormous progress has been made and continues to be made on the finishing side of the industry, and it is on this side that the greatest advance has been achieved in recent years.

With regard to marketing, although some merchanting houses ship all kinds of cloth to all markets, the majority specialise on one particular market or group of markets. Thus, a business house is said to be in the Far East trade, the India trade, the South American trade, or it might be in the West African trade.

"Cotton wool" was at one time the common description of our raw material, and it was then regarded as a substitute for wool, much in the same way that so-called artificial silk has been regarded as a substitute for natural silk. Our cotton textile industry dates back to the latter half of the sixteenth century. It was not, however, until the middle of the seventeenth century, long after the introduction of the spinning of "cotton wool," that goods entirely of cotton were manufactured here. Importation of cotton goods from India was opposed by the old and strongly-entrenched industries of wool production and manufacture. Tariffs were set up in order to check the importation, but high tariffs and prohibitions appear to have given a stimulus to importation of the raw cotton and to home manufacture. It was mainly the successful spinning of cotton and the development of new and improved methods which enabled formidable headway to be made.

In the modern sense, however, cotton spinning and manufacturing is a comparatively new industry, commencing in the last twenty years of the eighteenth century. At the beginning of the nineteenth century our annual consumption of the raw material was equal to one hundred thousand bales, each of 500 lb. or nearly a quarter of a ton in weight. Large as the figure may sound, yet this quantity would not nowadays keep Lancashire mills running for a fortnight. By 1843, for the first time, the million bales mark was reached. The figure to-day of cotton consumed in this country—from all sources—is placed at well over three million bales per annum, which represents a consumption of over sixty thousand bales a week.

As in the early days achievement in spinning greatly promoted rapid development, so to-day the strength of our position in the world's competitive markets is greatly dependent upon the maintenance of supremacy in this section and of the high efficiency in the manufacture of fine cotton goods. The fact that approximately four-fifths of the world's mule spindles—the best instrument for the production of super yarns—are to be found in Lancashire, is a sufficient indication of the situation with regard to the production of fine cotton goods. Approximately, a quarter of the British cotton spinning industry depends upon Egypt for its supply of raw cotton of long staple. America still supplies the great bulk of the cotton required, but supplies of Empire-grown cotton are now regularly on the market, and increasing efforts are being directed to developments in this direction. Long-stapled cotton is essential for the fine counts of yarn in the spinning of which Lancashire stands pre-eminent. As the industry continues to develop in foreign countries, it is regarded as quite certain that competition in the world's markets will become keener and keener, and will take a wider and higher range, with the result that Lancashire trade must tend towards a still greater proportion of fine spinning and the manufacture of cloths from yarns of fine count. The hope is that with world-wide advances in the standard of living the demand for finer goods will correspondingly increase. The adaptability of the industry to change of conditions inspires confidence as to its future—an adaptability proved, for instance, by the rapidity with which it has utilised artificial silk, and by the manner in which some districts have effected changes in the character of their productions in order to overcome difficulties of dislocation of trade and markets following the great war.

There are over half-a-million of insured persons in our manufacturing industry. The spindles number approximately 59 millions, or one-third of the world's total, whilst looms number 800 thousands. Normally, about 80% of the cotton fabrics produced are for shipment. Last year (1925) the exports of yarn exceeded 189 million pounds in weight. Of cotton cloth over 4½ thousand-million square yards were exported—an amount which, if converted into a continuous web, would provided a cotton bandage 100 yards in width right round the world. The figure of 4½ thousand-million square yards for 1925 compares unfavourably with 1913, when it was 7 thousand-millions, and it emphasises the severity of the trade depression of last year.

In addition to the manufacturing industry, the development of the British textile machinery industry has been remarkable. Just as Britain is the largest producer of textiles, so she is the largest manufacturer of textile machinery. It has been an enormous advantage to the industry that the engineering establishments have been developed in proximity to the mills, thus admitting of effective co-operation between machine maker and user. The annual export of textile machinery from Lancashire provides a substantial quota to the total value of the exports of this country.

Organisation as to trade and commerce of the industry has reached a high pitch of efficiency. The general organisation, however, is remarkable for the extent of its ramifications and the energy with which the various interests are pursued. The comparative freedom from industrial disputes, particularly in the very difficult post-war period, is high testimony to efficiency of control on the sides of both employer and employed.

Technical education has progressed rapidly. The modern movement of especial interest in this connection has been that of continued instruction long after entry into the industry. Indeed, the organisation to-day offers facilities for the maintenance of absolutely continuous interest in the technical problems of the industry. An indication of the progressive spirit which pervades the rank and file of the cotton industry is to be found in the number of textile societies, managers' associations, and other organisations, one or more of which exist in every important locality and which have for their object the promotion of a wider knowledge of the particular branch of the industry in which members are employed. These organisations, which have no real parallel in any other of our great industries, in addition to preserving existing technical skill, play a great part in the rapid dissemination of new knowledge.

The scientist and the technologist are being more and more employed. Moreover, the industry supports the largest of the co-operative research associations in the country—at the Shirley Institute, Didsbury. Many private concerns, too, maintain individual research departments. The Textile Institute, of which I am the President at the present time, and the headquarters of which are at Manchester, seeks to bring together to one common platform the technological and the scientific interests of the whole of the textile industry. This Institute promotes meetings and conferences for the reading of papers of technical and scientific interest, and also issues a journal which is regarded as the leading scientific periodical devoted to textiles.

Recently reconstituted by Royal Charter, the Textile Institute now provides for the award of post-graduate Diplomas, in the form of Associateships and Fellowships, to those of its members who qualify therefor by existing qualifications, or by examinations, or by both means.

Finally, it may be said for the cotton industry, that its gigantic output, its stupendous capital, and its strength of position in international trade, all combine to place it in the first rank of British manufacturing industries.

NOTES AND NOTICES

The Textile Society Movement

In the interests of technical advancement, the potentialities of the movement which has resulted in the establishment of textile societies and kindred organisations in the various areas of the textile industry are obviously great, when the numerical strength of the organisations is fully revealed, as was the case at the conference of representatives of these organisations which took place at Blackburn Technical College on Saturday, 9th October. A few years ago the Textile Institute, appreciating the efforts of the Societies, initiated a movement for the bringing together of the various organisations with a view to co-operation and discussion for mutual benefit. It may certainly be said that the movement has grown and an annual conference is now an established event. The Institute continues direct association with the movement, undertaking the secretarial work of the conferences, and bearing the incidental expenses. At the conference at Blackburn, Mr. J. H. Dawson, of Brierfield, President of the Federation of Textile Works Managers' Associations, opened a discussion on "The Work of Textile Societies and its Relation to Technical Education." It was characteristic of Mr. Dawson, as his utterance indicated, that he should have spared neither time nor effort to secure reliable information. By direct communication with the officials of all the organisations he had obtained first hand knowledge of their activities, objects, and numerical strengths. It was surprising to learn that the organisations represented at the conference had a total membership of 10,000, all of whom might be said to be interested in the technical advancement of the industry. The movement is probably on a scale without parallel in industry. The 1927 conference is to take place in October next and the General Secretary of the Institute would be pleased to receive, on behalf of the movement, any invitation on the part of a participating organisation, or from any textile teaching institution which might be visited in conjunction with the conference.

London Section Activities

The London Section, which started to arrange its winter programme somewhat later than usual, has already obtained the promise of several interesting papers. Among these must be mentioned "Development of Bast and Leaf Fibre Cultivation in the British Empire," by Dr. Goulding, of the Imperial Institute; "Fabric Testing for Retail Distribution," by Mr. W. C. Whittaker, who for many years has controlled the testing department of one of the largest west-end stores; "Flax Markets," by Mr. E. Wigglesworth; "Standard Lancashire Cloths," by Mr. A. R. Down; "Household Linen," by Mr. D. Anthony-Langsdale; and a paper on weaving faults, by Mr. L. J. Mills. Other functions which it is proposed shall take place are a visit to the Imperial Institute for the purpose of viewing the textile exhibits, a visit to a rope-walk, and a dinner-dance on the evening of the day of the Annual London Section Meeting. In all probability at least two of the papers will be read in the Clothworkers' Hall, by kind permission of the Clothworkers' Company. The courteous attitude of this great Livery Company, which for the past three years has generously placed its magnificent hall at the service of the London Section for certain lectures, provides a small but not unimportant illustration of the consistent present-day benevolence of the Clothworkers' Company to the industry of which at one time it was the governing body and guardian.

Section Meeting at Belfast

With a view to resuscitation of sectional activity in the area of which Belfast is the centre, a meeting of members of the Institute took place at the Technical College, Belfast, on the 16th September. Mr. W. H. Webb, of Randalstown, was voted to the chair, and there were also present Messrs. F. Anderson, F. J. W. Shannon, G. R. Beatty, R. V. Eves, W. H. Gibson, F. Bradbury, O. V. Greeves, J. Kirkwood, W. J. Cowden, and others. The General Secretary (Mr. Athey) attended and stated that it was the desire of the Council that a small Committee to engage in Section activities should be appointed. It was suggested that at least two meetings for the delivery of papers, with discussions to follow, should be arranged for the oncoming session, whilst members of the Section might possibly hold a meeting of a social character with a view to bringing members together. The Secretary also offered a statement with regard to the Institute's Diplomas, and explained at length the scheme of post-graduate qualifications to members and the conditions attached thereto. On the motion of Mr. Anderson, seconded by Dr. Gibson, it was decided that a Section Committee be appointed, together with an Hon. Secretary, in order to promote meetings. It was decided that the Committee be constituted as follows—Messrs. W. H. Webb, Dr. Gibson, F. Anderson, F. Bradbury, Jas. Crawford, F. J. W. Shannon, W. J. Cowden, G. R. Beatty, and J. Kirkwood. Mr. F. J. W. Shannon was unanimously elected Hon. Secretary, and the meeting was concluded with a vote of thanks to the Chairman and to the Institute Secretary.

The Textile Institute Annual Conference

Our report of the proceedings of the above-named Conference—held at Buxton (Derbyshire), 20th to 22nd October—will appear in the next issue of the Journal. The event has been postponed from last Whit-week owing to the general strike, which immediately preceded that week. Deferred events usually suffer, and if the attendance at Buxton was not quite up to the average, nevertheless it was indeed fortunate that the programme of lectures was available substantially in the form in which it was originally framed, Sir William Bragg kindly renewing his engagement to deliver the Annual Mather Lecture of the Institute.

Diplomas of the Textile Institute

Applications for the Associateship of the Institute have already necessitated the conduct of two oral examinations in General Textile Technology, the Selection Committee having insisted upon a satisfactory level of knowledge covering the whole field of textile technology in addition to attainment in a particular branch or in special branches. The Committee's experience of the examinations held suggests that the stipulation in regard to a satisfactory knowledge of general textile technology has not only been justified, but that it will need to be rigorously maintained. Indeed, the Selection Committee has recently considered the matter of the preparation of regulations and a syllabus to be issued in relation to future examinations of this character, and a special Sub-committee has been appointed to canvass the whole question, prepare a scheme, and report in due course to the Committee.

Research Directorship Change

The resignation has recently taken effect of Mr. H. J. W. Bliss, Director of Research for the British Research Association for the Woollen and Worsted Industries, the activities in connection with which are centred at Headingley, Leeds. Mr. Bliss had been for several years past in close and direct touch with the affairs of the Textile Institute, and his services were greatly appreciated. An announcement issued by the Association in question, states that following repeated misfortunes which have befallen the family of Mr. H. J. W. Bliss, M.A., F.I.C., he has asked the Association to receive his resignation, as he feels that a break with painful local surroundings would be in the best interests not only of himself, but also of the organisation of which he had been Director of Research since its inception. These circumstances are well known to many in the West Riding. The Research Control Committee greatly regret that under the circumstances they find themselves with no alternative but to accept Mr. Bliss' resignation. They are anxious that it should be understood that they hope and expect Mr. Bliss will obtain an appointment of a suitable character elsewhere, and they will give him all the assistance in their power. Sir James P. Hinchliffe and Mr. Henry S. Clough referred at some length to the spade work which had been done under Mr. Bliss' direction and to the fact that the Association has now become an effective force in the trade. Mr. Bliss expressed his personal thanks to all members of the Council and Committee for their unvarying courtesy and support. He much regretted the necessity of leaving the service of the Association but had the satisfaction of knowing that work in all its branches was proceeding smoothly, and that many important results are within sight. Dr. S. G. Barker, D.I.C., A.Inst. P., head of the Association's Physics Department, has been appointed to succeed Mr. Bliss as Director of Research.

Cotton Growing in Uganda

Sir William F. Gowers, Governor of Uganda, was the principal guest at a luncheon given by the British Cotton Growing Association at Manchester on the 5th October. Lord Stanley presided and commended the work of Sir William Gowers, whose appearance in Northern Nigeria coincided with the beginning of the work of the Cotton Growing Association in that country.

Sir Wm. Gowers emphasised the importance of Africa as a consumer as well as producer, but said there must of course be production to secure consumption. Fortunately cotton was probably the best single crop on which Uganda could rely. In 1911, some 9,000 bales were produced and there was steady increase up to the war. By 1921, the output was 47,000 bales; in 1924 the yield was 124,000, and 196,000 in 1925. There was a larger acreage in 1926, but climatic conditions were unfavourable. Up to end of August the amount was 170,000, and the total should reach 180,000. He must admit the danger of the drop in price of American cotton, which would be disappointing to the native in Uganda. The probability was, however, that in the long run it would pay the Uganda native better to grow cotton than any other crop, though it might take him the longer to realise the fact if prices remained at a low level. He (Sir William) believed it was possible for the Protectorate to supply 500,000 bales of cotton per annum, and even within four or five years 350,000 bales might be reached.

Institute Membership

At the September meeting of the Council of the Institute, the following were elected to membership—D. N. Aspden (Warehouse Master), Binnyston Gardens, Bangalore City, India; Christopher Barrow (Technical Chemist), 37 Rowland Street, Beswick, Manchester; Harry D. Belland (Superintendent), Dominion Textile Co. Ltd., Dominion Cottons Branch, Verdun, Quebec, Canada; Benno Borzykowski (President of Borvisk Company), 78 Rue de Provence, Paris, France; Thomas E. Craven (Textile Instructor and Lecturer), 83 Grafton Road, Keighley; Howell K. Hallett (Cotton Manufacturer), Kendall Mills Inc., Paw Creek, N.C., U.S.A.; John Kenyon (Mill Manager), The Villa, Green Lane, Leigh; Joseph McIsaac (Principal, Textile School), Wilts. County Textile School, Trowbridge, Wilts.; Benjamin Musgrave (Yarn Merchant and Agent), Wensley Villa, Fagley, Bradford, Yorks.; Pierre Leblan (Cotton Spinning Mill Manager), 87 Rue de Lannoy, Lille Fives, France (Nord); Henry O. Richardson (Works and Analytical Chemist), Ashworth House, Ashworth Road, Dewsbury, Yorks.; E. R. Scragg (Silk Textile Machinist), c/o Ernest Scragg & Sons, Ltd., Macclesfield; H. Sutcliffe Smith (Executive Director, Bradford Dyers' Association, Ltd.), Ingerthorpe Grange, Markington, near Harrogate; Frank Stoyle (Chief Chemist), c/o The Bulmer Rayon Co. Ltd., Stowmarket, Suffolk; Zoltan Szaloki (Assistant

Textile Professor), 1 Karap utca 13, Budapest, Hungary; W. Arthur Turner (Secretary), The Worsted Spinners' Federation, Ltd., 20/26 King's Arcade, Bradford, Yorks.; Alfred Wilman (Silk Noil Spinner and Manufacturer), Station Mills, Hadfield, near Manchester; Harold L. Johnson (Hosiery Manufacturer; in charge of Cutting Department), 3 Gedling Grove, Nottingham; Charles J. Wright (Assistant Chemist), 44 Kilnside Road, Paisley, Scotland; A. L. Patterson (Research Physicist), Kaiser Wilhelm-Institut fur Faserstoffchemie, Faradayweg 16, Berlin-Dahlem, Germany.

COMMUNICATION

To the Editor

"The Hygroscopic Properties of Colloidal Fibres and their Relation to Technical Processes"

Sir

In the August number of the *Journal of the Textile Institute* (P137) there appears the report of a paper read at the recent meeting of the British Association by Messrs. Barker, Hirst, and King, in which it is stated that the authors "Presented a paper . . . in the course of which the theory of elasticity of colloidal fibres was developed." May I be allowed to point out that this wording is misleading ? It implies that the paper is an original contribution to the theory of fibre elasticity (or an account, at least, of the authors' previously published original work), whereas the theory described by the authors was put forward and developed by me more than two years ago.[1,2] The omission of any indication that this portion of the paper is not the authors' own work is regrettable since it may lead to wrongful attribution in other journals.

There is another point which calls for comment. The authors attempt to correlate the various phenomena (elasticity, heat of wetting, swelling, &c.) and arrive at the conclusion that they "are explained by assuming the keratin substance of wool to be of the type of structure observed in dried gelatin jellies, rather than to the surface area or due to any grosser heterogeneous structure such as would be involved in the individual cells of scales or cortex, or the easily observable pores found by Mark."

So far as the elastic properties are concerned, this conclusion is extremely dubious. It is true that a fine-grained heterogeneity is capable of giving rise to the peculiar "elastic after-effect" exhibited by fibres, but it by no means follows conversely that any particular instance of the effect is necessarily due to the fine-grained heterogeneity. My theory postulates a heterogeneity which is most simply described in terms of an elastic and a viscous phase, and makes no attempt to specify more closely the precise nature of the phases. A general theory of fibre elasticity can do no more than this, since different fibres show such great differences of structure. Thus the cotton hair is quite different biologically from the wool fibre; and a filament of artificial silk has no visible structure at all. Further research may reveal new facts by means of which the theory can be developed further for specific fibres, but it is highly probable that the line of development will be different for each fibre.

The evidence available at present points to the physical properties of the wool fibre being dependent upon a heterogeneity more complex than that of gelatin jelly. The two-phase theory has been recently applied to the study of the elastic properties of rods of gelatin jelly by Poole[3] who shows that such rods when loaded extend in a manner characteristic of the most simple conceivable type of two-phase system. As I had shown previously, the mode of extension of a wool fibre indicates a complex type of heterogeneity. Moreover the viscous phase itself behaves as a gelatinous fluid, and may possess a complex structure.

The above considerations throw considerable doubt on the above conclusion put forward by Barker, Hirst, and King, and indicate that it is by no means safe to neglect the "grosser heterogeneous structure" of fibres. In the case of the wool fibre a more elementary consideration is that a wool fibre is far from being perfectly soluble in boiling water.

REFERENCES

[1] Shorter, Journal of the Textile Institute, 1924, **15**., T207.

[2] Shorter, Contribution to the General Discussion held by the Faraday Society and the Textile Institute on Physical and Physico-Chemical Problems relating to Textile Fibres. Trans. Far. Soc., 1924, **20**.

[3] Poole, Trans. Faraday Society, 1925, **21**, 114.

Didsbury, 20th September 1926. S. A. SHORTER.

AUTHORS' REPLY

By the courtesy of the Editor we have seen Dr. Shorter's criticism of the report of our paper, and are surprised that he has thought fit to use for criticism a brief note of the paper, when he has neither seen the original in extenso, nor was he present at the British Association meeting. In the original paper, which is now in the press, we have duly acknowledged authorship of every point both in the text and in the bibliography.

With regard to the scientific criticisms raised, we feel that our complete paper, when published, will be the most effective reply.

Leeds, 2nd October 1926.

S. G. BARKER.
A. T. KING.
H. R. HIRST.

REVIEWS

The Finishing of Woven Fabrics. By Roberts Beaumont, M.Sc., M.I.Mech.E. Scott, Greenwood & Son, London. Price, 15s.

The publication of a second edition of this work is a tribute to its excellence. Since the late Roberts Beaumont originally wrote this book, a considerable amount of investigation and research has been undertaken. New knowledge had been obtained in respect to the crabbing, lustring, and finishing of wool fabrics; detergents and agents used for scouring and milling, and also in respect to the properties of wool fibres. New theories regarding the phenomena of fibre movements and wool felting during wet finishing processes have been advanced. It is pleasing to note that these matters have been thoroughly considered and dealt with. The new publication in addition to being completely revised contains two new chapters, this having been done very efficiently by Mr. Alex. Yewdall, of the University of Leeds. The work is well written and illustrated, and provides an excellent treatise on the theory and practice of cloth finishing. —E.M.

Handbook of Weaving and Manufacturing. By Henry Greenwood. Published by Pitman & Sons, Ltd. (124 pp. and Index. 5s. net).

The contents of this small treatise indicate its very wide scope, for it treats of the subject of weaving and, in fact, of all other allied subjects literally from A to Z, and in alphabetical order after the manner of a dictionary or encyclopedia. Some idea of the scope of this book will be gathered from the following items, which are a mere fraction of those given in the complete contents—"Yarn and Cloth Calculations; Types of Yarns; Conversion Tables; Loom Drafts; Tie-ups and Peg Plans; Details of all Manufacturing Machines, with notes on Mill Driving; Humidifying; Maintenance of Hygrometers; Ventilation; Fire Appliances; Useful Tables," &c. In a very short Preface, which is a model of brevity, the author says—"This small treatise endeavours to put in concise form, practical information suitable for students, weavers, overlookers, managers, and others engaged in the textile industry," and concludes with the hope "that the practical information contained in this book will be of use to the industry, and fill a gap in modern textile literature."

The book certainly contains a vast amount of information and useful data, but its description as a "treatise" is a misnomer inasmuch as it does not expound or "treat" of the various subjects after the manner of a class text-book. In the present volume, the various subjects are arranged in a more or less haphazard manner, so that it assumes somewhat of the composite character and style of the "Useful Compendium" or "Handy Book of Reference." The subject matter, too, is so very concise and condensed, and written in many instances in such a loose style of phraseology as oftentimes to defeat the author's aim. For though brevity is a commendable feature, still clarity of expression should not, especially in a "treatise" for students, be sacrificed to mere brevity. Information for students should be explicit and accurate, not vague or inaccurate as, unfortunately, is the case in several instances in the book under review. For example, on page 3, a type of artificial silk is given as "Viscous" instead of "Viscose"; nor is it a fact that "coco-nut fibre" is "from the hard shell of the coco-nut," but from the outer sheath or husk enclosing the shell. Strictly "Bump Yarns" signify counts below 1s and not, as stated on page 7, "counts usually 3s or below." It is surprising to find in a modern treatise (page 14), a "Yarn Warping Table" occupying nearly a full page that could have been filled with much more useful matter. In the "Conversion Tables" (page 38), it is unfortunate that the headings of columns 2 and 3, 5 and 6, should read "per Running" and "per Sq. *Yard,*" instead of "Metre," an error which is also repeated in the example and answer given. "Pirn-warping" (page 56) should have been described as "Warp Pirning"; there is no such operation as the former. It is also misleading to repeat on page 56, as to state on page 53, that "pirn winding" is "to wind yarn from hank form on to a pirn for the shuttle," when it is commonly wound from all other forms of yarn packages. Also it is wrong (page 56) to define "reaching-in" as a "small machine for selecting the threads for the drawer-in," and "warp-winding" as "to wind yarn from beam or ball warp to pirns or paper tubes for the shuttle." Speaking of artificial silk, under "Weaving of Warp" (page 93), "the timing of the shed may be a little late to ensure the shed is open when the shuttle enters" should surely read "a little early." It is also wrong to say that "any undue stretch in the warp will show lack of lustre," although it is correctly stated under "Weft Winding and Weaving" (page 94) that "tight (taut) picks will show as bright picks." A little more careful editing and the correction of the errors such as those indicated above will enhance the value of this useful little handbook. —H.N.

Distribution of Textiles. Bulletin No. 56 of the Harvard Bureau of Business Research (Cambridge, Massachusetts, 1926. 196 pp. $3.50).

This study of the American textile industries is the work of a group of investigators connected with the Harvard Bureau of Business Research, but the survey was undertaken "at the request of men engaged in the textile industry and the funds for carrying it on were provided by an anonymous gift." Manufacturers and traders of all kinds in the textile industry gave generous help in the planning of the survey and the drafting of the schedules. The response to the inquiries of the field workers was very gratifying, and a large amount of confidential information was placed at the disposal of the Bureau. All this reads like a fairy tale to those who have attempted to carry out similar pieces of work in this country, where there is still such widespread apathy towards statistical studies of the textile trades. It is heavy uphill work to get our main body of textile industrialists even mildly interested in the collection of statistics. But the reading of this book leaves no doubt in one's mind about the value of such studies. The American textile producers have ample reward for their initiative in the precise information conveyed in this volume. We congratulate them and hope their example will speedily be followed in England. The study is confined to the distribution of woven fabrics, and shows the relative volume of textile goods flowing through the several channels of distribution. After a brief explanation of the reason for using the data provided by actual invoices of goods despatched through various channels, a detailed analysis is given of the results of inquiries relating to woollen and worsted fabrics, rugs and carpets, silk cloth and ribbons, and cotton fabrics. These results relate chiefly to the proportions in which goods pass from the manufacturer to wholesale piece merchants, the wholesale clothier or maker-up of garments, and the retail traders. In the course of the analysis, much light is shed on the economic problems of the American textile trades. In common with this country, American producers are feeling the change in the social habits of consumers. The "style factor" is shown to be the predominant cause of the hand-to-mouth trading which has displaced the steady trading for a season in goods that could be produced in bulk in advance. The suspicion that American demand for both cotton and wool fabrics is tending to move on to cheaper ranges of materials is confirmed. The reduction in the size of orders placed with manufacturers which is becoming so marked a feature of our trade in this country is another reflection of the vagaries of fashion. Recriminations between the several groups in the industry are as frequent in America as they are here when the problem of adjusting price levels and cutting losses is under discussion. The retail trade with them, as with us, is apparently the main stumbling block to the rapid adjustments that are needed to maintain the flow of demand. These and many other points are raised. The chief inference drawn by the investigators is that manufacturing and marketing must be adjusted to the new tendencies in demand. Changes of style should be viewed as "a positive, sales-stimulating influence." Better marketing means better team work than we have seen in the past. Americans are telling of organising more co-operative selling and cutting out the waste entailed by elaborate competitive sampling and production over an ever increasing range of cloths and styles. We are also talking of the same thing in this country. But where we are compelled to walk and talk in the dark for want of accurate statistical information, our American competitors are able to walk and talk in the light shed upon their problems by such valuable studies as these produced by the Harvard Bureau. —A.N.S.

The Testing of Yarns and Fabrics. By H. P. Curtis. London: Sir Isaac Pitman & Sons, Ltd. (pp. 161 and Index. 5s. net).

In an introduction to his work, the author states that it has been written specifically for those engaged in the manufacture, merchanting, retail sale, and use of textiles. With this object in view he has endeavoured to survey the field of textile testing, giving a general idea of the raw materials consumed in the industry, of the simpler chemical means used for their identification, and of the mechanical methods employed in determining quantitatively their physical properties. He has, however, overlooked the main consideration in the preparation of an elementary text book, namely, that accuracy is essential. One is astonished to hear, for example, that the central portion of the silk fibre is composed of *fibrion* (p. 25), that if wool be exposed to the atmosphere in warm, dry weather, it contains from 30 to 50% of moisture (p. 31), that weak sulphuric acid stains cotton blue (p. 33), and that moisture tests are usually carried out at 55° C. (p. 65). It is inaccurate, also, to say that Primuline may be diazotised with sodium *nitrate* and hydrochloric acid (p. 95), that "common yellow" is otherwise known as *chrysophimne* (p. 95), and that mercerised cotton (p. 101) and starch (p. 102) gives a blue colouration with potassium iodide solution. The author apparently believes that chloroform is a highly inflammable substance, and accordingly gives directions concerning its use (p. 104). It would appear unnecessary to recommend "gramme weights and metric weights" as advisable for use with the balance (p. 45), and he has his own ideas concerning the most convenient method of using a desiccator (p. 90). On account of its mistakes and mis-statements, he should revise this book as soon as is conveniently possible. —F.L.B.

GENERAL ITEMS AND REPORTS

Manchester Textile Exhibition

This exhibition, held at Belle Vue, was an important item in the Civic Week programme and proved well worth a visit. Over a hundred firms took space and were representative of the following sections of the industry—Engineering, spinning, manufacturing, and merchanting. In addition, stands were occupied by newspapers and textile journals, and there were also displays of work done by the students of various technical colleges and schools. As is usual in present-day textile exhibitions, artificial silk played a very important part, and many varied and beautiful exhibits were to be seen, both in piece goods and made-up garments. A model of the Port of Manchester formed the exhibit of the Manchester Ship Canal Company and attracted a great deal of attention. In connection with the exhibition, the British Model House, Ltd., held a mannequin parade in a specially-constructed theatre three times each day, and very full houses testified to the popularity of the feature. These parades were under the management of Mr. Arthur White, to whom every credit should be given for assembling a very attractive array of frocks and coats, and for the manner in which they were shown. A special feature of the parade was a display of period dresses—eighteen in all—dating from the eleventh to the nineteenth century, which gave a very clear idea of the evolution of fashion. Although some of the exhibitors had rather marred the effect of their stands by overcrowding, thus giving the impression of "heaviness," the exhibition as a whole was extremely good and, being of a general textile character, was of interest to all visitors. The organisers of the exhibition, *The Manchester Guardian Commercial*, are to be congratulated on a contribution well worthy of Manchester's Civic Week.

Textile Exhibition at Leicester

Since the last exhibition organised by the *Textile Recorder* at Leicester in 1923, there seem to have been few innovations in knitting machinery. Some minor novel textile accessories and small improvements to standard types of machinery, however, provided a note of freshness at this year's exhibition at Leicester, 8th to 23rd October. Perhaps as interesting exhibit as any was a fast-running ribbon loom made by a foreign firm, which was weaving unsized artificial silk yarns, with no extra twist, at a rate of 700 picks per minute. A simple device enabled the operator to change or vary the number of picks per minute, with celerity, accuracy, and ease. Worth mentioning also was an improved testing machine for stretch and breaking strength of artificial silk yarns, the findings being recorded automatically on a graph. A most ingenious jacquard embroidery machine was displayed on one of the stands. Using the normal selection device actuated by a continuous card, and applying it to control the movement beneath the embroidery needle of a fabric-holding frame, this machine, which, apart from the jacquard mechanism, resembles the ordinary sewing machine, was perhaps the most interesting novelty in the exhibition. As was natural at an exhibition in the Leicester district, a fair proportion of the floor space was given over to knitting machinery, most of which, apart from the more general use of jacquards in both flat and circular machines, was much the same as that shown three years ago. In the fabrics section there were several very beautiful and interesting collections of artificial silk yarns and fabrics, and it was noteworthy that practically all the English producers, together with agents of some important Continental producers, were represented. When it is remembered that at the last Leicester Exhibition only one British firm of artificial silk producers had an exhibit, whereas to-day no fewer than five have taken space, an interesting sidelight is thrown on the development of the artificial silk industry. Many firms of spinners exhibited mixture yarns of cotton or wool and artificial silk, and there were not wanting examples of fabrics of cotton and acetate silk, wool and viscose, which had been cross-dyed—a practice which may have been somewhat overdone. One important inference might be drawn from a visit to the exhibition as to tendency with regard to the character aimed at in production of both yarns and fabrics containing artificial silk. There seems to be a definite movement away from lustre emphasis and distinct effort in the direction of approximation to natural silk from the point of view of lustre. Mixture yarns, at any rate, were much more in evidence than previously, and this may have been due to the movement already indicated.

Collaboration and Distribution of Wool Textiles

A meeting of the Bradford Textile Society was held at the Midland Hotel, Bradford, on Monday, 11th October, when Mr. Arthur Hitt, the President, delivered the lecture. Mr. W. A. Elliott presided. Mr. Hitt said that they had had men in Yorkshire who, by great initiative, highly-trained technical skill, and all-round efficiency, had made their names familiar all over the world, but they had concentrated almost entirely on the side of production. Twenty years ago it might have been said that if we made the right cloths at the right price they would sell themselves. That did not obtain to-day. Our greatest problem was not so much production as marketing. He suggested that what was wanted was collaboration with retail distributors and the buying public; some form of co-operation in selling; and collective use of publicity. He suggested that the trade collectively should form an Advisory Council, in which the buying public and the wholesale and retail distributors should join with the manufacturers, in order to get a forecast with regard to probable fashions, make of cloth, colour, &c., some months prior to the season starting. That would eliminate the waste of experimental patterns and accumulated bad stocks which were costly to manufacturers, merchants, and dyers. The public, because of it, would have better value, and production and demand would be kept in tune. There were probably two hundred mills in Bradford trying to make the same or similar cloths, with two hundred selling organisations. This involved enormous waste in experimental patterns, giving the dyers many thousands of patterns to dye every year, the majority of which were never followed by bulk business. This waste would never help us to capture markets, and such methods did not mean economy in either production or distribution. How much better if these mills were formed into groups, allocating one cloth to one mill, and by something like mass production lower the costs and economise distribution. Bradford cloths were now filtering through to the public unrecognised by that public. Neither merchants nor retail distributors were functioning in the sense of linking up the British maker of the cloth with those who wore it. Nothing had been more revolutionary during the last twenty years than the increased influence of publicity. Its demands alone must have the tendency to drive firms into groups, as no concern could adequately finance it in addition to other distributing costs. Applying publicity to the Bradford trade involved the fundamental recognition of the cloths by the public when it saw them. A selvage controlled by the Bradford Chamber of Commerce was one of the suggestions made. Failing this, cloths could be offered under registered names, but whether selvage or name, propaganda was essential. The future outlook seemed to depend on our recognising the public willingness to buy Bradford goods; the merit of the goods; the pressing need to secure greater prosperity for the industry. All these were contributing factors to collaboration, markets, and distribution.

Mr. W. H. Suddards said collaboration must have a much wider scope than the mere object of raising prices. Unless it was going to improve methods of production and develop greater initiative and greater economy in production, it would be useless. The idea behind collaboration must not be that it would be more profitable to the individual Bradford manufacturer; it must be of benefit to the nation as a whole.

Mr. Wm. Wright said that assuming they could manufacture the right type of cloth for certain markets and were willing to give credit, there were still difficulties which the exporter had to meet. The first of these was the price factor. In that respect they would be the gainers when countries with depreciated currencies were brought on to a gold standard. There was also the difficulty of the reduced buying capacity of the foreigner. A good deal could be done to stimulate that buying capacity by indirect methods. For instance, China, with 400 million people, bought only twice as much as the Argentine, with 10 million people. If a vast country like China could have its purchasing power developed by building railways and so forth, she would become a very powerful customer.

Mr. A. M. Chapman said that what Bradford wanted was a big volume of trade on standard cloths. The novelty trade would not keep them employed.

A vote of thanks was accorded to Mr. Hitt, on the motion of Mr. John Mason, seconded by Mr. J. Lester.

45—COLOUR PROBLEMS IN THE WOOLLEN AND WORSTED INDUSTRIES

By S. G. Barker, Ph.D., D.I.C., and H. R. Hirst, B.Sc., F.I.C.

(British Research Association for the Woollen and Worsted Industries, Leeds.)

Paper Presented to the British Optical Convention, London, April 1926

The decorative value of textile materials of all kinds is one of the most important factors in their production. Strength and durability are highly essential in a fabric, but the property most readily observed and which contributes most to the æsthetic sense is its colour or coloured pattern. This is, therefore, of commercial importance. The object of this paper is to survey the present position from physical, chemical, technical, and trade points of view, and to embody results of practical work in the laboratories of the British Research Association for the Woollen and Worsted Industries, Leeds. The immediate problems to be faced are manifold, but there seems to be no doubt that three main questions present themselves initially.

(1) The choice of standard illumination.
(2) The fastness and durability of a colour to the influence of external conditions.
(3) The determination of the exact shade of a colour, and its numerical representation.

Under heading (2) we may first consider what these external influences might be. Firstly, we have chemical action. The effects of alkalis and acids and such natural causes as perspiration, &c., are readily estimated by chemical methods and analysis. Secondly, we have physical influences. Humidity, temperature, light, friction, &c., under our daily atmospheric conditions. The methods of estimating the action of these quantities can only be said to be in a very unsatisfactory condition.

There is no international standard method for expressing the fastness of various colours to a standard source of light. The usual method in dye-houses is 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 are sent out for exposure. Hence there arises an ambiguous position in which fading is sometimes expressed as fastness to sun and air, and at other times as fastness to sun and air and chemicals.

First and foremost in the difficulties experienced, is the fact that no standard source of daylight is available for comparative tests to be made. It is obvious that this standard source of light should approximate in properties, as closely to daylight as possible. Let us first enumerate the properties required in such a light. The light must be reproducible and constant over long periods, both as to quality and quantity of light. It should produce the same changes in dyed material as sunlight would effect if the material were exposed in actual use. Sunlight itself is very slow in action and very variable both in quantity and quality. Some idea of the variation of intensity of sunlight is given by curves due to Dr. H. B. Gordon (Fig. 1), giving the results of tests made in Arizona and New Jersey. To quote from his paper, "The fading action to dyestuffs of New Jersey summer sun, was on the average four or five times as rapid as that of Arizona winter sun." The curves shown here show the variation in intensity of sunlight throughout the year in New Jersey. P. R. Ord (Messrs. Adam Hilger, Ltd.) has

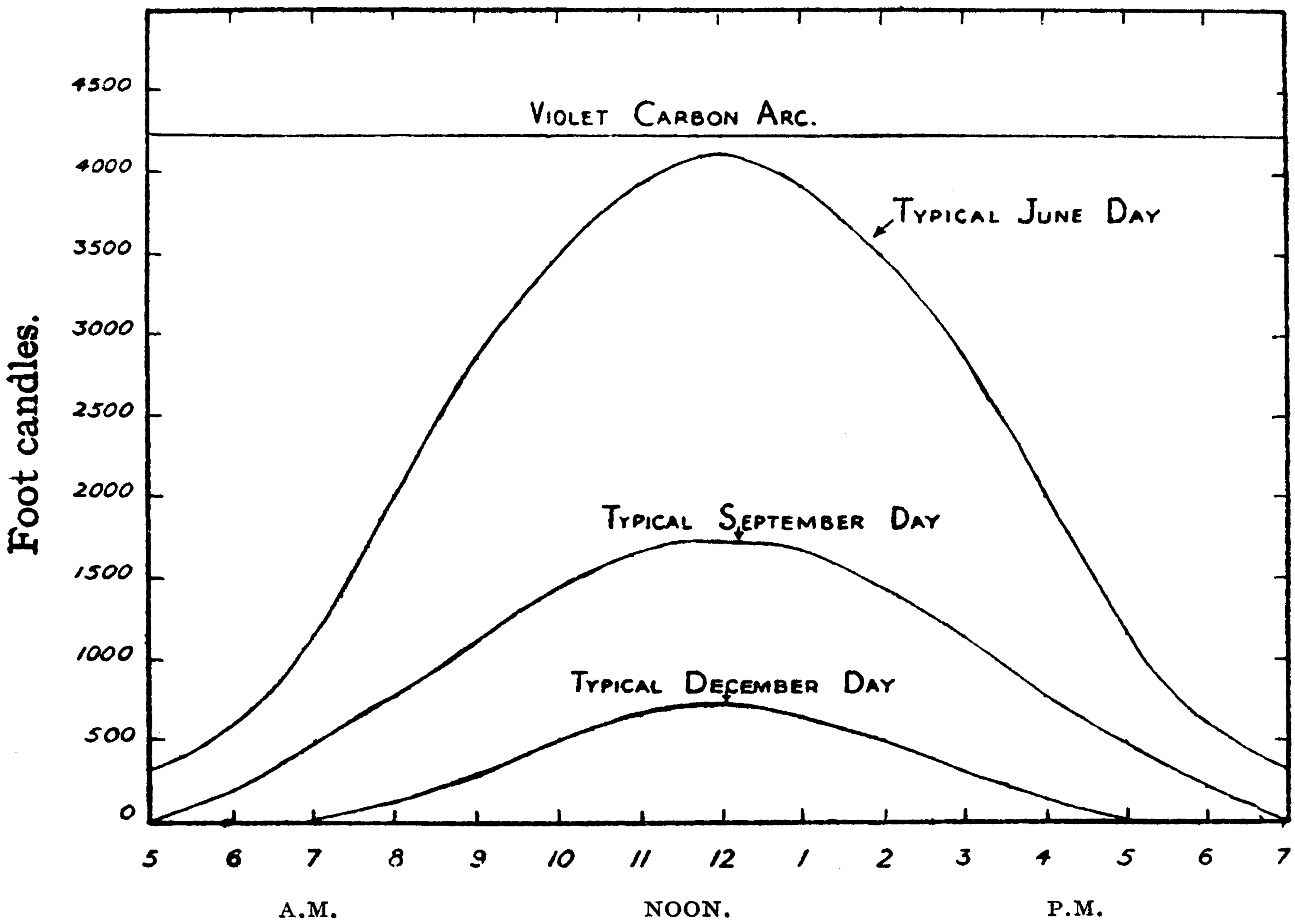


FIG. 1
Variation in the intensity of sunlight with time of day and season of the year.

shown, as a result of spectro-photometric experiments on the relative variations of "red," "green," and "blue" energy in the spectrum of north sky light, that the ratio of green to red varied between 31% and—25% on various days, while the corresponding variation of blue to red was between 45% and —25%.

The limits of the solar spectrum are influenced by the seasons, by the height of the sun above the horizon, i.e., the time of day and latitude, by the altitude and by the atmospheric conditions prevailing. The spectral range decreases very considerably the lower the sun is in the heavens, i.e., with the longer path through the earth's atmosphere that the radiation has to traverse. The range in the N. hemisphere is at a maximum in July, whilst in winter the smallest amount of ultra-violet radiation is present. In winter the amount of ultra-violet radiation at high altitudes varies considerably from that found at low ones, the greatest amount of both calorific and ultra-violet radiation being at the higher points. With the exception of July the intensity of the calorific radiations is always greater than that of the ultra-violet. It is thus seen that the extreme variation of sunlight itself coupled also with its slow action, renders it undesirable as a source of light for comparative fading tests. An artificial source of light is therefore sought and one with approximately the same energy distribution as summer sun at sea level is required. In this regard many workers have investigated the various sources of light, but there seems to be no unanimity as yet as to the precise energy distribution of a standard source or its method of production.

In 1901 Lummer and Pringsheim completed their experimental examination of the distribution of energy of a "black body" radiator at various temperatures and found that the total energy increases very rapidly for all wave lengths with increase of temperature and also that the maximum moves towards shorter wave lengths. The energy fall towards this region is more rapid as visibility is approached. In practice, artificial sources of light consist of some body raised to a state of incandescence and consequently a large proportion of the energy is emitted as heat and does not affect the light sensation at all.

We should, therefore, expect the maximum energy of the spectrum in such cases to be well away in the infra red. The problem was attacked by Wien, and in 1896 he put forward on thermodynamical principles, the formula—

$$E_\lambda = C_1 \lambda^{-5} e^{-\frac{C_2}{\lambda T}}$$

where C_1 and C_2 are constants, λ the wave length in terms of μ, and T the absolute temperature. This fitted in with experimental results for short wave lengths, but in 1900 Planck put forward an amended expression—

$$E_\lambda = C_1 \lambda^{-5} \left(e^{\frac{C_2}{\lambda T}} - 1\right)^{-1}$$

T for the sun is approximately 5,000° abs. Taking into consideration the limits of experimental error, &c., we conclude that for practical work on energy distribution Wien's law is sufficiently accurate when dealing with the visible spectrum.

Langley investigated the infra-red portion of the spectrum with the bolometer and Abbott continued on similar lines. Priest examined the data thus obtained for the energy distribution in the visible spectrum and a curve for mean energy distribution for noon sunlight was the outcome. This curve shows that such sunlight closely, though not strictly, resembles the radiation of a black body of temperature 5,000° to 5,300° absolute. The maximum energy occurred at a wave-length of 0·59 μ.

Nichols has compared the radiation from the sky under varying conditions with that of a standard acetylene flame. The energy distribution of such a flame has been fully investigated by Coblentz and the results of his work appear in the Bureau of Standards reports, the most important being No. 362, Scientific Papers of the Bureau of Standards, 12th Feb. 1920. The values of sky radiation are easily deduced from Nichol's results. Various other workers have also contributed to the solution of the problem.

Several energy distribution curves, for which we are indebted to Dr. L. C. Martin (Cantor Lectures, 1924), are shown in the accompanying diagram (Fig. 2) and show the energy distribution curves for blue sky, high and low sun, black body at 5,000° abs., gas-filled electric lamp, and a standard acetylene flame. Nichol's values, as obtained above, show daylight to be a very variable quantity. The scattering effect of fog, mist, or dust causes the energy distribution to fall more nearly approximate to those of artificial light, owing to the elimination by scattering of the shorter wave lengths. In 1910 Ives suggested that standard daylight should be the radiation of a black body at 5,000° abs. H. P. Gage (Sibley, *Journal of Engineering*, No. 8, May 1916) suggested that an average "daylight" should be a compromise between blue sky light and sunlight and such as would be given (in accordance with Planck's law) by a black body of temperature 6,500°–7,000°. This approximates to the north light desired by artists and is also recommended by Dr. L. C. Martin. Incidentally it may be mentioned that the results of fading experiments made by us show that north light fading is of the same quality as south light fading, but it is not so rapid in action.

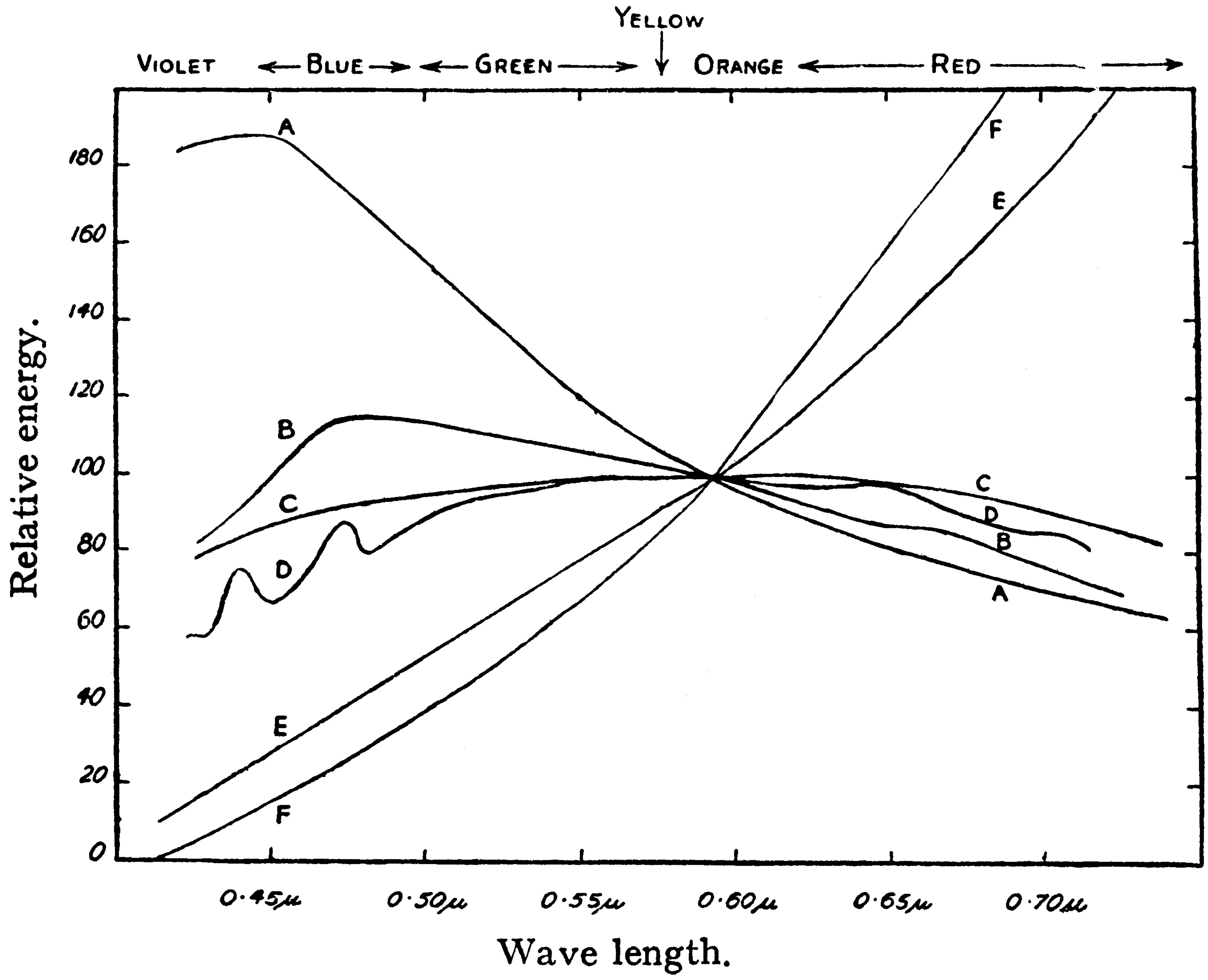


FIG. 2

Energy distribution in the spectra of various illuminants

A—Blue sky.
B—High sun (data from the Smithsonian Institute).
C—Ives' suggested standard (black body at 5000° C.).
D—Low sun (Smithsonian)
E—Gas-filled tungsten lamp.
F—Acetylene flame.

If such a standard could be fixed, then the work of finding a suitable daylight lamp would be definite, for a close approximation to the same energy distribution would be aimed at. Since energy distribution is such an important factor in these investigations a brief note may be given on a method of comparison recently adopted by the authors for comparing the energy distribution of various sources of artificial light.

Nicholson and Merton established a method for the measurement of the photographic intensities of the lines of the helium spectrum, wherein it is shown that the photographic intensity due to a particular wave length can be measured by using a wedge of neutral glass. The apparatus and method used by us is essentially the same as that of Nicholson and Merton and consists of a spectrograph, in front of the slit of which is mounted a neutral-tinted glass wedge, cemented to a similar wedge of colourless glass so as to form a plane-parallel plate. The spectra of the various sources of light were photographed through the neutral wedge, and the resulting photographs consist of continuous spectra which are dark along the edge corresponding to the thin edge of the wedge and which fade away towards the region corresponding to the dense end. Thus the height of the spectrum on the plate at any particular wave length corresponds to its intensity and it is essential that an accurate determination of the height of the curve at all points be made. A ruled process screen is utilised for this purpose as in Nicholson and Merton's experiments. The negative obtained from the spectrograph is reversed by printing on to a plate covered with lantern slide emulsion, and carefully developed. The process screen is placed in contact with the film side of the lantern plate and then both are placed in an enlarger. The enlarged print (about four times the original) provides an enlarged reproduction of the original negative in which the spectrum photograph is made up of minute dots about one 100th of an inch apart. The limits of the spectrum can now be pricked out right across the record by observing the last visible dot when seen through an ordinary magnifying glass. The points so obtained can be joined by a fine line and thus the intensity curve is obtained. In order to calibrate the plate, a spectrum of the carbon arc is taken upon a different portion of it for each negative. The helium spectrum is also added below each exposure for purposes of identification and calibration of the spectrum. As a preliminary, of course, a precise knowledge of the constants relating to the wedge must be obtained.

Theoretical Discussion

The wedge of neutral glass shows no absorption of a selective character, but there is an increase of absorbing power with decreasing wave length. If light of incident intensity I_i falls on such a wedge at any point and I_t is the intensity transmitted, the density at that point of the wedge is defined as

$$-\log_{10} \frac{I_i}{I_t}$$

Let P_λ be the "coefficient" of extinction of the glass for light of wave length λ. It is such that if the incident intensity be I_1 and the transmitted intensity passing through a thickness y of glass be I_2, then $I_2=I_1 e^{-yP_\lambda}$

If α be the angle of the wedge and x is the distance of any point along it from the thin end, then $y=x \tan \alpha$ or for the whole wedge of length l the intensity ratio is—

$$\frac{I_2}{I_1}=e^{-P_\lambda\, l \tan \alpha}$$

This is the ratio of transmitted light at its ends for the same incident intensity. An expression called by Nicholson and Merton *the "density"* of the wedge, is therefore given by—

$$-\log_{10} \frac{I_1}{I_2} \text{ or } l \tan \alpha P_\lambda$$

and this is denoted by D_λ for a particular wave length λ.

Now if l_λ be the height of the spectrum before enlargement and h_λ its visible height after enlargement and if l and H be the corresponding quantities for the whole length of the wedge $\frac{h_\lambda}{H} = \frac{l_\lambda}{l}$ since the magnification is the same in both cases, or $h_\lambda = \frac{l_\lambda H}{l}$.................(A)

Let I_c be the intensity at which a point of the spectrum corresponding to a particular wave length (λ) is first visible. Then if I_λ be its original photographic intensity and if a thickness l_λ of the wedge reduce its intensity to I_c we have

$$\frac{I_c}{I_\lambda} = 10^{-P_\lambda l_\lambda \tan\alpha} \quad \text{or} \quad \log_{10}\frac{I_\lambda}{I_c} = P_\lambda l_\lambda \tan\alpha$$

or substituting from (A) above

$$\log_{10}.\frac{I_\lambda}{I_c} = \frac{P_\lambda l h_\lambda}{H}\tan\alpha = \frac{D_\lambda h_\lambda}{H}$$

Thus we get $\frac{I_\lambda}{I_c} = \text{Antilog}\frac{(D_\lambda h_\lambda)}{H}.$

This expression gives the photographic intensity of the original wave length λ.

For a comparison of the relative photographic intensities of different wave lengths throughout the spectrum we do not need the actual knowledge of I_c.

The photographic intensity of wave length λ is therefore defined as Antilog $\left(\frac{D_\lambda h_\lambda}{H}\right)$

The density gradient of the wedge was determined by the use of Nicol prisms as is given by Nicholson and Merton, and the value of D was determined throughout the spectrum and a curve drawn. The reduction of photographic to absolute intensities necessitates the use of a photographic record of some standard source of radiation extending over the whole region of wave length examined. As a standard of radiation the positive crater of the carbon arc burning in air at atmospheric pressure was adopted and the assumption made that the distribution of energy in this source is that of a black body at the temperature of vaporisation of carbon. A difficulty found by Nicholson and Merton which restricted the accuracy of the method was the exact definition of the temperature of the arc actually used. In order to verify our work further the arc was compared with a standard acetylene flame such as is already mentioned in this paper, the distribution in which was fully investigated by Coblentz. The acetylene flame is convenient and easy to use.

Assuming Wien's Law for a black body, a measure of the intensity for a given wave length λ is given by

$$\lambda^{-5}\, e^{-\frac{a}{\lambda T}}$$

a is given by Kaye and Laby as 1·4 and T was taken as 3,750° C. absolute for the carbon arc as given by Dr. Harker of the N.P.L. with λ in centimetres

$$I = \lambda^{-5}\, e^{-\frac{a}{\lambda T}}$$

and this value can be worked out for all wave lengths throughout the spectrum.

These intensities can now be expressed as a ratio of the intensity of any one wave length taken arbitrarily, this wave length being ascribed an intensity value of unity. We thus have a method by which we can work out the absolute intensity of the various wave lengths of the spectrum of the source under test. It is shown by Nicholson and Merton that absolute intensity of a source for a particular wave length λ

$$= \frac{\text{Photographic intensity of source for } \lambda}{\text{Photographic intensity of arc for } \lambda} \times \text{Absolute intensity of arc} \ldots\ldots \text{(B)}$$

The photographic intensities are known from the formula

$$\frac{I_\lambda}{I_c} = 10^{\frac{D_\lambda h_\lambda}{H}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (C)$$

which can be worked out for each wave length of the spectra recorded on the plate as shown above.

For any particular wave length the critical intensity I_c affecting the plate (which is a function of the wave length) may be treated as constant, as also may D_λ. It is, therefore, obvious that in the determination of absolute intensity of a source for a particular wave length the quantity I_c

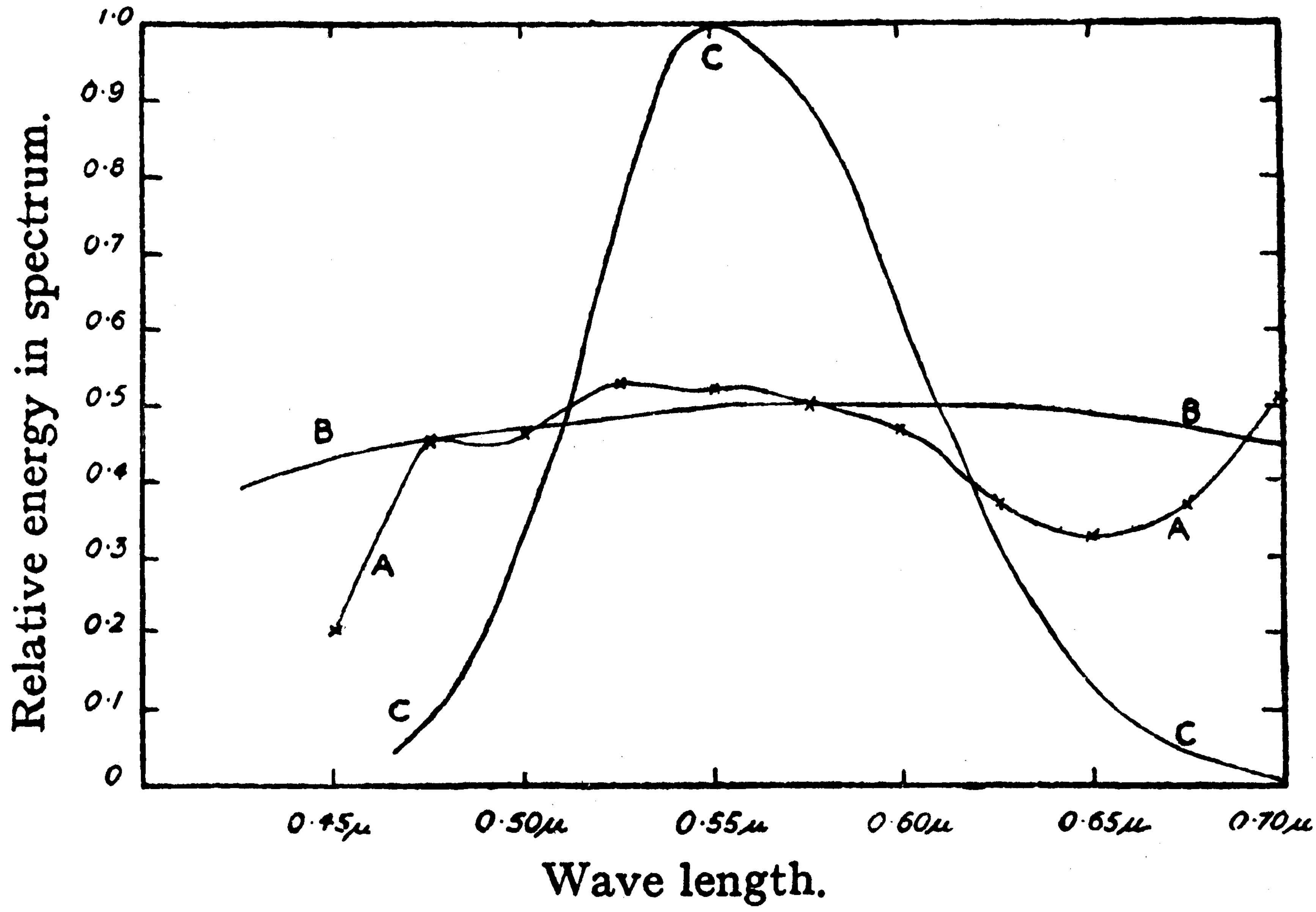


FIG. 5

A—Energy distribution in spectrum of a particular artificial daylight lamp.
B—Energy distribution mean sunlight.
C—Visibility curve.

is eliminated by division on taking the ratio of the photographic intensity of the source, to that of the carbon arc for the same wave length. Thus if $\frac{I_\lambda}{I_c}$ represent the photographic intensity for the source under test and $\frac{I^1_\lambda}{I_c}$ the same quantity for the carbon arc, whilst h_λ and h^1_λ represent the heights of the enlarged spectrum record taken through the wedge as indicated previously for a particular wave length, H and D_λ being constant we have from formula (C)—

$$\frac{I_\lambda}{I_c} = 10^{\frac{D_\lambda h_\lambda}{H}}$$

and

$$\frac{I^1_\lambda}{I_c} = 10^{\frac{D_\lambda h_\lambda}{H}}$$

Therefore taking ratios of photographic intensities

$$\frac{I_\lambda}{I^1_\lambda} = \frac{10^{\frac{D_\lambda h_\lambda}{H}}}{10^{\frac{D_\lambda h^1_\lambda}{H}}} = 10^{\frac{D_\lambda}{H}(h_\lambda - h^1_\lambda}$$

The ratio of the photographic intensities can thus be determined since D_λ, H, h_λ, and $h^1{}_\lambda$ are all known and thus formula (B) can now be worked out and absolute intensities found.

In this way the distribution of energy throughout the spectrum of any particular source can be measured and for black body radiators, as shown by Plaskett, Griffiths, and Harris, the temperature of the source can be found if required. This method is being applied by us to the problem now before us of determination of energy distributions for sources of light for artificial daylight fading experiments. Figs. 3 and 4 show some typical records.

In the course of the work, the effect of placing various screens between the source of light under test and the spectrograph was noted. A ground glass screen considerably altered the curve of energy distribution and ordinary glass gave a considerable modification. This shows that for fading tests it is essential that the material of the enclosing globe should transmit all radiation as far as possible. Fused quartz or Vitaglass are excellent for this purpose, but the devitrification of the former and the heat resisting properties of the latter give great disadvantages in their use.

Light radiations can be modified by transmission through or reflection from certain material substances and such modifications arise frequently by reason of selective absorption of some of the wave length components of the original beam. So long as the work is restricted to the visible spectrum, these screens and reflectors are of great use in simulating daylight, but for fading tests there is a loss of intensity and frequently a removal of the shorter wave lengths which is unavoidable.

The simple nature of the curves obtained for the energy distribution of various sources shows that there is no very complicated nature for the properties of a light filter necessary for the correction of the excessive energy of the longer wave lengths and, knowing the energy distribution in the particular source, the required densities or transmission coefficients for the filter can easily be calculated. The full discussion of light filters is unnecessary here as the literature is well known, but we would welcome any cooperation in this matter if there is a possibility of devising a standard fading source by the employment of such filters. Dr. Martin (Cantor Lectures) gives a comparison of the energy distribution of the spectrum of a typical daylight lamp and that of sunlight. It is seen from these that there is an excess of energy at the extreme red end of the spectrum and a deficiency in the extreme violet, and whilst in these regions visibility is low, so that the eye cannot perceive the discrepancy in colour matching, yet for standard fading experiments these radiations are all important and the lamp is thus rendered unsuitable.

Further, experience has shown that it is these radiations beyond the visible spectrum which are extremely powerful in effecting colour deterioration. Certain dyestuffs—known as sensitive tints and dealt with later—show different shades when illuminated by light from different sources and this phenomenon is due to the strong absorption of the central portions of the visible spectrum and the consequent variation of shade and colour when there is variation at the extreme ends. It would, therefore, seem that one must attempt the production of a source of light which would reproduce daylight or sunlight as nearly as possible without filters and then possibly correct these by filtration or reflection to a limited extent, the objection to the latter process being stated above. Thanks chiefly to the therapeutic qualities of sunlight, attention has recently been focussed on this matter. By the kindness of Messrs. Cox Cavendish Electric Co. Ltd., we have been able to secure a reproduction of the spectra of various illuminants, and from an American source we have also obtained details of the spectrum of the violet carbon arc. (Figs. 6 and 7.) Our results show how these sources fit in with true requirements. The latter is certainly amongst the best obtainable for the purpose of fading tests, but our results show that they are really little criterion as to what actually happens in sunlight under varying atmospheric conditions.

The tungsten carbon arc is being investigated as a possible source of illumination for fading experiments. It is extremely rich in the ultra-violet, but careful scientific work has yet to be done on it before a definite decision can be made.

In a recent paper by Hermann (*Chem. Zeit.*, 1924, p. 813) it is shown that sunlight consists of vibrations of light of 2,000 to 40,000 Å.U. and is particularly rich in 8,000 to 40,000 Å.U., and only contains 1% of 2,000 to 3,000 Å.U. The mercury vapour lamp has been suggested as a possible standard source, but it yields 25 to 30% ultra-violet light and visible light of only 4,000 to 6,000 Å.U.

Hermann divides dyes into four categories expressed as follows—

Category 1—Colours destroyed by short wave length = Microtrope system.
2—Colours destroyed by long wave length = Macrotrope system, e.g., Auramine.
3—Colours destroyed by short and long wave lengths = Homotrope system.
4—Colours destroyed by longer ultra-violet wave lengths have more effect than the shorter wave lengths, i.e., 3,000–4,000 Å better than 2,000–3,000 Å = Mesotrope system.

Examination of the eight norms of the German Commission on colour fastness for wool, three were in Category 1, four in Category 4, and one in Category 3. The cotton colours gave six in Category 1 and two in Category 3. None in Category 2.

As an outcome of this work it is suggested that there is a selective bleaching power for different wave lengths. The paper concludes that ultra violet light from the mercury lamp is not a satisfactory substitute for daylight in fading tests.

Harrison used two types of lamp for comparison with sunlight—a small Heracus mercury lamp, 110 volts 4 amps., 222 volts 2 amps., and a large Westinghouse mercury lamp 220 volts 3·5 amperes, and with patterns placed 25 cm. from the lamp, exposures were made and the results compared: 140 hours sunlight compared with 24 hours with the small mercury lamp, and 170 hours sunlight with five hours with the large lamp. The results show considerable differences in the relative fading, thus Brilliant Fast Blue 2G 1% gives a fading expressed by 1 unit for sunlight and by the small mercury lamp 8 units, whereas Brilliant Pure Yellow 6G 1% shows 9 units by sunlight and 2 by the mercury lamp.

"The results show an interesting effect; with four yellows tested, Cotton Yellow and Chrysophenine are faster to sunlight than Thioflavine and Auramine. With light from the small lamp the four colours were practically of the same fastness, whilst with the large lamp, which gave a light of high intensity, Thioflavine and Auramine were faster than the other two."

"Light of high intensity does not act relatively the same on all colours as light of low intensity."

A white flame carbon arc of 5,000 c.p. with the globe removed was used by Mott, and was stated to give "essentially similar results" to sunlight, but showed greater speed. Best June sunlight for 50 hours gave an effect equal to between 10 and 20 hours of 28-ampere white flame arc at 10 inches.

There is a growing tendency to rely on the results obtained by exposing patterns to the arc lamp as a substitute for exposure to daylight. We have made a number of comparative exposures of worsted patterns dyed with typical dyestuffs, and in all cases the fabrics were dyed according to the normal instructions of the dyestuff makers. The patterns were exposed to sunlight from 23rd July to 17th September 1925, facing south; one set was exposed in the country 15 miles from Leeds, and the other set in Leeds itself, the average relative humidity being 80·5%. The former, after exposure, were comparatively clean, whereas the latter were dirty and had to be cleansed with Saponin solution before comparison. The patterns were exposed without a glass covering for four periods each of 14 days, so that the shortest exposure was 14 days and the greatest 56 days. It was found by comparison with type exposures that each period of 14 days gave approximately the same amount of fading of a new strip. The faded patterns were examined and grouped into five classes representing relative fastness. Patterns from the same dyed worsted were exposed to the arc for two periods each of 70 hours. The patterns were placed 10 inches from the arc at an average temperature of 132° F. and approximately 75% R.H.

The two sets were compared and it was found that different dyes exposed to the arc lamp showed a different relation to the sunlight fading. A list of results follows. + or — numbers were given to the electric arc faded patterns as they corresponded to the 1 to 4 sunlight fading periods; + signifies more fading than sunlight and — represents less fading than sunlight.

Judgment of the results was entirely by direct observation and no observations were made with a tintometer or other absolute colour measuring apparatus. The figures are, however, sufficiently approximate.

It will be seen that there is a wide variation in the relative fading, but it will be noted that five patterns of Indigo dyed worsted, dyed to shades increasing from a pale sky blue to a full navy, behave identically to sunlight and to the electric arc.

The table below gives opposite to each dyestuff the group of relative fastness to sunlight judged according to the system suggested by us, and figures representing the comparative amount of fading by the flaming arc lamp to exposures in the country (Clifford) and town (Torridon).

From 71 patterns exposed for 42 days at Clifford, 70 hours arc light gave an average fading ratio of 1 : 1·23 and from 140 hours an average ratio of 1 : 1·97. For 60 patterns exposed at Torridon for 70 hours arc light the ratio was 1 : 1·47 and for 140 hours 1 : 1·78.

The main point to notice is that the electric arc fading does not place the dyestuffs in order as regards fastness to sunlight. The second period of exposure in our experiments gives a greater relative amount of fading by the arc than the first period, and further, this relative amount is greater than that of sunlight.

We have not yet had the opportunity of investigating the effect of variation of relative humidity of the atmosphere surrounding the patterns; the relative humidity actually in contact would be affected by absorption of heat and by local temperature. But we give the results because they have

	Name of Colour	Per cent.	Relative Fastness to Sunlight Group	Comparison with Arc Lamp			
				Clifford		Torridon	
				1st Period	2nd Period	1st Period	2nd Period
1	Indigo Carmine X	4	0	—	—	0	0
2	Ponceau RG	1½	I.	− ¼	− ¼	+ ½	+ ½
3	Brilliant Bordeaux B	2¾	I.	+1	+1½	+1	+1
6	Xylene Blue AS	3	I.	+1½	+4	+2	+2
7	Azo Rubine	2¾	II.	+1	+1½	0	+ ½
9	Azo Acid Red L	4½	II.	+ ½	+1½	+1½	+1½
10	Victoria Rubine O	3	II.	+2	+2	+1	+2
11	Alizadine Orange M paste	3	II.	0	+3	0	+1
13	Khaki Yellow WN paste	3	II.	− ½	0	0	+1
14	Neolan Violet R	½	II.	+1	+3	0	+ ½
15	Kiton Red S	4½	III.	0	+1½	+ ½	+1
16	Neolan Pink B	2	III.	0	+2	+1	+2
17	Chloramine Fast Red F	2½	III.	+1	+3	+2	+2
18	Chloramine Fast Red F	2½	III.	+1	+3	+2	+2
19	Sorbine Red	4½	III.	+1	+2½	+2	+2
20	Lanafuchsine SG	4½	III.	+1	+2½	0	+1½
22	Erio Fast Fuchsine BL conc.	5	III.	+2	+4	+3	+3
23	Neolan Violet R	0·5	III.	+2	+2	+3	+3
24	Eriochromal Grey R	½	III.	+3	+3	+1½	+2
25	Indochromine RR	3	III.	+3	+4	+2	+2
26	Alizarine Blue SCB	10	IV.	+2	+3	+3	+3
27	Solway Blue Black 3B	4	III.	+2	+3	+1	+2
28	Solway Blue B	4	III.	+1	+2	0	+1½
29	Indigo	—	III.	0	+2	+2	+2
30	Indigo	—	III.	0	+2	+2	+2
31	Indigosol O	15	III.	+2	+2½	+2½	+2½
32	Alizarine Blue Black	4	III.	+2	+3	+3	+3
33	Ultra Viridine	3	III.	+2½	+3	+3	+3
34	Neolan Green B	2	III.	+2	+2	+2	+3
38	Solochrome Yellow Y	1	III.	−1	−1	−1	−2
39	Erio Flavine A conc.	3	III.	−1	−1	− ½	− ½
40	Chlorazol Fast Red FG	2½	IV.	+1	+1	+1	+2
41	Diamine Fast Red F	2½	IV.	+2	+2	+3	+3
42	Diamine Fast Red F	2½	IV.	+1	+2	+3	+3
47	Oxyphenine GG	3	IV.	0	0	−2	−2
48	Metachrome Yellow MY paste	7	IV.	+3	+3	−2	−2
49	Metachrome Violet B	3	IV.	+2	+3	+3	+3
50	Alizarine Blue OCB	5	IV.	+2	+3	+3	+3
51	Alizarine Blue OCR	5	IV.	+3	+3	+3	+3
52	Erio Alizarine Blue G	4	IV.	+2	+2	+2	+3
53	Gallocyanine BD paste	20	IV.	+4	+4	+2	+3
54	Neolan Blue G	6	IV.	+3	+3	+3	+3
55	Indigo	—	IV.	0	0	+3	+3
56	Alizarine Cyanine Green F pdr.	4	IV.	+3	+3	+2	+2
57	Solway Green E	4	IV.	+2	+3	+2	+2
58	Alizarine Cyanine Green G conc.	4	IV.	+2	+3	+2	+3
59	Soledon Jade Green	10	IV.	+2	+3	+1	+2
60	Omega Chrome Brown 2R conc.	3	IV.	0	0	0	0
61	Anthracene Brown WL powder	4	IV.	+3	+3	+2	+2
62	Eriochromal Brown G	4	IV.	+2	+3	+3	+3
63	Alizadine Brown M paste	4	IV.	+1	+2	+ ½	+2
64	Metachrome Brown BR powder	4	IV.	0	+2	+2	+3
67	Naphthol Green B	7	V.	0	0	0	0
68	Indigo	—	V.	0	0	0	0
69	Indigo	—	V.	0	0	0	0
70	Era Chrome Dark Blue B	5	V.	+3	+3	+3	+3
71	Chrome Fast Cyanine B	5	V.	+3	+3	+3	+3
72	Anthracene Blue BDG	4	V.	+3	+3	+3	+3
73	Eriochrome Black T	6	V.	0	+2	—	—
74	Solochrome Black T	6	V.	− ½	− ½	—	—
75	Solochrome Black 6B	5	V.	+1	+3	—	—
76	Solochrome Violet R	3	V.	+3	+3	—	—
77	Chrome Fast Violet B	3	V.	+1	+2	—	—
78	Eriochrome Violet BB	3	V.	0	+2	—	—
79	Omega Chrome Red B	4	V.	0	0	—	—
80	Eriochrome Red B	4	V.	+3	+3	—	—
81	Solochrome Red B	4	V.	+3	+3	—	—
82	Alizarine Red	—	V.	+2	+2	+3	+3
83	Monochrome Brown H paste	4	V.	0	+2	—	—
84	Oxyphenine R...	3	V.	−1	−1	—	—
85	Diamine Fast Yellow FF	3	V.	−1	−1	0	0
86	Diamine Fast Yellow FF	3	V.	0	−1	—	—

been obtained in a manner which is generally adopted by the trade. The results are not satisfactory and if such a method is generally used in its present state misleading conclusions will be obtained. Further investigation is necessary and possibly some modification in the source of light will have to be made and method of control of the humidity adopted.

In all these tests the arc was enclosed in a glass globe, since owing to the close proximity of the fabrics to the flame deleterious effects would be caused by scorching and also by the oxides of nitrogen, &c., given off. The effect of the glass globe on the transmitted radiation is of great importance. Luckiesh has given a table for different glasses 2 mm. in thickness, showing their transmitting power and these are tabulated below, together with other results derived from other observers. (See Figs. 8 and 9.)

Type of Glass	Absorption Limit
Vitaglass	2,750 Å
Uviol Crown Glass	2,800 Å
Pyrex Glass	2,900 Å
Common Glass	2,950 Å
Light Crown	2,950 Å
Extra Light Flint	2,980 Å
Medium Crown	3,000 Å
Light Flint	3,050 Å
Best Crown	3,100 Å
Medium Flint	3,150 Å
Ordinary Window Glass	3,300 Å

Quartz varies according as to whether it is fused or crystalline, the latter being much more transparent. Quartz absorbs in the region 1,850 Å. Recent work in America on fused quartz globes shows that comparatively quickly the heat of the arc affects its transparency considerably so that it soon becomes about the same as ordinary glass. (Fig. 8).

A point of note here, however, since wool is of a colloidal nature, is that gelatin is transparent to near and middle ultra-violet radiations. Vitaglass produced by Lamplough contains a large proportion of quartz and other constituents not present in ordinary glass, and has the property of transmitting radiation up to 2,750 Å. It is thus freely transparent to all the ultra-violet rays which occur in sunlight and is highly suitable for the globe construction for the arc in such fading tests. Figure shows the result of tests applied to this glass. It is hoped to use this in future experiments.

The precise influence of temperature in fading is little investigated, although Mott states that in common with the greater number of photochemical reactions, the temperature coefficient (i.e., the ratio of the rate reaction at one temperature, to that at 10 degrees lower) of the fading of dyes is small. Schwezoff investigated the effect of temperature on the rate of bleaching of dyed collodion sheets and found that between the approximate limits of 18° and 90° Centigrade the temperate coefficient for visible radiation was only 1·036 to 1·084. It must be borne in mind, however, that aniline dyes particularly, are photoelectric and temperature has small influence on the photoelectric effect. In, however, the case of alkali metals, polarisation of the rays increases the photoelectric effect when the vibrations in the rays are vertical to the metal acted upon. If they are horizontal there is no influence whatever. The photoelectric effect is probably directly proportional to the amount of ultra-violet absorbed (Grotthus' Law). The precise effect of polarised light on the question of fading has been little investigated and consequently the question is one which has yet to be answered fully.

Another point requiring investigation is the angle at which the light falls on the fabric during fading tests. In our experiments the patterns were exposed so that the light fell perpendicular to their surface. In sunlight the light falls at all angles and the effect of this is not yet investigated.

Humidity, however, plays an important part in all textile matters and certainly in fading of dyestuffs it is important. Of the relation of humidity to fading, and of temperature and humidity combined very little is known.

Photometric Investigation

There appears to be little available information about the variation of the fading power of sunlight. G. C. Wardle in a private communication has given us some interesting unpublished results obtained recently by exposing patterns dyed with Victoria Blue to sunlight during six separate months, and the results obtained by exposing to five different cloud conditions.

We have compared the results of the fading in full sunshine with Scott's light table and Burton's exposure table for photographic purposes and the following extract will give some idea of the agreement of the fading of the blue dyed pattern with variation of sunlight.

	Fading Units. Dull Light	Dull Light Ratio. 100 for June	Fading Units. Full Sun	Scott's Table, Ratio
June	10	100	100	100
May	8	80	80	80
April	6	60	60	66
March	5	50	40	50
February	2	20	30	28
January	1	10	25	16·7

It is evident that in full sunshine the amount of fading is in good relation to Scott's light values, in dull light the fading value is one-tenth that of full sun (for general photographic purposes one-quarter is generally correct). It will be noticed that in January there is a falling off in fading value in dull light, whereas in full sun it appears better than one would expect.

The results so far show that sunlight gives a fairly constant relative fading under all conditions for this particular dyestuff; a similar examination of other shades would yield valuable results.

The precise effect of fading by light of various colours or by monochromatic light of different wave lengths has been little investigated. As early as 1885 Depierre and Clouet examined 76 typical colours dyed on calico, in different coloured lights. They found that red rays had the least action, yellow rays exert the strongest action on material dyed red or blue, and blue rays had the greatest effect on orange, yellow, green, and violet. It was also found that white light had the greatest fading action, and that light complementary to the colour of the fabric had a great fading action, and that a coloured light essentially the same shade as that of the fabric had no effect. Thus there is some connection between fading and the wave-length of the incident light.

Gebhard asserted that light of different wave lengths may cause oxidation to proceed in different ways and that oxidation in the light may be different from that in the dark. Really precise and reliable data on this point are scarcely known and this is a problem which needs tackling in a strictly scientific manner.

Technical Applications of the Problem

The production of coloured fabrics necessitates some fairly exact knowledge of the fastness of the dyes used, but unfortunately this information is by no means accurately standardised, or rather there is no agreed international system of standardisation. The question of relative fastness has been discussed by Commissions both in Germany and America.

The German Commission in 1914 and 1916 suggested eight groups or norms of fastness to light, specifying for each norm a dye of definite quantity and method of application to wool and cotton, so that these standards shall be exposed with every batch of patterns for comparison. Hirst has suggested an alternative scheme of six groups only, in order to simplify and make the degrees of fastness more equal, it also being thought advisable to take each standard pattern to represent the minimum fastness for each group.

It is not always considered necessary to use the fastest dyes for certain articles of commerce. Material intended for a short wearing life only requires a dye which will last for the life of the garment. Also shades are demanded which can only be supplied by means of relatively fugitive dyes; this applies mainly to pale or certain very bright colours.

Another problem arises in the mixing of dyes to obtain certain shades. All the dyes used, frequently as many as three or four, must be of equal fastness, or rather their fastness must be such that the occurrence of fading will leave the material of the same tone as the original. Further we have been approached by practical dyers who have had curious experiences when using mixed dyestuffs. In some cases the mixture is more fugitive than would be expected, but in one case picric acid and indigo carmine, both notoriously fugitive, when mixed in a certain proportion give a fast result.

There is also the question of suitability of certain manufactured materials to withstand the processes required in dyeing. Finally there is the ever-present question of cost. We have tried to induce dyers to use specially fast dyes, but we are confronted with the cost problem, which may, however, prove short-sighted in view of the productions of foreign competitors who are supplying definitely faster dyes to markets where sunlight is more prevalent than in this country.

A method for easy and rapid exposure is necessary so that actual mixtures may be readily tested and also a simple method for recording changes in hue is desirable; if information can be obtained which in some way connects the adsorption spectra with fastness to sunlight, it would be easier to predict the result of combination shades. Or, more precisely, the amount of fading should be ultimately expressed in simple numerals just as the durability of metals can be so recorded.

Amongst previous investigations there are several publications on the technical aspect of fading.

Mott gives a general account of the subject, with particular references to paints.

Cunliffe presents a very complete bibliography of the subject.

Dreaper devotes a considerable space to this matter and there is a concise section in "A Manual of Dyeing," by Knecht, Rawson, and Loewenthal.

Influence of Air and Gases

Before considering the effect of light on dyed materials it is important to eliminate the effect of other causes. The influence of gases which surround the fibres has been the subject of investigation. Chevreul found that if dyed patterns are exposed to sunlight in exhausted glass tubes, and in tubes filled with inert gases, the amount of fading was negligible. More

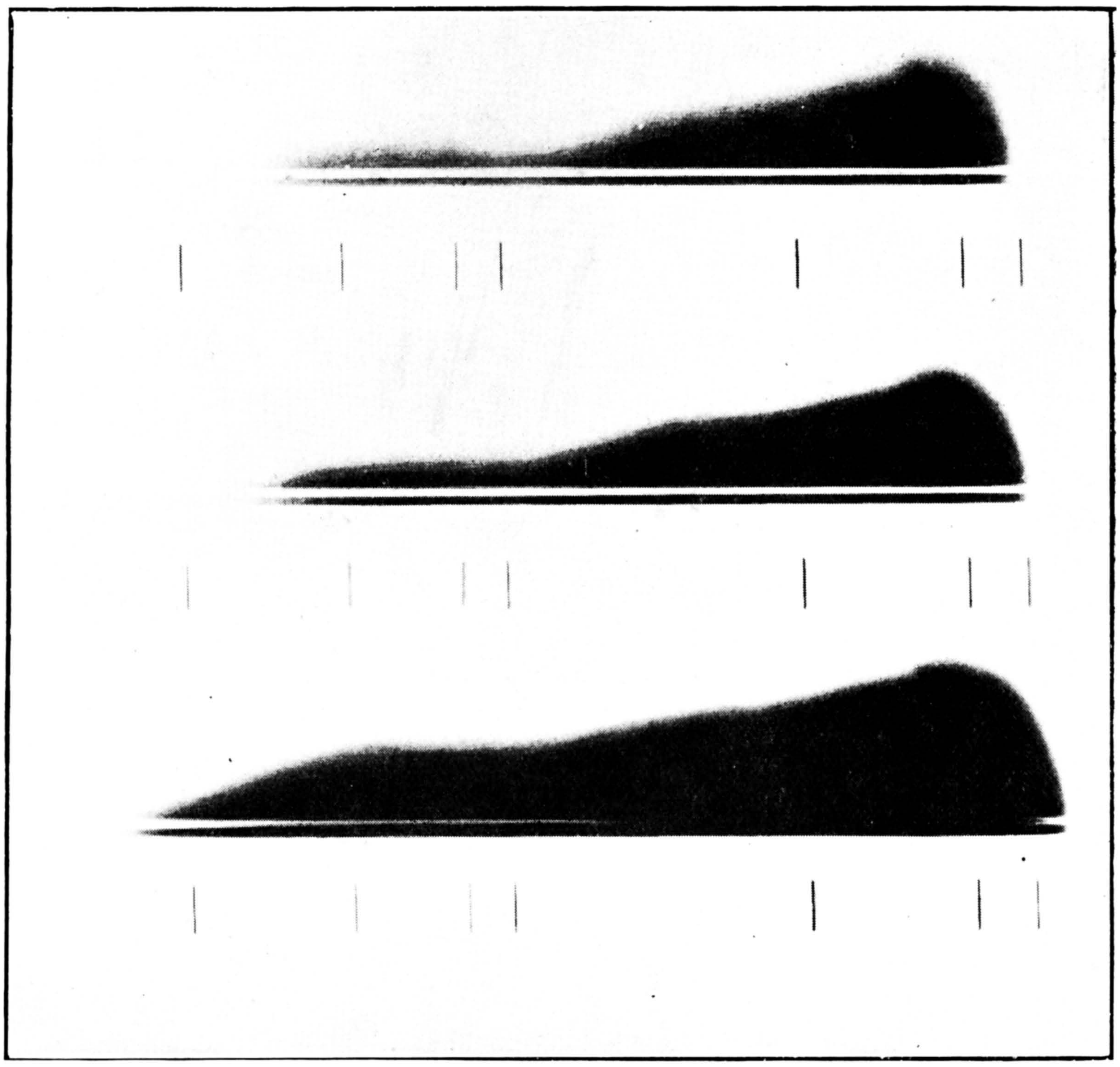


FIG. 3
Typical record showing plate for determination of distribution of energy in various spectra.

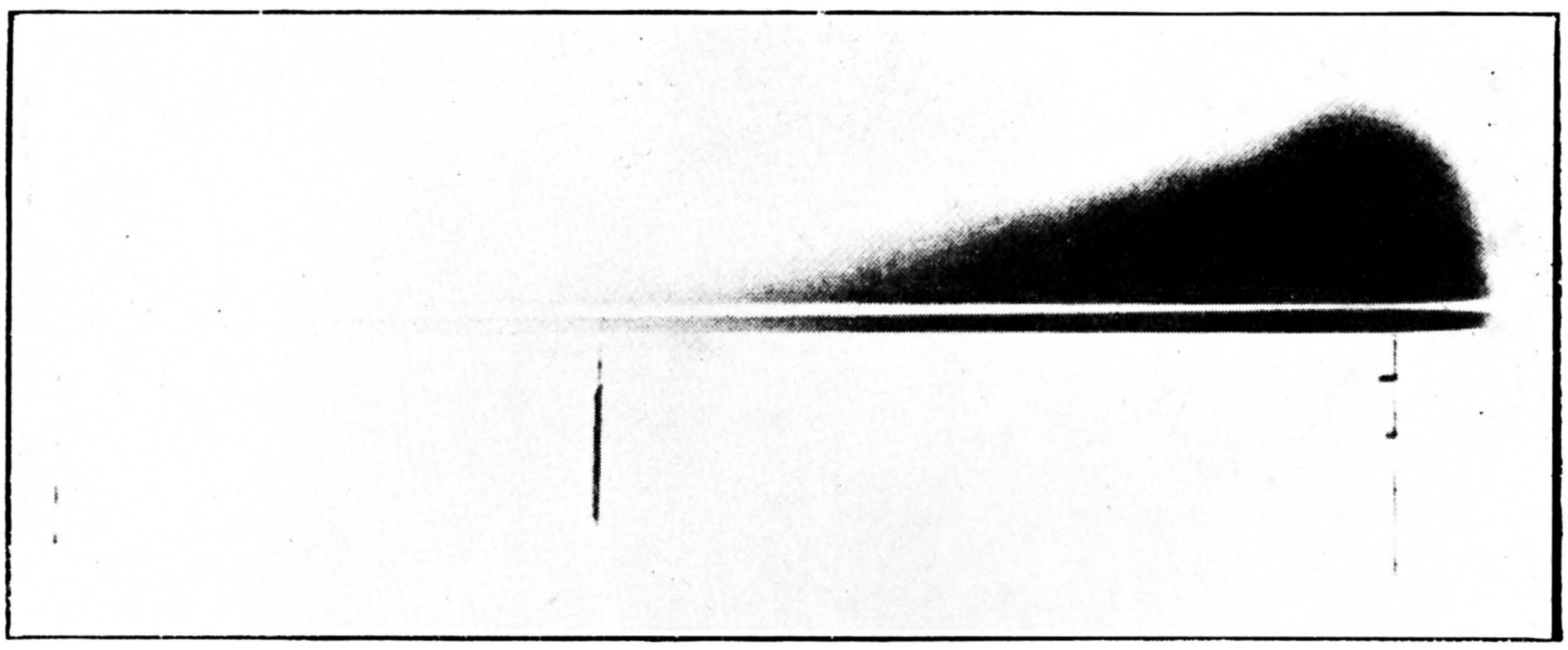
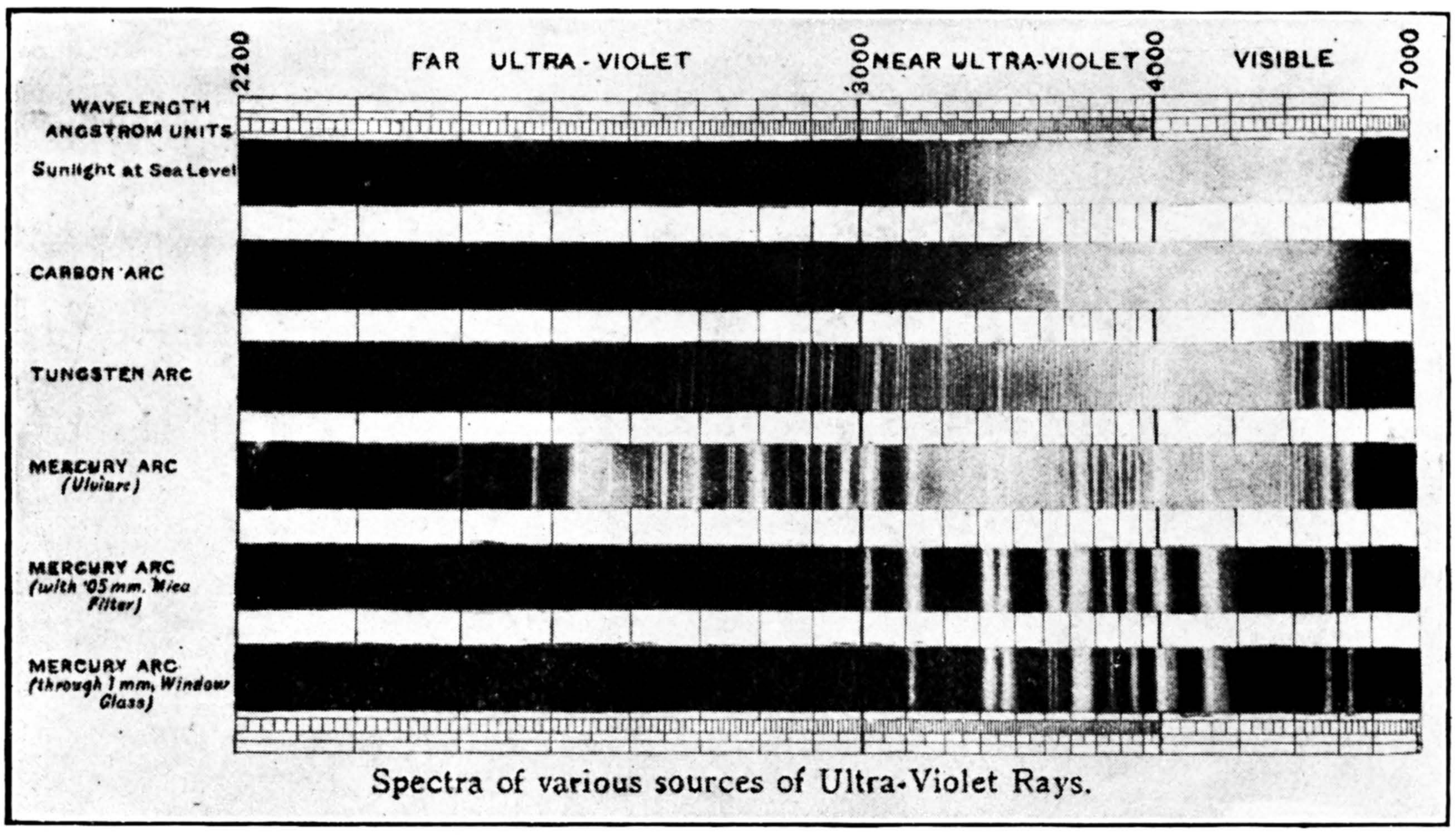


FIG. 4
Enlarged record showing effect of process screen.

face page T496



Spectra of various sources of Ultra-Violet Rays.

FIG. 6

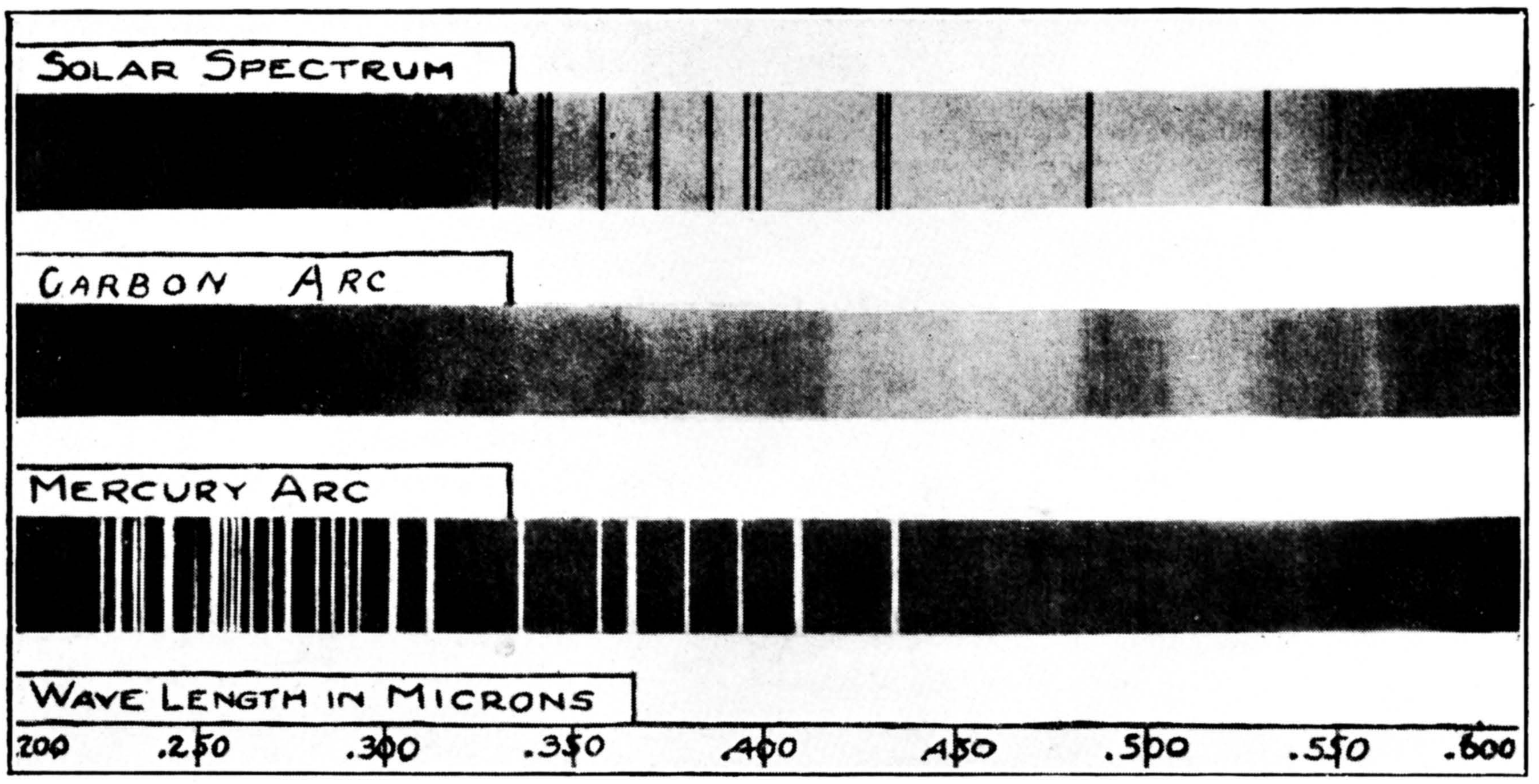


FIG. 7

Comparison of spectra of sunlight, violet carbon arc, and mercury arc.

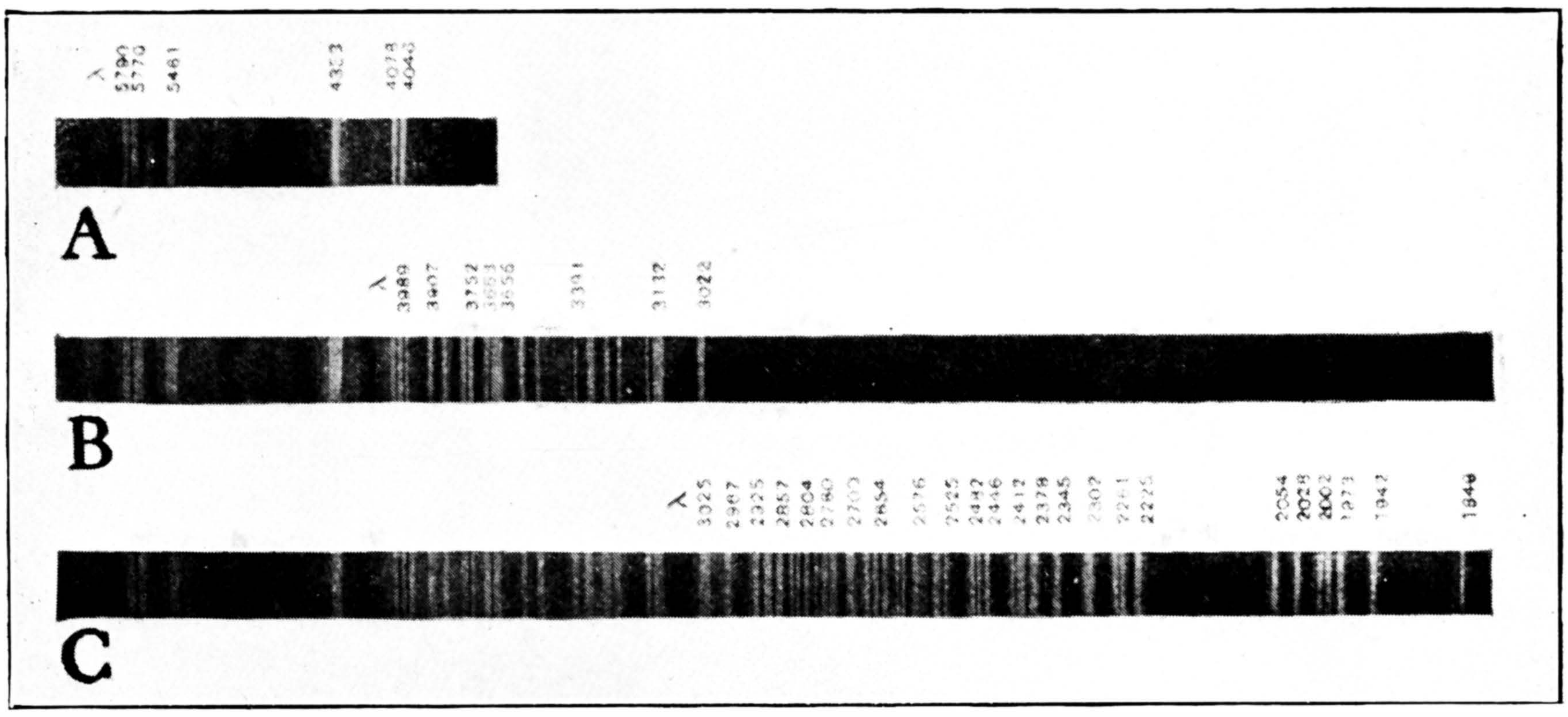


FIG. 8

Spectra of mercury vapour arc taken through various transparent media.
A—Visual spectrum.
B—Transmission through crown glass.
C—Transmission through clear fused quartz.

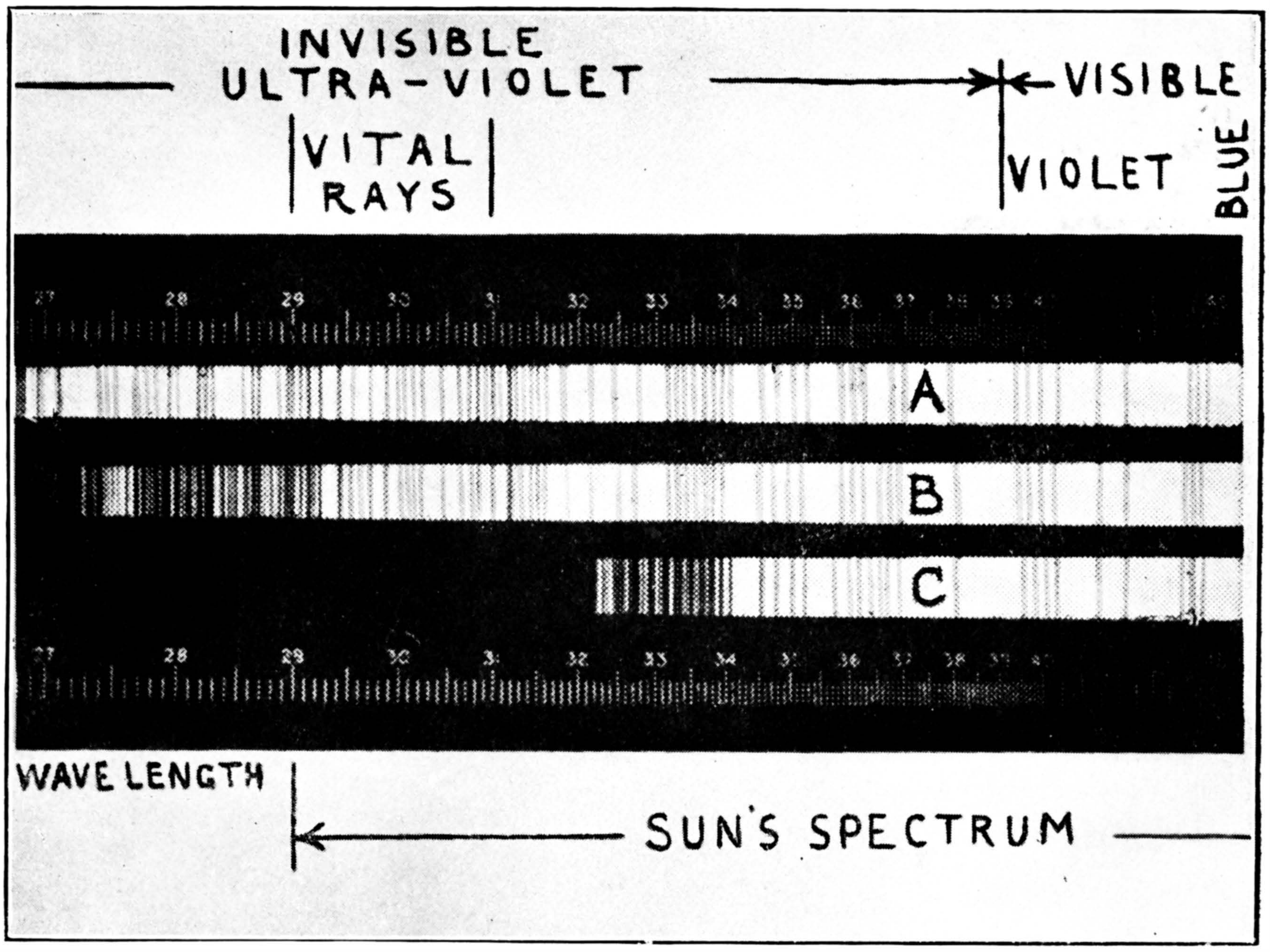


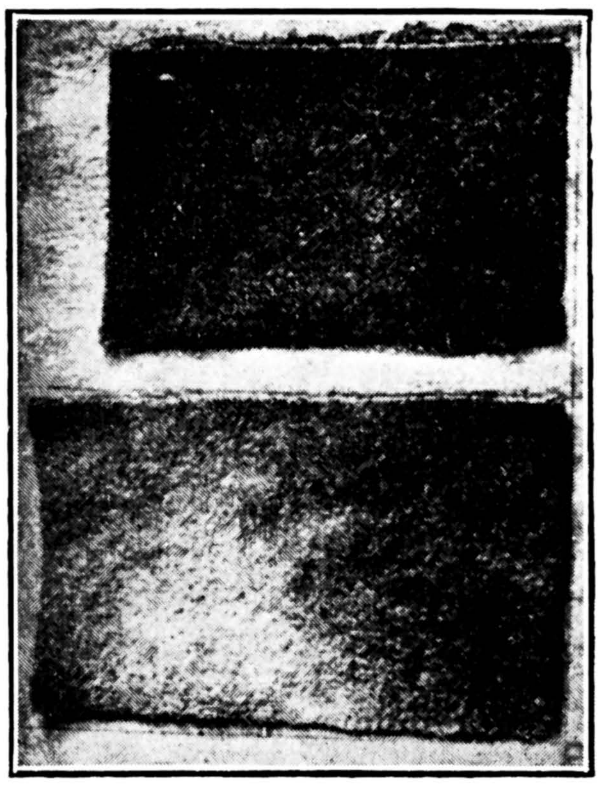
FIG. 9

Spectrum photograph, showing the composition of light from an electric arc between iron poles taken by the Hilger quartz spectrograph with wave-length scale.

A—Light of iron arc without any screen.

B—Light of iron arc passed through vitaglass 2 mm. thick. This shows that vitaglass transmits the vital rays to the extreme limit of the sun's spectrum.

C—Light of Iron arc passed through ordinary glass 2 mm. thick. The vital rays are completely obstructed.



Dry atmosphere.

Saturated atmosphere.

FIG. 10
1% Formyl Violet S4B, exposed to sunlight for 28 days.

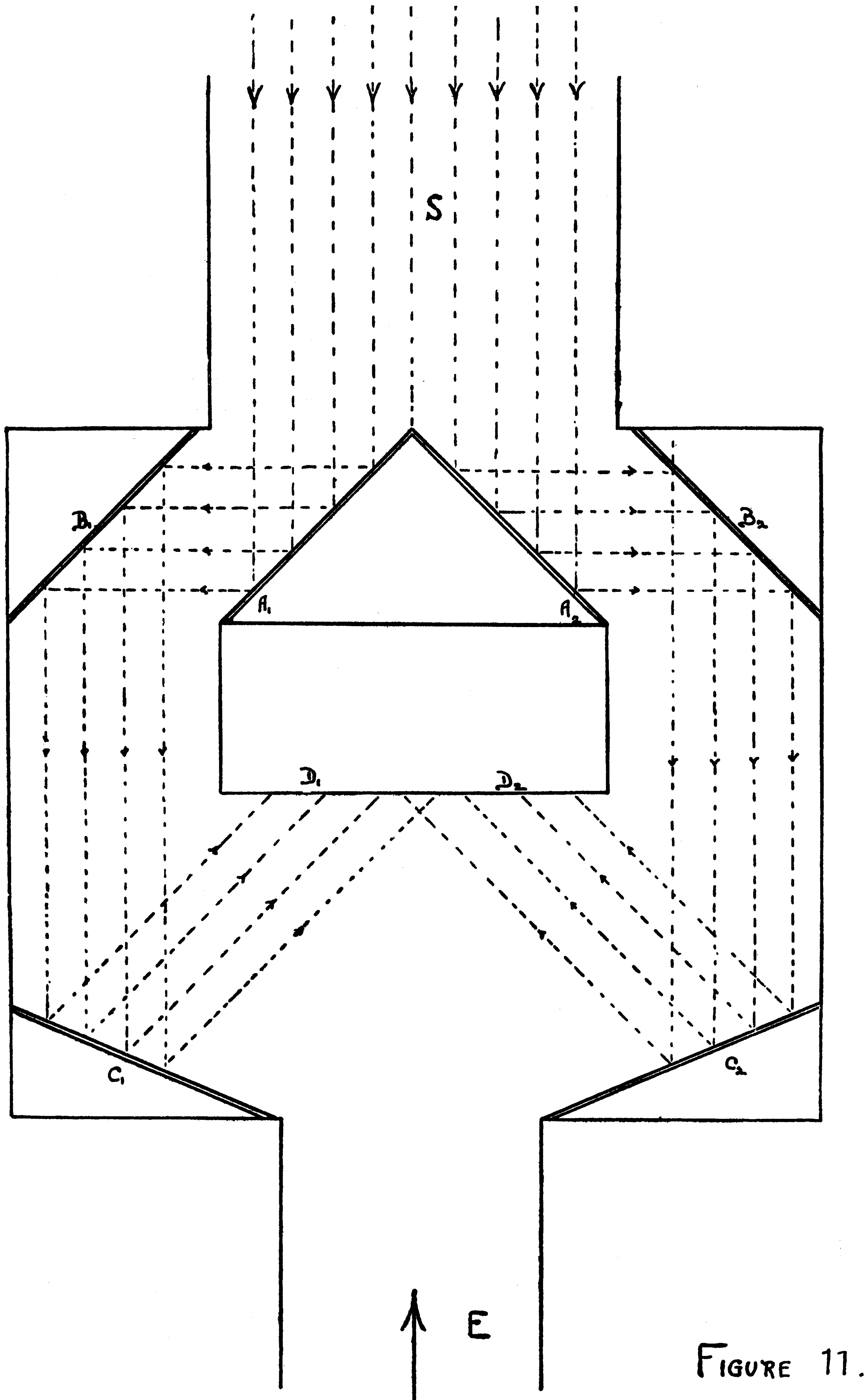


FIG. 11

recently Gebhard and others have confirmed this statement. Moisture without the presence of oxygen and dry oxygen filled tubes, hydrogen or nitrogen gases, and as will be shown later, oxygen and water vapour appear to enter definitely into reaction with the dyestuff fibre system when exposed to sunlight.

Brownlie states that an alkaline atmosphere increases the bleaching effect of sunlight on the dyestuff fibre system. Alcohol and pyridine increase enormously the bleaching effect of sunlight, whereas an acid atmosphere reduces the amount of fading. Choloroform or solvent naphtha slightly retard the fading, and some other organic solvents have no influence.

With reference to the increased fading due to alcohol vapour it has been shown by King that alcohol is absorbed by wool in the same manner as water vapour, and held very tenaciously, so that in the presence of alcohol vapour we have a totally different system and one may expect a definite reaction to take place in the presence of light, with the probable formation of aldehydes or other reducing substances.

The statement that alkali increases fading appears to be generally accepted, but this statement should only be taken as approximate. We have found exceptions to this rule and are investigating the matter more fully; it is, however, important that when patterns are tested that they should be of such alkalinity or acidity as would obtain with the material when in actual use.

The humidity of the atmosphere surrounding the dyed material when exposed to light has a considerable effect on the rate of fading. Brownlie states that the greater the humidity the more rapid is the fading action of light, and that the well-known increased rapidity of fading in sea air is due to greater clearness of the atmosphere, more moisture, and the presence of hydrogen peroxide or ozone, probably produced by evaporation of water from large areas. It must be remembered that there is a large amount of reflected light from large areas of water which will of course increase the total amount of incident light on the dyed material. The same probably applies with regard to the greater bleaching effect of light when snow is on the ground; for instance, in the drying of furs, "burns" occur when they are exposed to the air with snow on the ground, exactly the same as on exposing to hot sunshine. Snow of course reflects ultra-violet rays extremely well.

It is well known that the amount of fading caused by light differs considerably in dry and moist climates where the amount of sunlight can be assumed to be equal. For all standard estimations of fading the degree of saturation of the atmosphere has to be carefully considered.

It is important to remember that in all cases one must not consider the effect of light alone, but light plus atmosphere, and it would be preferable to speak of atmospheric fading rather than light fading. This question of atmosphere is much more important when attempting to substitute artificial sources of light, for sunlight. In any instrument used for the purpose it is essential that the atmosphere surrounding the patterns can be readily controlled, not overlooking the effect of intense radiation in raising the temperature of the solid material.

Chemical Reactions occurring during Fading

From the above it will naturally be assumed that part of the fading is a chemical reaction as well as a physical effect of light itself.

Gebhard assumes firstly a reaction between oxygen and water ions, with the resulting formation of perhydrioxyl ions.

$$\overset{+}{O}\cdot\overset{-}{O} + \overset{+}{H}\cdot\overset{-}{OH} \rightleftharpoons HOOOH \rightleftharpoons \overset{+}{HO}\cdot\overset{-}{OOH}$$

and, secondly, union of the dyestuff.

Experiments "based on the change in concentration of ions in solution upon electrolysis, have shown that where the concentration of the perhydroxyl ions is highest, the degree of fading taking place in the solution is greatest," and that "dyestuff peroxides" have been formed on the fibre in the case of many differently constituted dyestuffs.

In pure dry air, peroxides of the dyestuffs are formed which are relatively stable, and show reactions for peroxides and not for hydrogen peroxide before any colour change is visible; but on the admission of moisture, perhydroxides tend to be formed and there is a more rapid destruction of colour. We have two types of peroxides formed; $A\left\langle\begin{matrix}O\\O\end{matrix}\right\rangle$ a relatively stable form and a labile highly reactive form of the peroxide hydrate type $A\left\langle\begin{matrix}O\text{—}OH.\\OH\end{matrix}\right.$

The dyestuff peroxides are formed during exposure to dry air, but peroxide hydrates result from the addition of perhydroxyl ions produced by the union of oxygen atoms with the ions of water. "The peroxide hydrates are highly reactive and the active oxygen they contain may act on the unchanged molecules of the dyestuff and upon other members of the system (for instance, the fibre) with the production of acids and phenols. The existence of acid groups produced in some such manner has often been noticed."

Even in moist atmosphere peroxides alone may be formed, when from the constitution of the dyestuff or its combination with other substances the peroxide hydrate passes into the more stable peroxide. Such dyestuffs are said to be fast to light, as they give no change on long exposure.

Harrison criticises Gebhard's conclusions and considers that the existence of peroxides in the presence of cellulose is problematical, and that Gebhard omits to consider the fibre itself, whereas under the influence of light and atmosphere, the fibre may have a reducing action. Harrison has shown that certain colours are bleached by light from the mercury-vapour lamp in the absence of air, but in the absence of the fibre they were unaffected. There is no doubt that, under the action of light, wool fibre is changed in composition, its colour and strength being altered, and also its capacity for redyeing begin much altered. Under the influence of light many possible reactions may occur—

(1) The light may convert oxygen into ozone, and this or the ozone itself may oxidise the dyestuff.
(2) The fibre may reduce the dyestuff.
(3) Or both these reactions may occur at the same time.
(4) The air or ozone may oxidise the fibre and produce substances more capable of reducing the dyestuff.
(5) The air or ozone may oxidise the dyestuff and produce a substance more easily reduced by the fibre and its oxidation products.
(6) The fibre may reduce the dyestuff or otherwise react with it to produce substances more easily oxidised by the air.
(7) The light may cause one portion of the colour molecule to react with another.

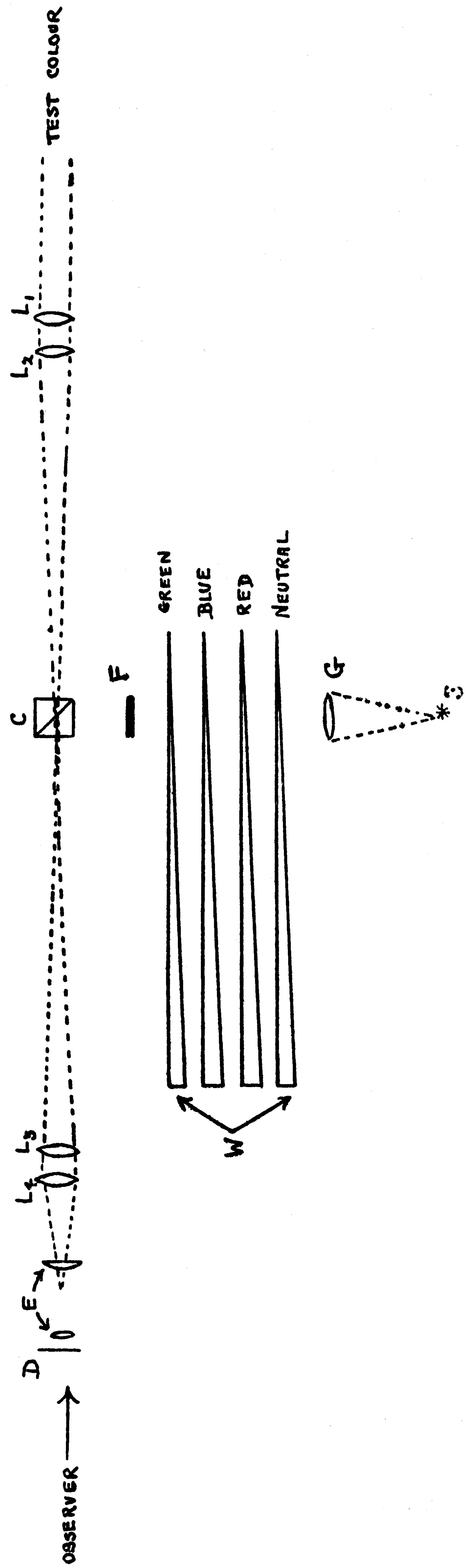


FIG. 12—Eastman Colorimeter.

He considers that each theory may be correct, but is applicable to a limited number of dyestuffs.

H. S. Hirst and E. K. Rideal, in a recent letter to *Nature*, state that during the course of an investigation on the photochemical combination of gases their attention was directed to the marked diversity in the rate of combination of gases such as hydrogen with oxygen, &c.

The authors proceed to note their own work on the catalytic action of a mercury surface, and show that in the presence of the same there is considerable acceleration of the rate of reaction. They had, however, not completed the investigation of the influence of water-vapour on such surface reaction. This work is of great interest from our point of view since fading is probably a photochemical surface reaction. It is possible that the variation in rates of fading is partially due to variation of catalytic power of the substances upon the fibre surface around it, such as the dyestuff itself, water vapour, &c. In the case of different kinds of fibres the amount of reaction may vary with the surface area exposed to the fading agency. Cotton fibres are of a flat, ribbon-like nature, whilst those of wool are elliptical and almost circular in cross section. The action of water vapour in such photochemical reactions is of supreme importance since wool is so very hygroscopic in nature and its physical properties are so variable according to its moisture content. The precise function of water in the fading process is, as yet, unknown.

Brownlie discusses the relation of chemical constitution of dyestuffs to fastness to light, and their behaviours towards oxidising and reducing agents—the results are confusing but he classifies them as follows—

(1) Colours derived from phenol and its homologues and their sulphonic acids and carboxylic acids are fast to light, fast to oxidising agents, although turned a trifle darker in colour, and fast to reducing agents.
(2) Colours derived from phenols containing more than one hydroxyl group are loose to light, and as regards oxidising and reducing agents vary from loose to fairly fast.
(3) Colours derived from alpha and beta naphthols are loose to light, fairly fast to oxidising agents and loose to reducing agents.
(4) Colours derived from amidonaphthol sulphonic acids 2 : 8 : 6 and 2 : 8 : 3 : 6 are fast to light and loose to both oxidising and reducing agents. Those from 1 : 8 : 3 : 6 and 1 : 8 : 2 : 4 are loose to light, not fast to oxidising agents, and loose to reducing agents.

As oxidising agent, N/50 permanganate was used and, as reducing agent, dilute hydrosulphite solution. The dyestuffs were direct cotton colours.

He gives lists of dyes showing the influence on the fastness of the dye molecule, by the addition and substitution of various radicals and apparently the fastness can be more or less accurately known by the chemical constitution, but so far no apparent theoretical connection is discernible.

Influence of Oils, &c.

Hannay experimented with dyed cotton cloth treated with oils, soaps, &c., using ammonium soaps of various fatty acids. Castor oil fatty acids increase fading, whereas stearic acid has a protective influence. The general conclusion is that unsaturated fatty acids present in greater or less degree influence fading in the same proportion.

These results are not surprising, for fatty oils which contain unsaturated groups form stable peroxides in dry air, which readily liberate oxygen in the presence of moisture. We have no information with regard to the action of oils on the fading of wool dyed material, but an investigation would be worth while because manufactured wool practically always contains about 1% of fatty acid after scouring.

Dextrine is known to increase the fastness of dyes.

The reduction of colour may be due to either oxidation or reduction. The formation of a dye is generally an exothermal process, whilst its decomposition is due to an endothermal reaction which is brought about by the application either of light or of electrical energy. Grotthus stated that only those rays of light which are absorbed are effective in producing chemical change. The law of Ritter, Herschel, and Becquerel states that rays of long wave length exert an oxidising action as opposed to the reducing action of rays of short wave length. It thus appears as though both types of reaction can occur and, arguing from the statement that absorbed rays are effective, some relation might be established between the fading of certain colours, say red or blue, and their behaviour to oxidising and reducing agents.

It has been found that in some cases light does cause change in chemical constitution; e.g., Kernbaum finds that distilled air-free water in a quartz vessel evolves gas in a few hours when exposed to light, showing that water has been decomposed by the light. Tian finds that the velocity of decomposition of hydrogen peroxide in aqueous solution increases with increasing frequency of the exciting ultra-violet radiation.

The action of light on ferric salts is well known; they are reduced to ferrous salts. We have an example of a piece of white worsted cloth which was contaminated with iron during the bleaching with SO_2 when the iron would be present as ferrous sulphite. The action of light has formed a brown stain of a ferric salt. Thus here we have a definite case of light acting as an oxidising and as a reducing agent.

It is also known that when Professor Rutherford exposed dyed patterns to positively charged helium atoms from radium emanation, cellulose was greatly damaged and many direct and basic colours and indigo were bleached, but little action was observed on Indanthrene and Para Red. "Flavanthrene was turned green just after exposure, showing that it was reduced presumably by the oxidation products of cellulose." From the table of results the effect of radium emanation is different in degree and quality from sunlight.

Influence of Sunlight on Wool

It has been observed that when undyed wool is exposed to sunlight a considerable amount of acid wool products are formed and are readily soluble in alkali. The brownish colour given by long exposure is similar to that obtained by a short exposure after an alkaline treatment, and both can be removed by acid. V. Bergen shows that sunlight destroys the epithelial scales and then the fibre is readily damaged by dilute alkali, and that wool wetted with 0·5% solution of sulphuric acid prior to exposure was far more damaged than wool previously wetted with a 1% solution of carbonate of soda. After exposure to sunlight more acid was found in the acidified fibre than was originally present. This he explains by the generation in the fibre of free acid from the sulphur which it contains.

As dyes on acid wool are generally less affected by sunlight than alkaline wool, it is suggested from the above that the fibre and the decomposition of the fibre is not such a serious factor with dyed wool as with cotton, and there is a considerable difference in the behaviour of the two fibres dyed with the same dyes, to the action of light. We have examined fibres submitted to the action of a flaming arc lamp and notice that a similar disintegration takes place, and also the formation of acid products producing a yellow colouring matter when neutralised.

Measurement of Colour

To turn to the question of colour matching, it is of extreme importance that the amount of fading should be measured absolutely. The exact amount of fading as also the exact depth of colour in a particular shade is a matter of great urgency. In order to obtain really scientific information, account must be taken of the constitution of the light reflected from the dyed material and not of the dye in solution. There are many records of visible absorption spectra of dye solutions but none available for the constitution of the light reflected from dyed patterns. In many cases the colour of the dye solution is quite different from that of the dyed cloth.

To turn to colorimetric measurement a brief survey of the various methods available is given below.

Colorimeters measure colour in terms of its visual appearance, and not in terms of spectral distribution. The stimulus corresponding to a given colour sensation may be expressed algebraically in terms of the amount of red, green, and blue stimuli required to form a mixture corresponding to the stimulus specified. The most frequent application of colour measurement is the reproduction of the stimulus resulting from the illumination of a "coloured" surface by white light. The possible variations in the colour of certain articles when viewed under daylight and artificial light alternately are well known, and also there is variation according to the direction in which the articles are viewed, owing to diffused reflection of the light. It is necessary in colorimetry to specify a standard method of illumination and observation. Dr. Martin and others have suggested that the illumination shall be parallel white light incident at 45° to the normal, and that the direction of view shall be normal to the surface illuminated.

An instrument for obtaining uniform illumination by daylight over a limited area, as shown in Fig. 11, has been devised in our laboratories. The light enters through a rectangular opening S and is incident on the two plane mirrors A_1 and A_2, placed at right angles to one another and so that the light rays are incident at 45°. The light, after reflection at these mirrors, falls on to the two plane mirrors B_1 and B_2, and, after reflection at these, is incident on the two plane mirrors C_1 and C_2. These mirrors are very lightly ground, so that there is some diffusion of the light. After the final reflection at the mirrors C_1 and C_2, the light is incident on the two surfaces D_1 and D_2. The mirrors are arranged so that the angle of incidence of the light is 45°. Hence any materials to be tested for colour are inserted at D_1 and D_2 and are observed through the rectangular opening at E, thus being seen under uniform illumination by light incident at 45° to the normal.

The chief essentials required in a standard source of illumination for colour comparison are (1) that the photometric intensity should be constant, (2) that the distribution of energy in the spectrum should also be constant and should conform to some prescribed standard giving the physical and visual effect of average daylight.

Colorimeters are instruments for mixing certain primary colours in order to obtain a desired colour. These primary colours are fixed arbitrarily for the various instruments, but Guild has shown how the various results can be transformed into terms depending on standard primaries, these being defined by appropriate spectrum lines.

For purposes of colour matching, the most satisfactory instruments probably are the tintometer, the Eastman colorimeter, and the Guild trichromatic colorimeter. Of these the first two depend on the subtractive mixture of three primary colours. These colours are arbitrarily produced

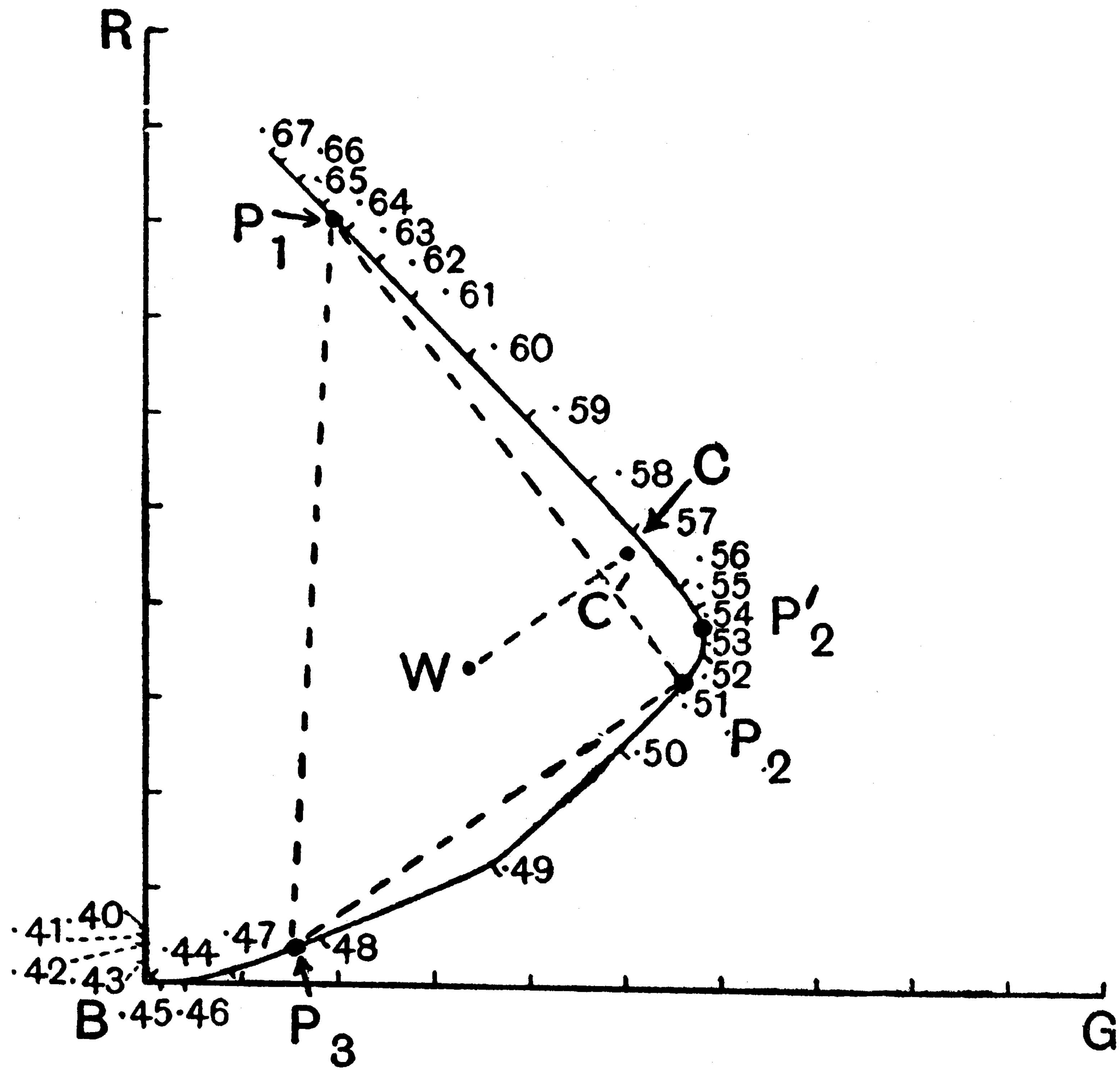


FIG. 13

by colour filters of red, green, and blue glass (or gelatine). The light is made to pass through varying portions of the filters, and hence any desired intensity can be obtained and it is possible to match almost any colour, except a limited range of the more saturated hues intermediate between the primaries.

The principle of the tintometer is given below. The filters consist of flashed glass with varying saturations of the subtractive primaries (crimson, yellow-green, and blue), a complete colour matching set numbering 465 glasses. The steps of depth of colour are adjusted so that combination of equal numbers of the three colours gives greys, and any colour can be expressed as (x red, y yellow, z blue). Light from a white plate passes through the filters and illumines half the field of view, white light from the pattern under test illumines the other half. The glass filters are permanent, so that the only precaution necessary is to control the light used. This should be diffused light from a north window. Since the grey combinations of filters of equal scale number have a somewhat high transmission in the extreme red, care must be exercised when choosing the standard source of light that it does not contain any excess of red.

Every set of glasses for the tintometer undergoes elaborate tests before leaving the manufacturer, and the accuracy of reproduction appears to be high. Since no optical dispersing system is employed, no great intensity of light is required, and further it is beyond doubt that the steady and uniform matching field offers the best conditions to the eye. The illumination used for the colours under test is daylight from the north.

Lowry and M'Hatton have tested the calibration and they point out that the densities of the filters should be proportional to the scale numbers. The density of a filter is defined as the logarithm of the opacity where

$$\text{opacity} = \frac{\text{intensity of incident light}}{\text{intensity of transmitted light}}$$

i.e., $\log O = \Delta \alpha S$

where O=opacity, Δ=density, S=scale number.

Consider three filters of opacities O_1, O_2, and O_3 placed together so that light traverses each in turn, then the combined opacity of the filters $= O_1 \times O_2 \times O_3$ =incident light/transmitted light.

Taking logarithms, $\log O_1 + \log O_2 + \log O_3 = \log$ (combined opacity). Therefore if the scale numbers S_1, S_2, and S_3 of the filters are proportional to the densities, the scale number corresponding to the effect of the three in series will be $S_1 + S_2 + S_3$.

Lowry and M'Hatton give a curve showing that a linear law is obeyed within small limits of error, especially for numbers above 3. The law appears to be somewhat different between 0 and 3.

In making matches with low scale numbers it is advisable to compensate for the light reflected from the surfaces of the glasses by using an equivalent number of plain glasses in the beam from the substance under test. This will usually allow an exact match in intensity as well as in hue.

The Eastman colorimeter is represented diagrammatically in Fig. 12. C is a Lummer-Brodhun prism consisting of two prisms in contact, arranged so that one prism is illuminated by the standard light and the other by light from the colour to be matched. Light from a standard lamp S passes through dyed gelatine wedges of neutral, red, green, and blue colour, by which almost any desired colour can be produced through variation of the relative positions of the wedges, each being furnished with a scale. The light from these filters illuminates one-half of the field of view. The filter F is capable of reducing the light from the lamp S to the visual quality of noon sunlight. The other half of the matching field is illuminated by an image of the object under test, projected by the lenses L_1 and L_2. One of the features of the apparatus is that fittings are provided for illuminating the test substances with colour-corrected lamps. When testing opaque materials, the light is incident at 45° to the normal to the surface, while the line of view is normal. This instrument is simple to use and has very few parts which require adjustment.

Optical wedges, as used in the Eastman colorimeter, have been largely employed for work in the visible region of the spectrum. Dr. Toy (*Phil. Mag.*, 1920) showed that neutral grey gelatine wedges between quartz plates could be used down to about 3,000 Å.U., but the absorption-coefficient, and hence the wedge-constant, was increasing so rapidly with decreasing wave length that they would probably be useless beyond 2,900 Å.U. However,

G. M. B. Dobson and D. N. Harrison find by measuring the constants of such wedges on an accurate spectro-photometer, using a sodium-in-quartz photo-electric cell, that the constants actually increase but slowly beyond 3,000 Å.U. Using a newly-constructed wedge embodying certain improvements, the change in wedge-constant with wave length is found to be considerably smaller than that of a wedge of standard type, and either type of wedge can easily be used down to 2,380 Å.U.

The Guild trichromatic colorimeter is an additive instrument, and is the most recently invented. Fig. 13 shows the locus of pure spectral colours on a trichromatic chart. Every possible colour is represented by a point on this chart, and all the colours producible by mixing two constituent colours in various proportions are represented by point on the straight line joining the points which represent the constituents. Since all colours are due to the admixture, in various proportions, of the spectrum colours, then all colours are located in the area bounded by the spectral locus and the straight line joining its two ends, and this area is known as the colour field. Its precise shape and position on the chart depend on the particular trichromatic primaries for which the chart is drawn, but the essential characteristics are unaltered by such purely mathematical transformations.

It will be seen from the shape of the colour field that it is not possible to find three primary colours such that suitable combinations of them will give all other colours, for no triangle having its corners within the colour field can contain the whole field.

Let the primary colours of an instrument be the fully saturated colours P_1, P_2, and P_3 (Fig. 13). Then, as long as the primaries can be mixed to give white, i.e., as long as $P_1P_2P_3$ contains W, any desired hue can be obtained. A line from W to any point on the periphery of the field is a line of constant hue, the saturation being greatest at the periphery. But consider the colour C: the most saturated colour of the same hue is C^1, which may be produced by mixing P_1 and P_2 alone. This illustrates the result obtained in practice, namely, that spectrum colours cannot generally be matched by a trichromatic mixture. In order to measure a colour of higher saturation, a colour is added which will modify the given colour and bring it within the triangle. Then the modified colour is measured in terms of the primaries, and also the modifying colour alone is measured, and from these results the test colour can be found. Thus let the readings for the modified colour be

$$\alpha P_1 + \alpha^1 P_2 + \alpha^{11} P_3$$

and let the readings for the modifying colour be

$$\beta P_1 + \beta^1 P_2 + \beta^{11} P_3$$

then the readings for the colour under test will be

$$(\alpha - \beta)\, P_1 + (\alpha^1 - \beta^1)\, P_2 + (\alpha^{11} - \beta^{11})\, P_3$$

Since the colour cannot be directly matched, one of these coefficients will have a negative value.

Fig. 14 is a diagram of the Guild colorimeter, and Fig. 14a is a view of the side which is presented to the light-source. The shaded areas in the latter figure represent sector-shaped apertures each about 59° angular extent; these apertures are backed respectively by red, green, and blue gelatine filters mounted between glass plates.

The source of light is a 105-volt 100-watt "Fullolite" lamp, which has an opal spherical bulb about 8 cm. in diameter, and forms an extended source of fairly uniform brightness over its whole area. The lamp is placed with its centre at the focus of the outer zone of a condensing lens, which thus throws a circular beam of parallel light on the coloured apertures in the end of the box. Inside the box a prism CD is mounted so that it can rotate about an axis DE. During rotation the end C passes each of the sectorial openings in turn, and when C is opposite a sector light enters the prism, and, after internal reflections of the inclined faces, emerges along DE.

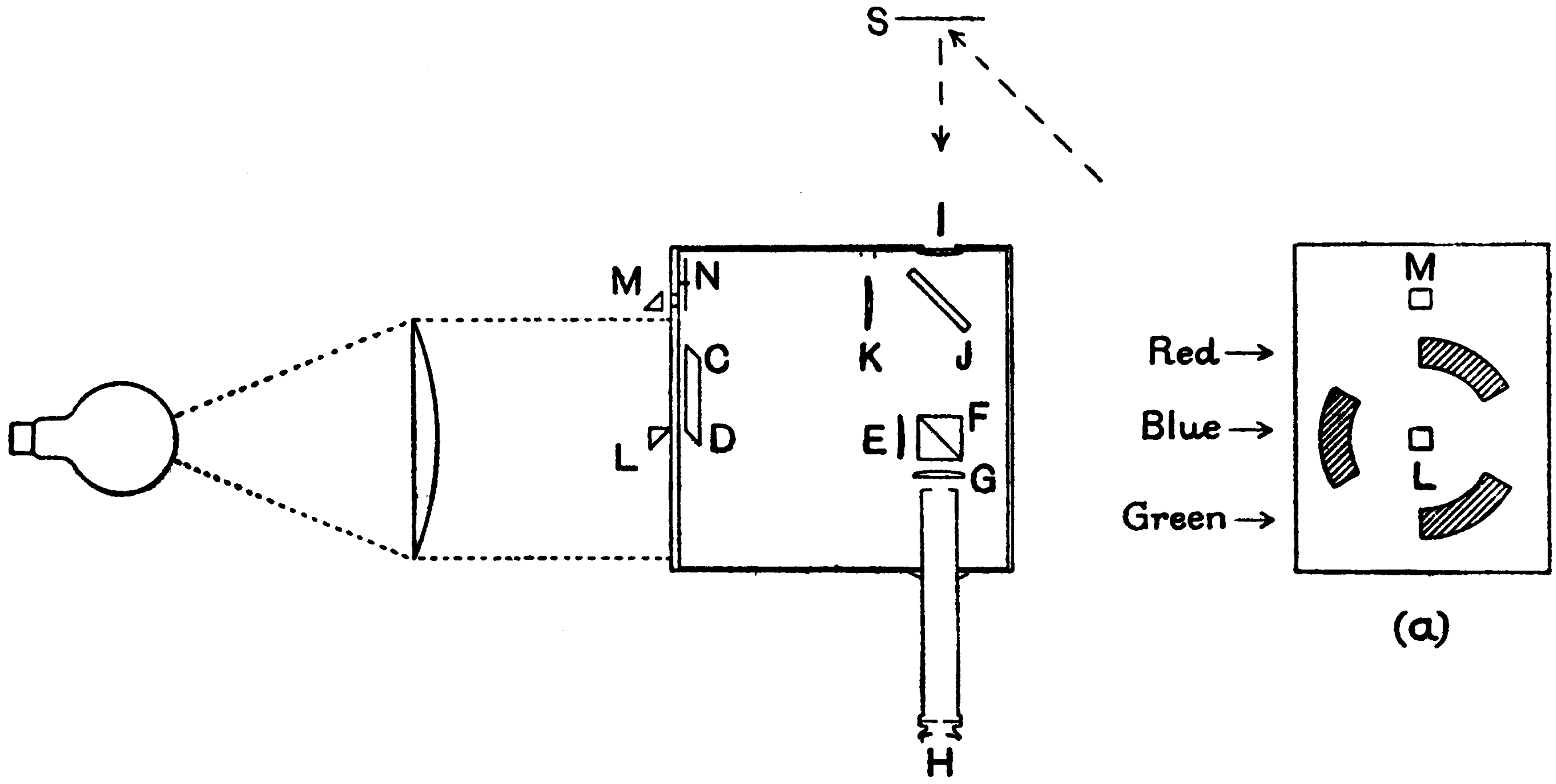


FIG. 14

A lens E is placed so that the effective stop, a circular hole in the mount of the prism CD is at its focus. F is a photometric prism to provide the matching field. This prism consists of two 45° prisms with one-half of their hypotenuse surfaces in optical contact. The line of division of the two portions is horizontal. A stop with a square opening of side 9 mm. is fitted between the cube and the lens G. The field of view, therefore, consists of two horizontal strips, 9 by 4·5 mm., and when the instrument is properly adjusted, the dividing line is practically invisible when a match has been obtained.

G is a lens with its focus at H, and an observer at H sees the reflecting section of the field illuminated by light from the particular sector to which C is opposite. Thus the colours red, green, and blue successively enter the eye, and when the speed of rotation of CD is sufficiently rapid, the colour sensations mingle and a mixed colour is observed. Each sectorial opening is fitted with a shutter so that the relative durations of the various stimuli can be altered, and hence various colours can be obtained.

If the colour to be matched is that of an opaque object, then the specimen is placed at S and illuminated by light incident at 45° to the normal. The colour is then seen uniformly in the field of view of the prism F. If the colour under test is that of a transparent substance, a white screen consisting of a plate heavily coated with magnesium oxide is placed at S and the specimen is placed against the window I.

In general the illuminant used is supposed to be white light. While there is no universally accepted standard of white light, it is usual to adopt as white a light having an energy distribution, within the visible spectrum, of a "black body" at 5,000° K. Daylight itself is too variable in colour, and all laboratory sources are of a much lower colour temperature than 5,000° K., so that a bluish filter has to be obtained with them to obtain white light.

The region of colour temperature for which the most reliable data exist is that obtainable from vacuum metal-filament lamps at approximately normal efficiencies. A point of particular interest within this range is 2,360° K., which may also be obtained from an acetylene flame, using the Eastman-Kodak standard burner.

Dr. A. F. A. Young has investigated the matter of standard white light, and has worked out a filter which will raise the apparent colour temperature of a source at 2,360° K. to 3,000° K. This filter, when placed between a source at 2,360° K. and the screen of a photometer, will give to the latter the colour corresponding to 3,000° K. A gas-filled lamp is arranged on the other side of the photometer and its voltage adjusted until a colour-match is obtained, when it will be operating at a colour temperature of 3,000° K. The lamp may then be used at this voltage as a sub-standard of the colour temperature 3,000° K., to serve as the basis of the white light. Needless to say, the voltage at which it is to be operated must be frequently revised by matching against the initial standard source at 2,360° K., as the ageing of the sub-standard is fairly rapid when run at such a temperature. It is necessary to procure lamps with a normal operating voltage considerably under the supply voltage, otherwise it may be impossible to reach the desired colour temperature. Low-voltage lamps with thick filaments are more suitable for running at such a colour temperature than high-voltage lamps of small current consumption.

A second filter is now required to raise the colour temperature from 3,000° K. to 5,000° K.

Approximately correct filters for use as above are—

2,360° K. to 3,000° K. : Solution A—Copper sulphate
Ammonia (density ·90)
Distilled water to
Solution B—Copper sulphate
Cobalt sulphate
Distilled water to

Solution A and solution B are contained in separate compartments of a double cell, of which the walls are of one of the white optical glasses (say, hard crown). The thickness of each solution should be 10·00 mm.

3,000° K. to 5,000° K. : Solution A—Copper sulphate
Ammonia (density ·90)
Distilled water to
Solution B—Copper sulphate
Cobalt sulphate
Distilled water to

A similar cell should be used as in the case of the other filter.

These solutions will enable a much closer approach to a standard white light to be obtained than any of the filters at present available. In the Guild colorimeter the colour to be matched enters at I and light from this aperture fills the transmitting portion of the prism F. A lens of about 20 cm. focal length is fitted at I, and if objects possessing structure, such as fabrics, &c., are placed near the focus of this lens, the structure will be imaged at H, and a uniform illumination is obtained in the field of view. Otherwise the structure would be visible in the field of view and correct matching would be impossible.

In order that the colour under test may, if necessary, be desaturated sufficiently for a match to be made, a plane parallel glass plate J is inserted in the test beam. Light is reflected by the 45° prisms L and M through a hole in the box. It passes through a regulating filter consisting of a circular lamp-black-in-gelatine wedge and then *via* the lens K and the reflecting J plate to the photometric prism. The lens K is merely to collimate the light from the aperture M, so that an image of this aperture is primed at H. Thus this added light illumines the part of the field of view which is occupied by the colour under test. The density difference between the lightest and darkest settings of this filter is about 2, giving a variation of 100 to 1 in the intensity of the light transmitted. By inserting colour filters between the prism M and the aperture, the added light can be made of any desired colour.

If the test field is brighter than can be matched by the instrument, its brightness can be reduced either by increasing the distance of the illuminant from S, or by inserting a rotating sector disc in the path of the beam. No so-called neutral filter can be used for this purpose.

On the other hand, if the colour under test can only give a feeble luminosity, the sector openings required for a match will all be very small, and hence percentage accuracy in reading their positions will be low. In such cases a neutral glass filter, transmitting about one-tenth of the light, is placed in front of the "Fullolite" lamp: then the sector openings will need to be about ten times as great in order to give the required match.

The possibility of standardisation of the colours and shades of all dyestuffs on some definite system is absolutely vital to the dyer, and a method of determining the exact amount of fading under various conditions so as to grade these dyestuffs into order of fastness or fugitiveness is equally important to the textile trade. In conclusion we would point out that dyeing is not only a science but would also consider the old time method spoken of as the "art of dyeing." There are many unknown variable factors such as the varying selective affinity of wool fibres for dyestuffs, &c., which have to be remembered and which are corrected directly by experience and judgment of the operator. Yet scientific investigation is an absolute essential to the future progress of the dyer, and, in presenting the problems as stated at the beginning we put forward what we consider the most important of the questions to be answered before further work can proceed.

Finally we would like to thank Mr. J. Guild, Dr. L. C. Martin, and Mr. G. C. Wardle, Messrs. Cox, Cavendish & Co., and Messrs. Kelvin, Bottomley and Baird for their kind help rendered to us during the writing of this paper.

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46—THE DETERMINATION OF DELIQUESCENT SUBSTANCES IN SIZED COTTON MATERIALS

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(The British Cotton Industry Research Association).

INTRODUCTION AND SUMMARY

The determination of the constituents of sized materials presents difficulties, first in the extraction, and secondly in the measurement of the small quantities obtainable from a convenient bulk of the sized material. Methods are now described for the determination of chlorides, zinc, magnesium, and glycerol which yield trustworthy results with quantities of sized material easily dealt with on the laboratory scale.

Chlorides are extracted by means of nitric acid and titrated by the Volhard (thiocyanate) method. Magnesium is precipitated from the extract as magnesium ammonium phosphate in the presence of free ammonium hydroxide, and zinc is then precipitated as zinc ammonium phosphate by rendering the filtrate neutral with acetic acid. The magnesium and zinc ammonium phosphates are separately collected and converted into ammonium phosphomolybdate precipitates and these are washed until neutral to litmus and dissolved in a definite quantity of normal sodium hydroxide solution. The unused alkali is finally titrated with normal hydrochloric acid and the zinc or magnesium calculated from the relation, 1 gram equivalent NaOH (1000 cc. of N-solution)=3.00 grs. P_2O_5=2·77 grs. Zn (5·80 grs. $ZnCl_2$)=1·03 gr. Mg. (4·04 grs. $MgCl_2$).

Glycerol is extracted by a mixture of alcohol and ether and oxidised to carbon dioxide by means of sulphuric acid and sodium dichromate in a gas burette. The volume of gas obtained is a measure of the glycerol according to the relation, 1 litre dry CO_2 at N.T.P.=1·369 grs. glycerol.

DETERMINATION OF CHLORIDES

Preparation of Extracts

(i.) *Cloth or Yarn.*—About 5 grams of the material are extracted by boiling with 20 ccs. of $2N$ nitric acid and 300 ccs. of water for one hour in an open flask. The liquor is then decanted and filtered, more water (about 100 ccs.) is added to the material and the extraction repeated. The two filtrates are mixed and made up to 250 ccs. (Extract A).

(ii.) *Size.*—About 1 gram of the wet size is heated overnight with 10 ccs. of $2N$ nitric acid at about 90° C., and the almost clear liquor (filtered if necessary) is suitable for chloride estimation. (Extract B).

Analysis of Extracts

One hundred ccs. of extract A, or the whole of extract B, are treated with an excess of 0·1 N silver nitrate solution, boiled to coagulate silver chloride, filtered, and the precipitate washed with hot water. The filtrate and washings are titrated with 0·1 N potassium thiocyanate in the usual way.[4]

The method has been checked by incorporating known amounts of chloride in a starch paste and analysing portions of the paste, and by sizing yarn with a measured weight of paste of known chloride content, and analysing this. Typical results are given in Table I., where the figures for chlorine found have been corrected for the raw cotton blanks, which are discussed below (p. 515).

Table I.

Material Analysed	% Chlorine from Mixing	% Chlorine Found
Farina paste	$0{\cdot}36_6$	... $0{\cdot}36_6$ $0{\cdot}36_0$
Sago paste	$0{\cdot}14_2$	... $0{\cdot}14_2$ $0{\cdot}14_4$ $0{\cdot}14_2$
		... $0{\cdot}14_3$ $0{\cdot}14_2$ $0{\cdot}14_1$
American yarn sized sago	$0{\cdot}46_0$	... $0{\cdot}46_7$ $0{\cdot}47_4$
American yarn sized maize	$0{\cdot}24_1$	... $0{\cdot}24_6$ $0{\cdot}24_6$

DETERMINATION OF ZINC AND MAGNESIUM

Preparation of Extracts

(i.) *Cloth or Yarn* is extracted as described for the chlorine analysis. (Extract A.)

(ii.) *Size.*—About 1 gram of the size is evaporated to dryness several times with fuming nitric acid in a 250 ccs. hard glass, narrow-necked flask, using a small funnel as a splash trap. The operation must be repeated till all organic matter is destroyed, when the mixture no longer chars. The white residue is dissolved in hot dilute hydrochloric acid and diluted to about 100 ccs. (Extract C.)

Analysis of Extracts

One hundred and fifty ccs. of "Extract A," or the whole of "Extract C," are treated with 20 ccs. of 2*N* ammonium chloride solution and with ammonia till alkaline and then boiled. Any precipitate of brown ferric hydroxide is filtered off, and the filtrate made just acid with hydrochloric acid. The solution is boiled, 20 ccs. of a 10% solution of diammonium hydrogen phosphate are then added, followed by 15 ccs. of ammonium hydroxide (*D* 0·880), and the mixture is shaken for half an hour in a stoppered bottle, allowed to stand, and filtered. The white crystalline precipitate of magnesium ammonium phosphate, part of which adheres to the bottle, is washed three times with 2·5% ammonia solution. The filtrate and washings are boiled to remove ammonia, cooled, ten drops of 0·4% bromocresol purple solution are added and then dilute acetic acid till the purple colour of the solution changes to a green-grey. After standing for half an hour zinc is quantitatively precipitated from the neutral solution in the form of zinc ammonium phosphate. The crystalline precipitate is soluble in either ammoniacal or acid solutions[6], and is washed three times with small amounts of hot water. The washed precipitates of zinc and magnesium ammonium phosphates are now dissolved on the filters and from the sides of the precipitation vessels with dilute nitric acid—15 ccs. of 25% nitric acid and 20 ccs. water—and the filters washed. The solutions are treated with 25 ccs. of 34% ammonium nitrate solution, boiled, and 50 ccs. of hot 3% ammonium molybdate solution are run in from a tap funnel with constant stirring. After standing for fifteen minutes, the yellow precipitate of ammonium phosphomolybdate is filtered off and washed with a cold 1% sodium nitrate solution till the washings are neutral to litmus.[5] The washed precipitate and filter paper are transferred to a beaker, treated with excess of normal sodium hydroxide solution and the unused alkali titrated with normal hydrochloric acid, using phenolphthalein indicator. There is no advantage in using more dilute reagents, since the end point is not sufficiently sharp. It has been found by experiment that one gram equivalent of alkali corresponds to 3·00 grams of P_2O_5 when the phosphomolybdate is precipitated under the conditions laid down. From the results the amount of phosphorus in the precipitate and hence the amount of zinc or magnesium in the original sample, are calculated.

The method has been checked by analysing standard aqueous solutions and starch pastes of known zinc and magnesium content, and by noting the reproducibility of results with sized yarn and cloth. Some typical analyses are given in Table II.

Table II.

Material Analysed	Weight taken	Zn calculated as $ZnCl_2$%		Mg calculated as $MgCl_2$%	
	gms.	Present	Found	Present	Found
Aqueous solution ...	10	1·30	1·28	0·91	0·91
	5	0·65	0·654, 0·647 0·672	0·455	0·447 0·452, 0·475
Farina starch paste	10	0·678	0·668, 0·679 0·678, 0·667	0·474	0·464, 0·475 0·469, 0·475 0·467
Cloth for dhooties	2	—	1·34, 1·27 1·29, 1·36	—	2·42, 2·43 2·42, 2·42
Sized cloth	5	—	0·64 0·65	—	2·32, 2·32 2·32, 2·32

DETERMINATION OF GLYCEROL

Yarn or Cloth.—About 10 grams of material are extracted in a hot[1] Soxhlet apparatus with acetone for four hours, and the extract, filtered if necessary, is evaporated to dryness in a distilling flask. The residue in the distilling flask is extracted three times with 25 ccs. portions of a mixture of two volumes of alcohol to one volume of ether in the cold, and the solution is filtered. (Extract D.)

Size.—About 2 grams of the size are ground with 40 ccs. of absolute alcohol, added little by little, 20 ccs. of ether are added, and the clear liquid decanted. The extraction is repeated and the residue is finally washed on a filter with more of the alcohol-ether mixture. The filtrate and washings (Extract E) contain practically the whole of the glycerol.

A little boric acid is added to "Extract D or E" to reduce loss of glycerol* and the extract then evaporated to dryness on the steam bath. The last traces of alcohol are removed by a current of air, blown through the flask for five minutes while still on the steam bath. The residue is washed from the flask with 20 ccs. of dilute sulphuric acid (1 volume H_2SO_4 to 2 volumes H_2O), and shaken in a separating funnel with 60 ccs. of light petroleum to remove any fat which might have been extracted by the alcohol-ether mixture. The aqueous layer is run into an evaporating basin and heated on the steam bath for half an hour to remove traces of light petroleum.

* Solutions of glycerol in 150 ccs. of alcohol-ether mixture (2 : 1) were evaporated to dryness with and without the addition of boric acid and the glycerol in the residue estimated, with the following results—Glycerol present originally 50 mgms.

	No boric acid	Boric acid (0·5 grams) added
Glycerol found	43; 42 mgms.	47; 47 mgms.

The aqueous layer is now filtered into a gas burette over mercury, 2 ccs. of 40% sodium dichromate solution are added, and the mixture is heated to 100° C. by means of a steam jacket to oxidise glycerol to carbon dioxide. (See Fig. 1.) The gas given off is collected over mercury in a second gas

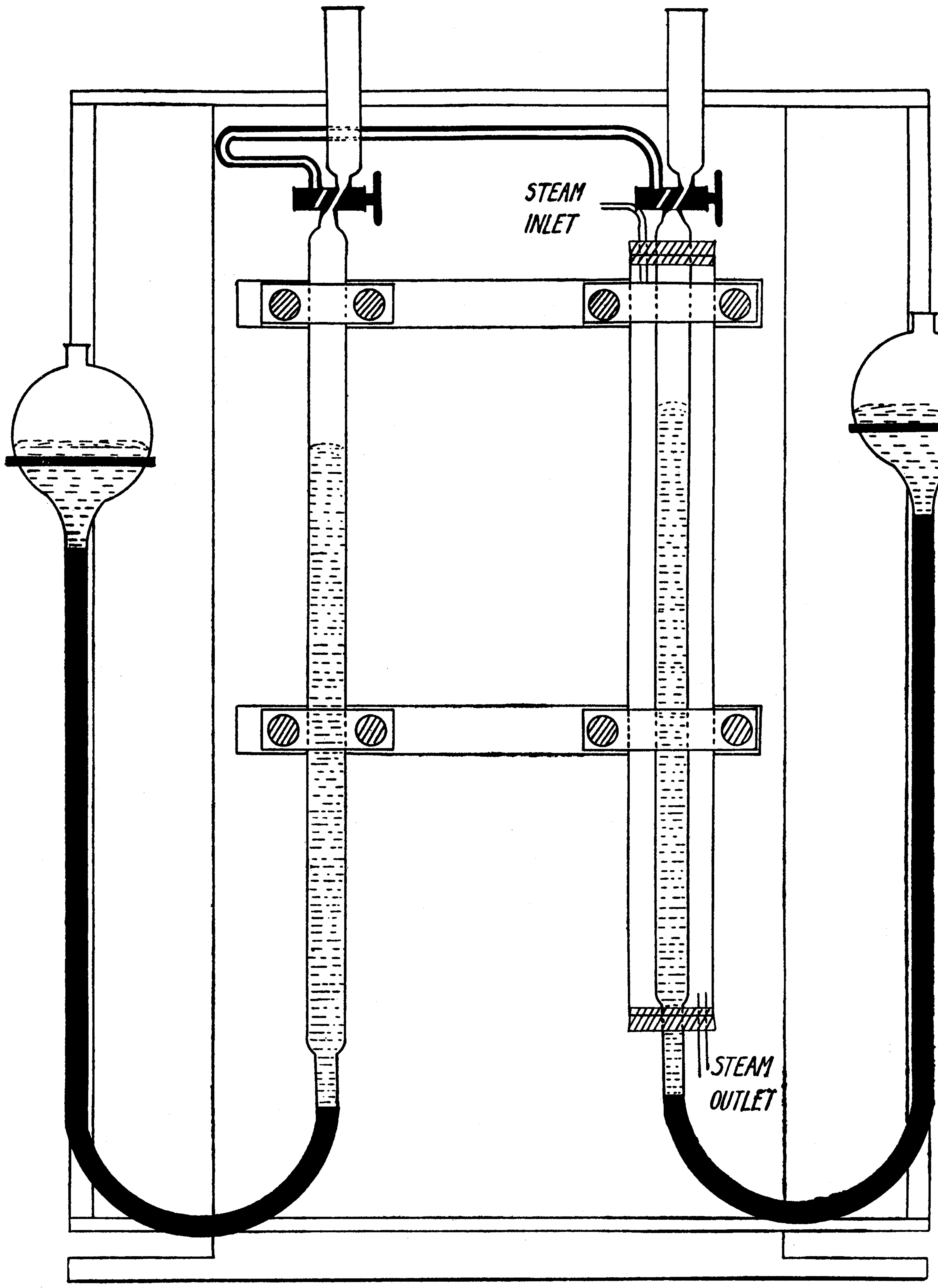

FIG. 1

burette connected to the first by capillary tubing. The last traces of dissolved carbon dioxide are removed from the reaction burette by causing the contents to boil by reducing the pressure after the reaction has proceeded for one hour. The volume of gas (saturated with water vapour) is measured and the small quantity of air (about 0·2 ccs.) estimated by absorbing the carbon dioxide with sodium hydroxide solution. From the volume of carbon dioxide, reduced to N.T.P., the amount of apparent glycerol in the sample is readily calculated. The results of some typical analyses are given in Table III.

Table III.

Material Analysed	Weight taken gms.	Glycerol Present mgms.	Glycerol Found mgms.
Aqueous solution	—	10·3	10·15, 10·3
	—	20·6	18·5, 20·5, 19·0
	—	51·5	51·2
Sized cloth containing tallow, $ZnCl_2$ and $MgCl_2$	6	—	6·0
Sized cloth as above, with 20·8 mgm. glycerol added	6	20·8	24·8, 25·6
Bleached cloth	10	—	3·0
Bleached cloth with glycerol added	10	52	51, 57
5% maize starch paste	—	31·7	29·8, 29·9
Trade size mixing—sago and soluble starches, clay, glycerol, Japan wax, $ZnCl_2$	4	74*	Sample I., 64, 66, 66, 66; Sample II., 65, 65, 67, 67
Yarn sized with above mixing	4	94†	95, 94, 90, 94, 89, 90

* This figure was calculated from the mixing on the assumption that the glycerol used in the mill was 100% pure.

† Calculated from the mean analysis of the size and the total size on the yarn.

A paper by Smith[3] on the estimation of glycerol in sized goods has recently appeared. The quantitative method described therein is possibly more suitable than that now put forward where a fairly large amount is present, owing to the greater selectivity of the "acetin" process of determination as compared with a combustion, but the method apparently breaks down for very small amounts of glycerol.

THE BLANK CORRECTIONS

When the amount of chloride, zinc, magnesium or glycerol present in a sized material is small, the blank correction often amounts to a large fraction of the whole. This correction may be considered as consisting of three parts—

(i.) The method blank, arising from such factors as the partial solubility of, or the absorption of, reagents by precipitates. This is a constant under uniform conditions of working if the same amounts of reagents are used.

(ii.) The raw material blank, due to the presence of small amounts of the substance estimated in the raw material. This tends to make the observed percentage of a size constituent higher than that calculated from the size mixing.

(iii.) The impurity blank, due to lack of selectivity in the method of analysis, whereby substances other than that being estimated pass through the processes with it and increase the final result by an unknown and variable amount.

For the chloride estimation the method blank is too small to be detected, but for the zinc and magnesium estimations, using the amounts of reagents indicated, it is of the order 0·0002 gram and 0·0012 gram respectively. The glycerol method blank is approximately 0·0003 gram, using redistilled solvents. The raw material blanks have been determined for some raw yarns, with the results given in Table IV. (corrected for method blanks).

Table IV.

Sample Analysed	Grams of Constituent per 100 grams of Sample: Chlorine	Zn (calc. as $ZnCl_2$)	Mg (calc. as $MgCl_2$)
Raw American yarn	0·04	Nil	0·25
Raw Indian yarn	0·04	Nil	0·31
Raw Sakel yarn	0·09	0·13	0·47

The figures in Table IV. of course represent the sums of the raw material and impurity blanks.

There is little doubt that the methods of analysis for zinc, magnesium, and chlorine are so selective that the impurity blank is negligible, and hence the figures obtained approximately represent the true amounts of the constituent. The method of estimating glycerol, however, takes account of any carbonaceous matter reaching the final stage, and depends entirely on the efficiency of the preliminary extraction and separation processes. It is thus quite conceivable that small amounts of polyhydric alcohols analogous to glycerol may not be separated. The raw material blanks given will include any substances which may be soluble in acetone, in alcohol-ether, and in dilute sulphuric acid rather than in light petroleum. An attempt has therefore been made to test the extracts qualitatively for glycerol. The acrolein test and the colour reactions of Denigès[2] have been applied for this purpose to an aqueous extract of the residue from the alcohol-ether distillation, fats being separated by treatment with petrol ether as in the quantitative analysis. For the acrolein test, the solution is heated with solid potassium hydrogen sulphate, the vapours condensed in a cold test tube and treated with ammoniacal silver nitrate. A smell of acrolein and a silver mirror in the cold are obtained if more than one milligram of glycerol be present. The colour tests for glycerol have been carried out as described by Denigès.[2,3] The results are summarised in Table V. for some of the raw materials of sizing.

Table V.—Colour Tests

Material Analysed	Glycerol %, by Combustion	Weight of Glycerol Mgms.	Acrolein	Thymol	β-Naphthol	Resorcinol	Guaiacol	Salicylic Acid	Gallic Acid
Bleached cloth ...	0·03	3·0	—	—	—	—	—	—	—
Raw Sakel yarn ...	0·07	6·7, 7·2	F	Incorrect colour					
Raw American yarn ...	0·11	10·7, 11·0	F	F	F	F	—	F	—
Maize starch	0·05	4·8, 5·0	—	—	—	—	—	—	—
Sago flour	0·19	19·3	F	F	F	F	F	F	F
Wheat flour (mouldy)	—	—	F	+	+	+	+	+	+
Farina starch film ...	Nil	Nil	—	—	—	—	—	—	—
American yarn, sized flour, starch and soap	0·10	10·2, 10·0	+	F	F	F	—	F	—
American yarn, sized maize and tallow ...	0·14	14·4	F	F	F	F	F	F	F
American yarn, sized sago, spermaceti, Japan wax and tallow	0·03	2·7	F	F	F	F	F	F	F
Tallow	0·72	7·2	+	+	+	+	+	+	+

\+ Positive reaction. F Faint reaction. — No reaction.

It appears that the qualitative tests confirm the presence of glycerol or of a substance of very similar chemical behaviour, wherever an appreciable amount is found by the quantitative analysis.

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47—THE DELIQUESCENT PROPERTIES OF MAGNESIUM CHLORIDE, OF CALCIUM CHLORIDE, AND OF GLYCEROL

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INTRODUCTION AND SUMMARY

The deliquescent chlorides of calcium and magnesium find a wide application in the cotton industry as components of sizing and finishing mixtures. Their value lies in their ability to be applied as weighting materials which remain liquid under normal conditions of use and storage of cloth, while it is commonly asserted that they are responsible for the presence of large quantities of water bound by the salts in virtue of their known hygroscopic properties. Though these chlorides are technically unobjectionable in goods which are not subjected to heat in the grey state, they cause dangerous amounts of tendering if they are present in cloth which is singed, or finished by a hot process. On this account glycerol* is sometimes used as a deliquescent in lightly-sized materials, and a question has arisen as to its efficiency as compared with the cheaper salts. In the present paper are recorded measurements on the hygroscopic properties of the three substances, made as a necessary preliminary to a study of their behaviour in textile materials. Some data obtained as a result of an examination of size and sized yarns containing deliquescents are quoted in order to show the necessity for caution in interpreting the measurements made on the pure substances.

The method of experiment has been to make up in sealed vessels successively more and more dilute solutions of the three materials, and after each dilution to observe the pressure of the water vapour in contact with their solutions. The records are given in Table I., not as water vapour pressure, but as percentage relative humidity, i.e., the percentage which the observed pressure is of the maximum possible water vapour pressure (that over pure water) at the temperature of the experiment.

Table I.

Parts of water taken up by 100 Parts of Deliquescent at 20° C.

Substance	Relative Humidity %												
	20	25	30	35	40	45	50	55	60	65	70	75	80
$MgCl_2$	Solid hydrates			178	191	207	222	240	262	283	315	351	413
30% Solution of $MgCl_2$	Loses water							2·0	9·2	15·5	24·5	35·0	53·0
$CaCl_2$	Solid hydrates			140	153	167	182	199	212	245	292	344	413
Glycerol	6·9	9·2	12·3	15·6	19·6	23·5	27·1	31·2	37·4	44·5	53·8	68·1	90·5

*Glycerol is known to the trade as "glycerine."

The series of changes of composition undergone by a mass of magnesium chloride to which water is slowly added is best illustrated graphically (Fig. 2). It is seen that starting with crystalline salt, $MgCl_2 6H_2O$, addition of water can go on until the composition has changed from 46·8% $MgCl_2$ to 35·8% $MgCl_2$ without any change of pressure. The explanation of this is that the first addition of water dissolves a small quantity of the salt, forming a saturated solution. The water vapour pressure of this has a definite value and this pressure must be maintained as long as it is possible for saturated solution to exist, that is until sufficient water has been added to dissolve all the solid. When all the solid is just dissolved, the solution is just saturated and contains 35·8 parts of $MgCl_2$ in 100 parts by weight of solution. The constant relative humidity at which this series of composition changes is possible is 34 per cent. and it is at humidities below this that there appears to be a possibility of magnesium chloride in a fabric crystallising out. As water is added to the saturated solution it gives rise to an increasing pressure of water vapour, expressed in the graph as an increasing relative humidity, as the concentration falls. For calcium chloride, somewhat similar behaviour is encountered, but the possible crystal systems are more numerous and the definition of the composition and humidity of a saturated solution is rather less satisfactory than with the magnesium salt. Glycerol does not crystallise and its graph is one of a smooth change of humidity with concentration.

The graphs are plotted with the composition of the solutions shown as dependent on the relative humidity, and it is from this point of view that the subject is considered in textile practice. It is, however, impossible to assume that the amount of water taken up by a sized cotton material exposed in an atmosphere of a definite humidity is simply the sum of the quantities which would be absorbed by the constituents if they were removed from contact with each other. It is not proposed to discuss the subject at any length, since on account of the difficulty of defining the composition of the material used, it cannot be claimed that the results are very exact, but measurements made on starch and on sized yarn containing deliquescents appear to show that the two chlorides have an inhibiting effect on the absorptive capacity of the materials to which they are applied. A similar inhibiting effect is indicated for glycerol in starch, and the experiments are quoted in order to indicate that no valid claim for the superiority of any deliquescent can be based on measurements made on the pure substances.

The measurements may be of service to those who require to maintain atmospheres of controlled humidity in vessels in the laboratory. The unsaturated solutions of the chlorides or of glycerol may, of course, be used in the same way as are those of sulphuric acid in water[9], and can be as readily checked by observation of their densities, while for biological work they avoid the toxic action which has been attributed to the acid[1]. It must be noted, however, that solutions of glycerol are themselves liable to attack by moulds. Of special interest is the self-controlling univariant system, hydrated magnesium chloride | saturated solution | vapour. If this is made up with such a proportion of salt as will ensure the continued existence of both solid and liquid, no analytical check is necessary, and it is possible to ascertain by inspection that in a vessel containing it the humidity at 20° C. is 34 per cent. An opportunity was taken at the beginning of this work to standardise the apparatus by an observation of the univariant system formed by ammonium nitrate and water, and on account of the convenient humidity which it determines the value found is given in Table II. It is to be noted, however, that this measurement is merely a repetition of one made by Prideaux[6] who has suggested the use of saturated solutions for stabilising the humidity of air.

Table II.

Relative Humidity at 20° C. over Two Univariant Systems.

Solid Phase	Liquid Phase	Relative Humidty in Vapour Phase (per Cent.)
$MgCl_2 6H_2O$ ...	Saturated solution of $MgCl_2$ ...	34
NH_4NO_3 ...	Saturated solution of ammonium nitrate	64·5

EXPERIMENTAL

Apparatus and Procedure

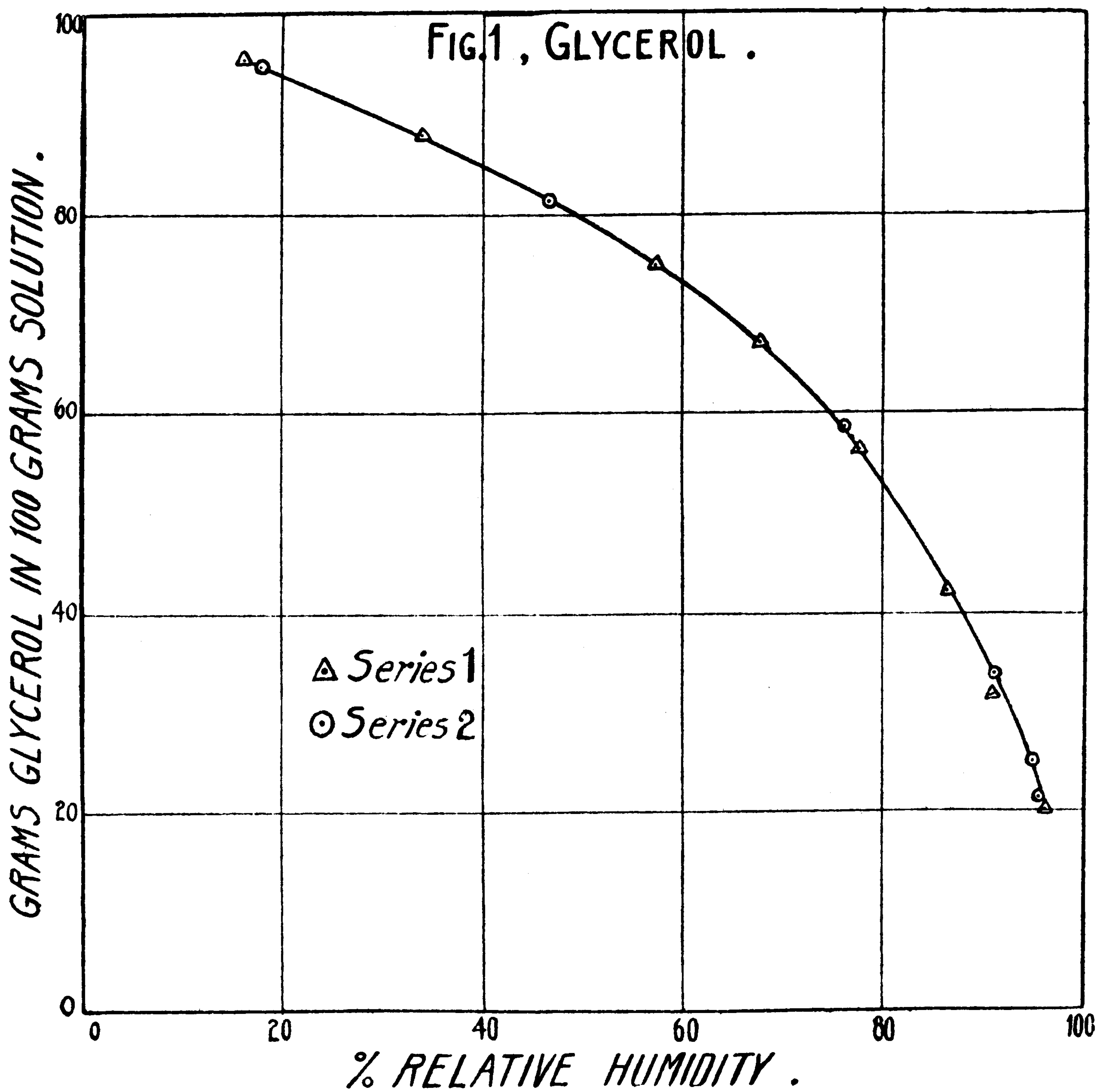
The measurements were made in a number of vessels of the type described elsewhere[3] (*loc. cit.*, Fig. 2). Each of these consists of a bulb of about 50 c.c. capacity, to which are sealed a mercury pressure gauge, and a closed pipette containing air-free water. Into the clean apparatus charged with water, and with its gauge attached, a known weight of material was introduced and the vessel then closed and connected to a vacuum pump. The period of evacuation varied, but was always sufficient to ensure that all air had been removed before the apparatus was sealed. When separated from the pump the whole apparatus was immersed in a thermostat at 20° C., at which temperature all the observations were made. During an experiment a small addition of water would be made to the contents of the bulb by cautious opening of the tap of the graduated pipette, and pressure readings continued from day to day until it was certain that the differences between successive readings were merely chance errors of observation. At this point a new measured charge of water was introduced and the pressure readings repeated. The records of added water and of pressure, combined with a knowledge of the weight and water content of the substance put in the apparatus, clearly provide all the data necessary to construct a composition/vapour-pressure curve for each system considered. The pressures measured are not recorded but are converted to relative humidities by dividing their value in millimetres of mercury by 17·51, the vapour pressure of water at 20° C.

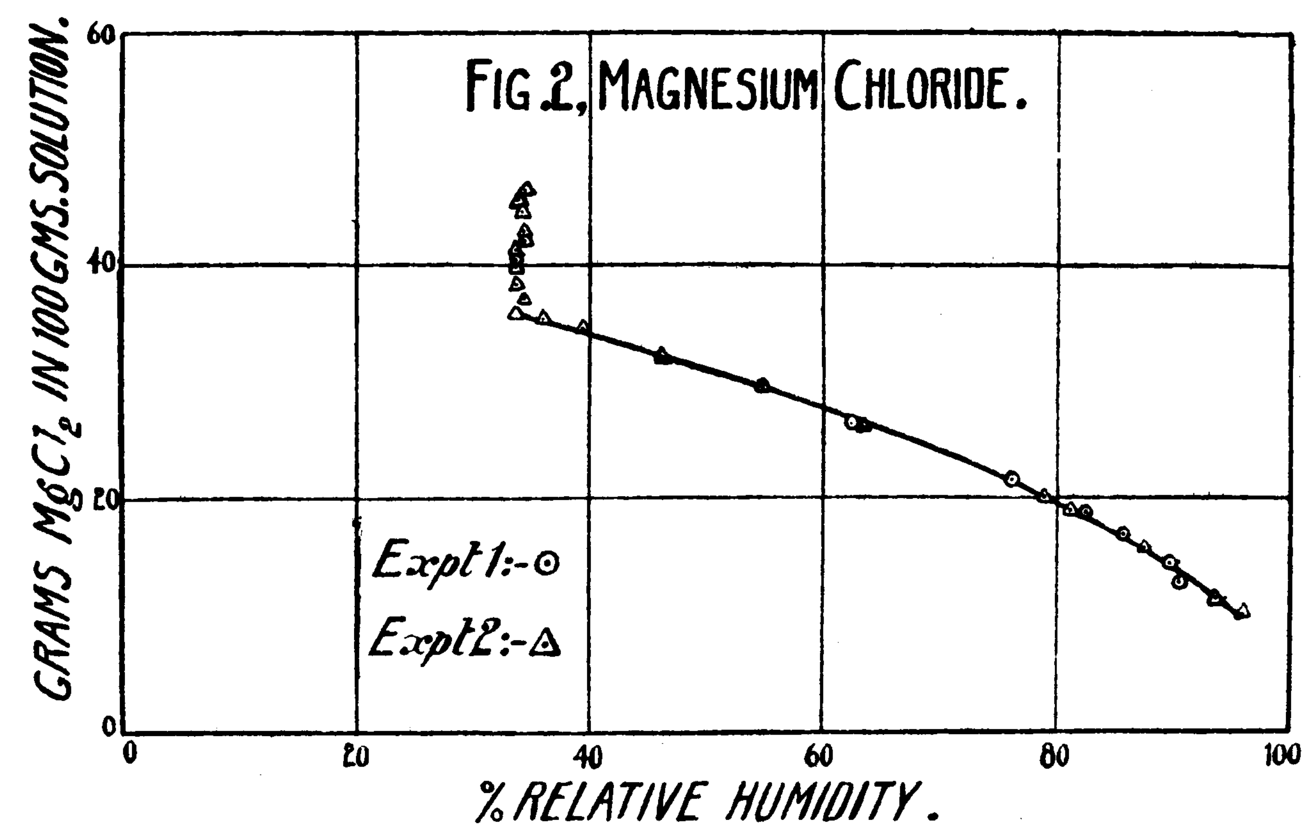
Materials Used and their Manipulation

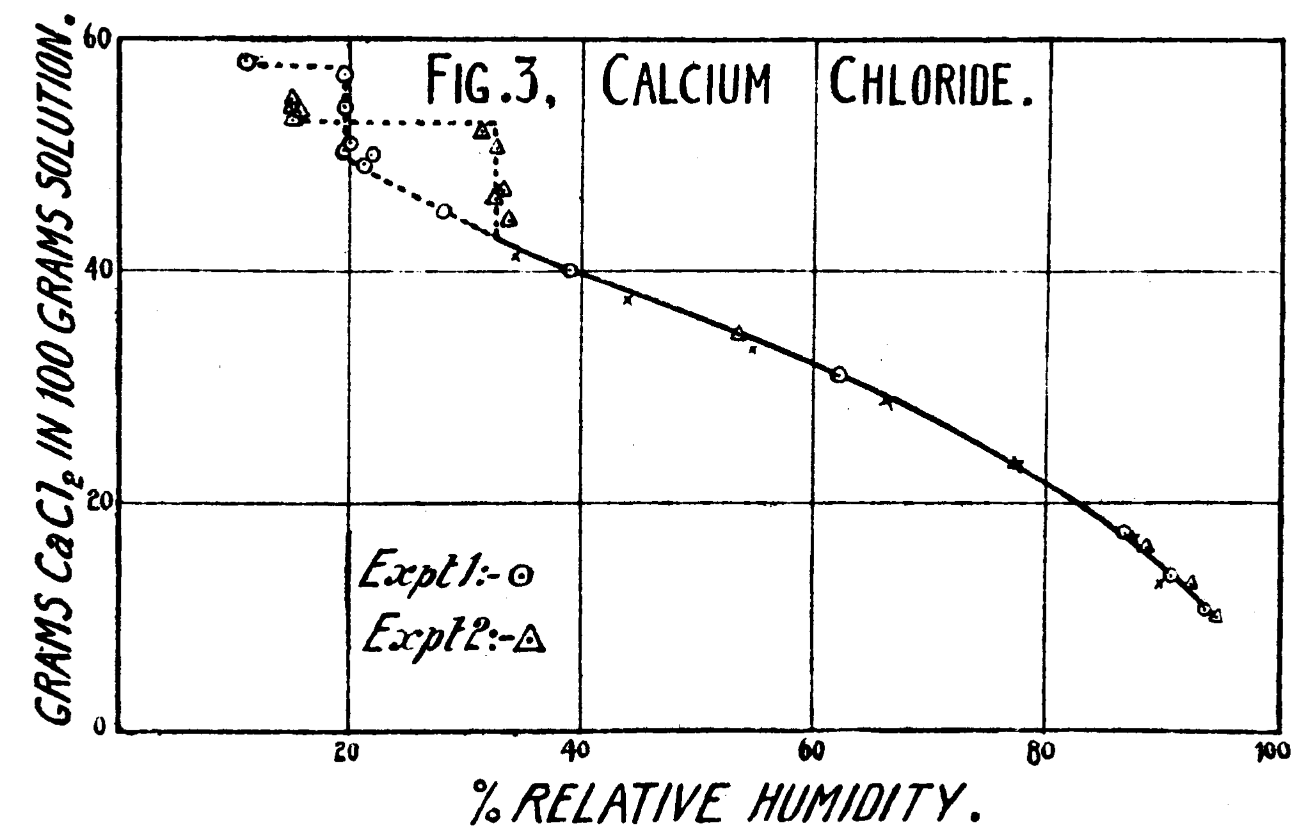
Glycerol.—The material used was medicinal glycerol which had been left in an evacuated desiccator over phosphorus pentoxide for three months. Two determinations were made and the two sets of points lie consistently on the same curve. From determinations of the density of the dilute solution resulting from one experiment, it was ascertained that its concentration was 20·2 per cent., a figure identical with that obtained by considering the weight of glycerol taken (2·263 grams) and the volume of water (8·93 c.c.) added to it.

It was concluded therefore that the glycerol used originally was anhydrous and did not take up an appreciable amount of water before it was sealed in this apparatus.

The experimental values are plotted in Fig. 1 and a smooth curve drawn, from which have been read the figures given in Table I. as part of the summary of the paper.







In Fig. 3 the crosses represent Paranjpé's data

Magnesium chloride.—Well defined dry crystals of the hexahydrate were rapidly transferred to the apparatus, which was immediately closed and evacuated. It was inevitable that the state of the system should be uncertain at the beginning, so no attempt was made to weigh the salt initially. In two series of experiments the final solutions were analysed by a determination of their total chlorine content, and of their concentration, this giving the information shown in the following table—

Table III.

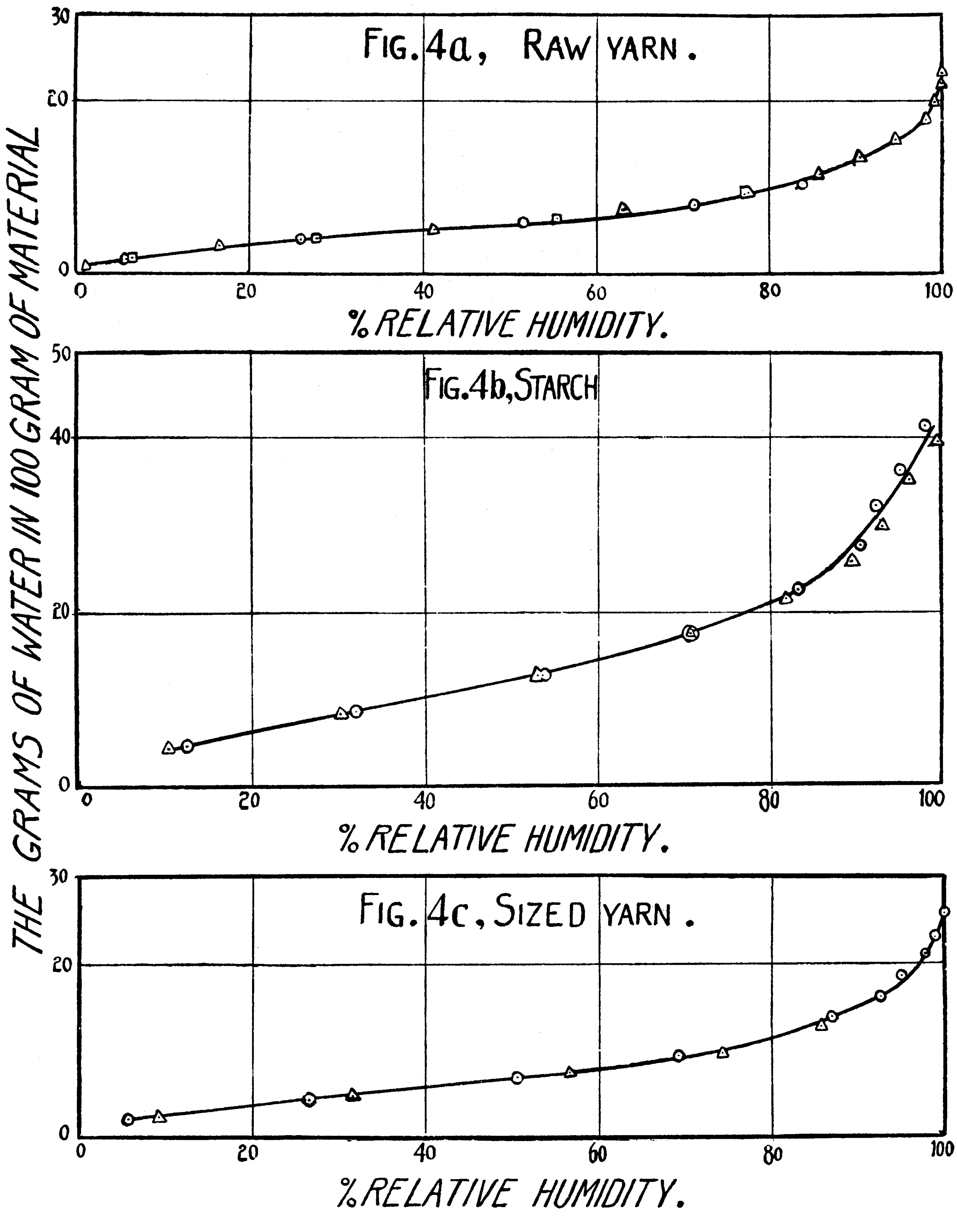
Series	Total $MgCl_2$	$MgCl_2$ in 100 Parts of Solution	Water in Final Solution	Water introduced from Pipette	Water in the Salt at Start of Experiment	
					Grams.	Mols./mol. $MgCl_2$
	Grams.		Grams.	Grams.		
1	1·143	10·06	10·21	9·19	1·02	4·7
2	1·740	13·79	10·88	8·78	2·10	6·4

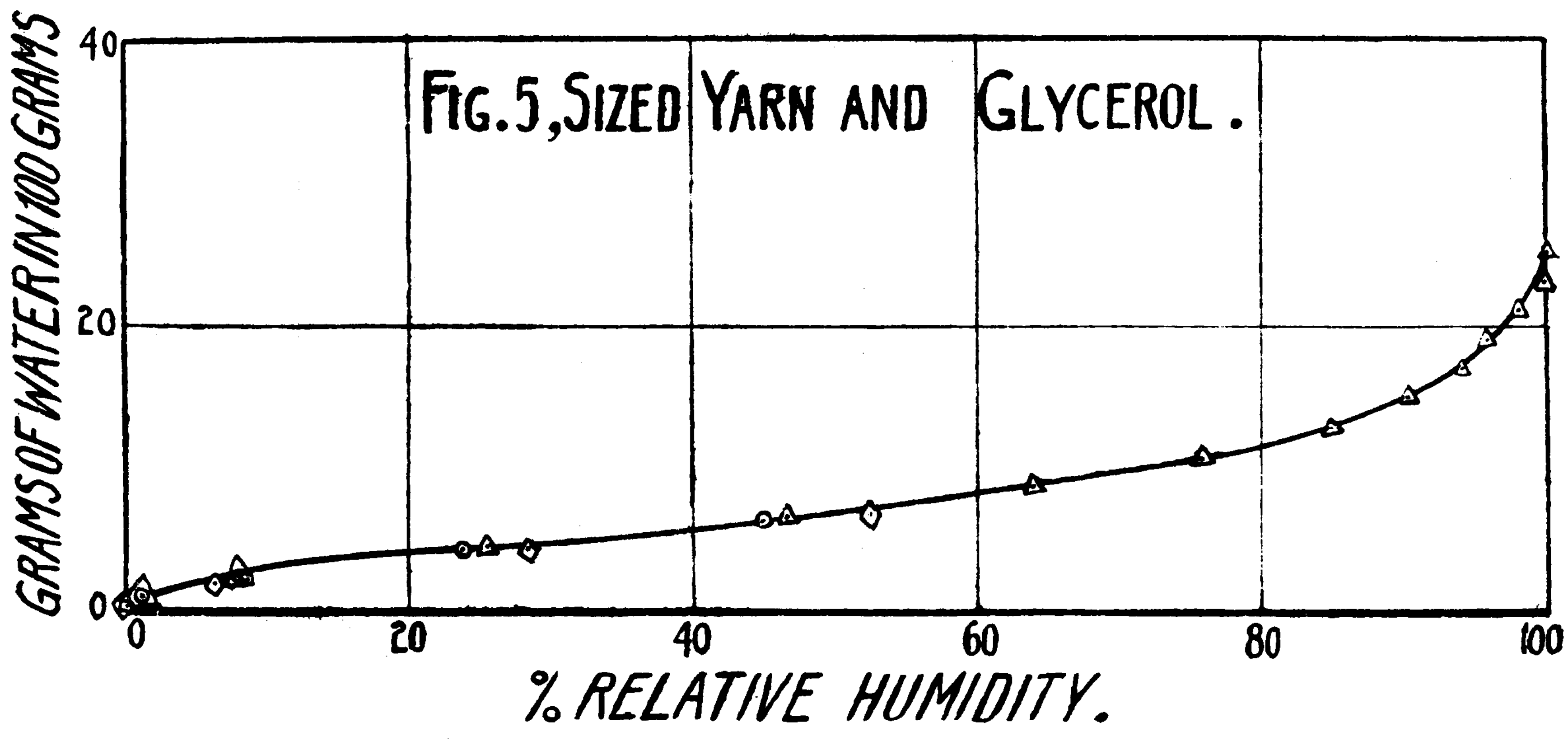
It thus appears that neither experiment began with the magnesium chloride holding the theoretical amount of water associated with the hexahydrate, but when allowance is made for the presence of the quantity ascertained, the data from the two experiments are found to be consistent and to define a curve such as is drawn in Fig. 2, where the two sets of points are distinctively plotted. The vertical portion of the graph shows the constancy of pressure over a saturated solution in contact with the solid salt, and the point where the two lines meet should give the concentration of a saturated solution. Reading from the graph this is found to be 35·8 per cent. of $MgCl_2$ in the solution, whereas Seidell[8] gives 35·3.

Calcium chloride.—This salt was treated in a similar way to magnesium chloride, the initial composition for two experiments being $CaCl_2.5{\cdot}1H_2O$ and $CaCl_2.4{\cdot}5H_2O$. For the latter the first pressure readings appear to correspond to the metastable system $CaCl_2.4H_2O$—saturated solution (solubility 50·5 per cent.; Roozeboom's[7] value 51·1), while for the other apparatus after an initial low reading the stable univariant system hexahydrate-saturated solution is found to have a vapour pressure of 5·7 m.m. and solubility 42·8 (Roozeboom's values 5·62 m.m. and 42·7 per cent.). The relative humidity over this system is thus 32·5 per cent., whereas Paranjpé[5] states that solid is present at a concentration of 41·2 per cent. with a relative humidity of 34. Apart from this discrepancy the figures now observed agree well with Paranjpé's as is evident from Fig. 3 where they are graphed.

Ammonium nitrate.—In order to test the method of measurement with a well-defined substance, pure ammonium nitrate crystals were employed, being weighed dry into the apparatus. Over a saturated solution a pressure of 11·3 m.m. was observed in agreement with the value given by Prideaux[6].

Starch and Sized Yarn.—Deliquescents were added in known quantity to starch which was evaporated to form films[4] or was applied to yarn. The composition of the starch mixtures was known synthetically, while the final composition of the sized cotton was obtained by removing the size and weighing the purified cotton, due allowance being made for the loss of water-soluble substances from the cotton on desizing. The various materials were dried by a normal process of evaporation, then at 110° C. for two hours and then weighed into the absorption vessel. Subsequent loss of water on evacuating was ascertained by observing the loss of weight of an exactly similar portion of starch, or yarn, placed in a weighing bulb in connection with the absorption vessel and evacuated with it over phosphorus pentoxide. Assuming the experimental material to have lost weight in the same proportion as the check quantity, it was possible to calculate the weight of "dry" substance in the vessel. That this was absolutely dry may be doubted, but the good correspondence between duplicate determinations which may be seen in the graphs makes it impossible that any important quantity of water remained in the evacuated substance. The bulbs were sealed and water introduced in the usual way, and readings taken over a wide range of humidities. The experimental observations are recorded graphically (Figs. 4 to 8) and only values read from the smooth curves appear in the tables. (Tables IV. and V.)





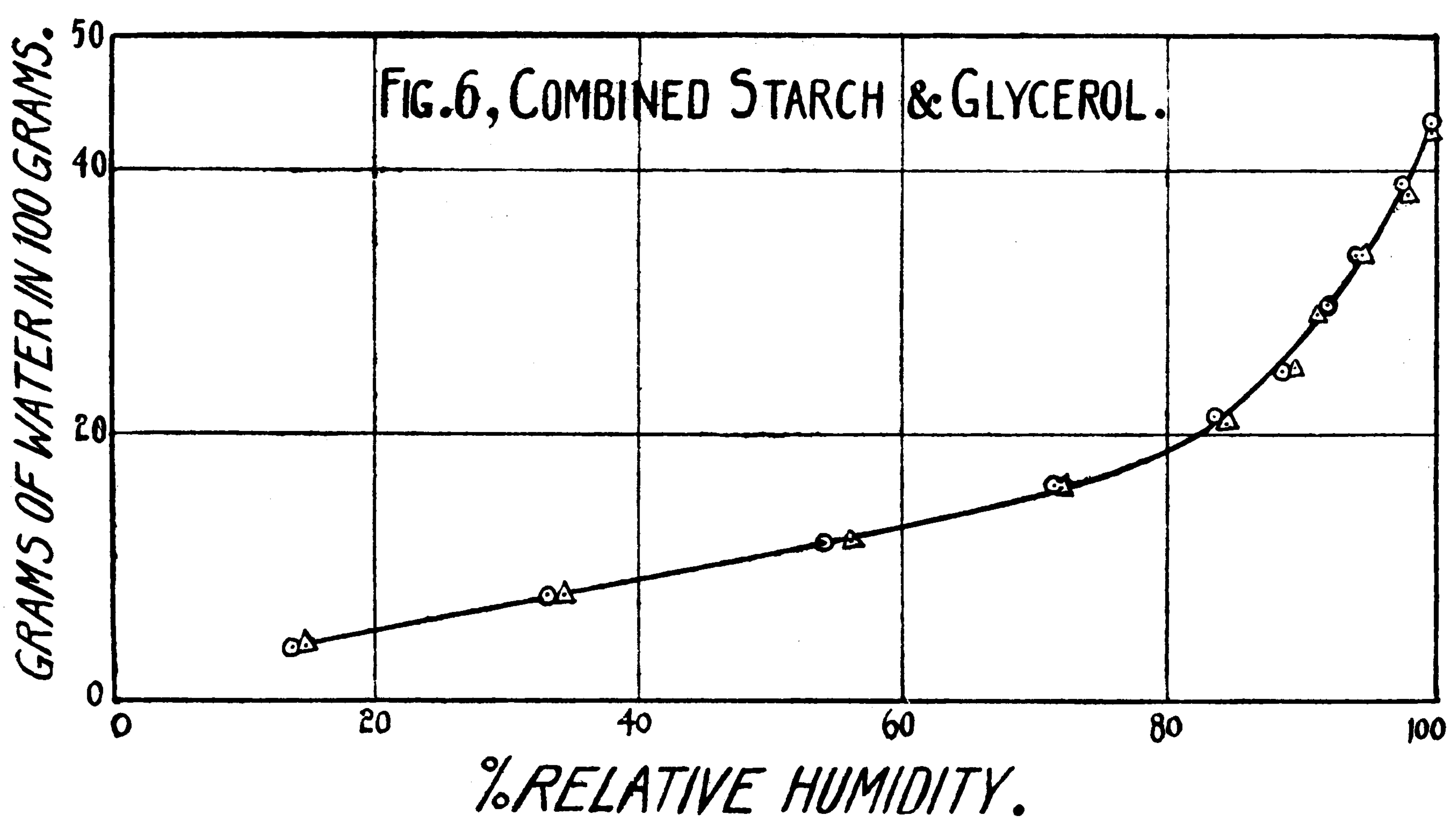


Table IV. shows two sets of values, the unenclosed figures referring to the interpolated readings taken from the graphs, while in brackets are given the amounts of water which would be calculated as the sum of the separate absorptions of the starch and cotton present. For the materials containing deliquescents the companion Table V. shows to what extent the observed value falls short of or exceeds that calculated. If there is a deficiency it appears as if the deliquescent is not only not absorbing water, but is also inhibiting absorption by the starch or cotton, and this is the condition which appears to hold in the region of lower humidity with both magnesium chloride and glycerol in starch. The method of expression is of course entirely arbitrary and a more general view would be that the absorptive capacities of both solid and dissolved substance satisfy each other to the partial exclusion of their calculated charge of water. Even where at higher humidities a positive difference exists, the amount of water is usually considerably less than would normally be taken by the deliquescent, though glycerol on sized yarn is a doubtful exception here.

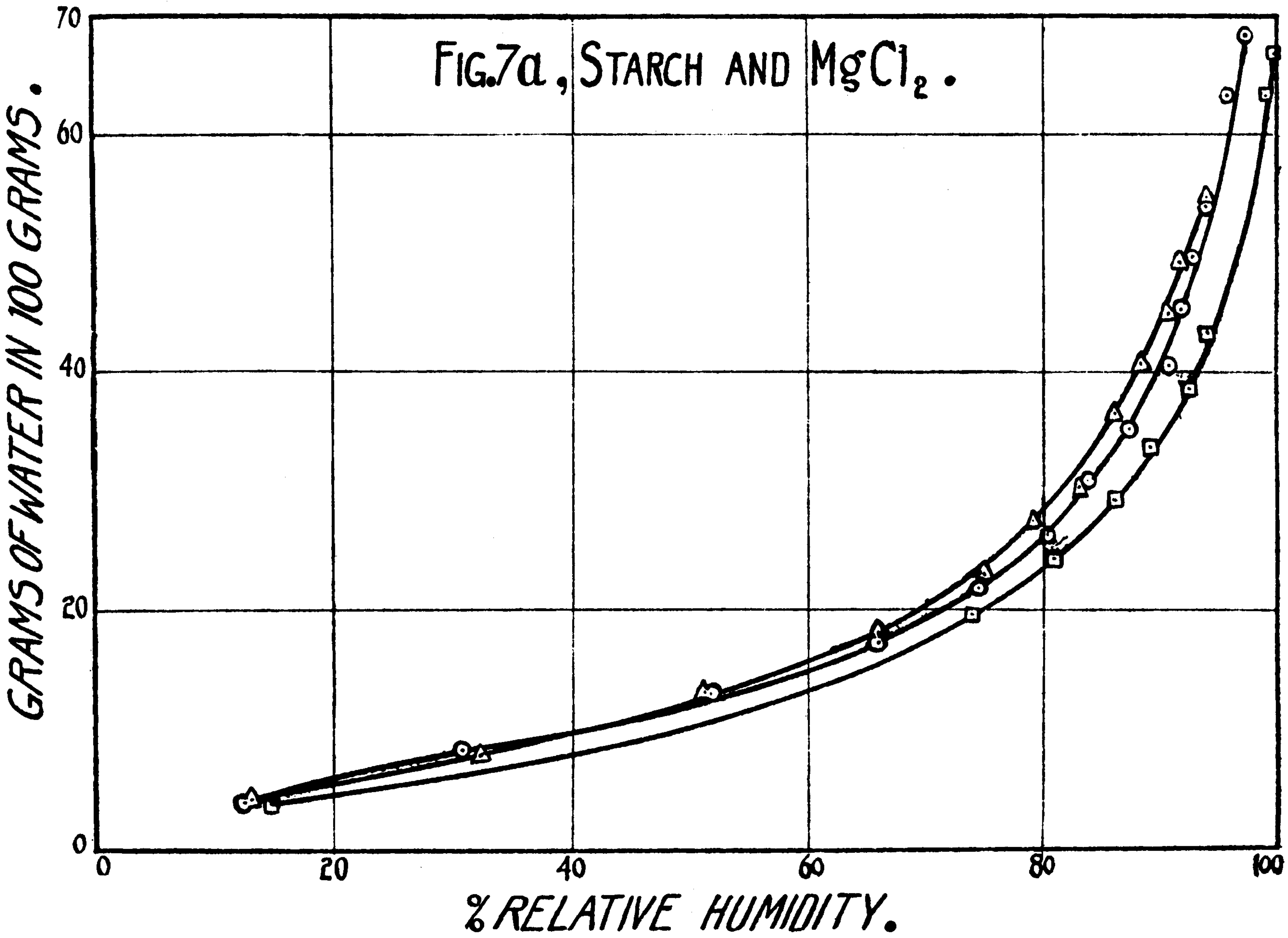


FIG. 7a, STARCH AND $MgCl_2$.

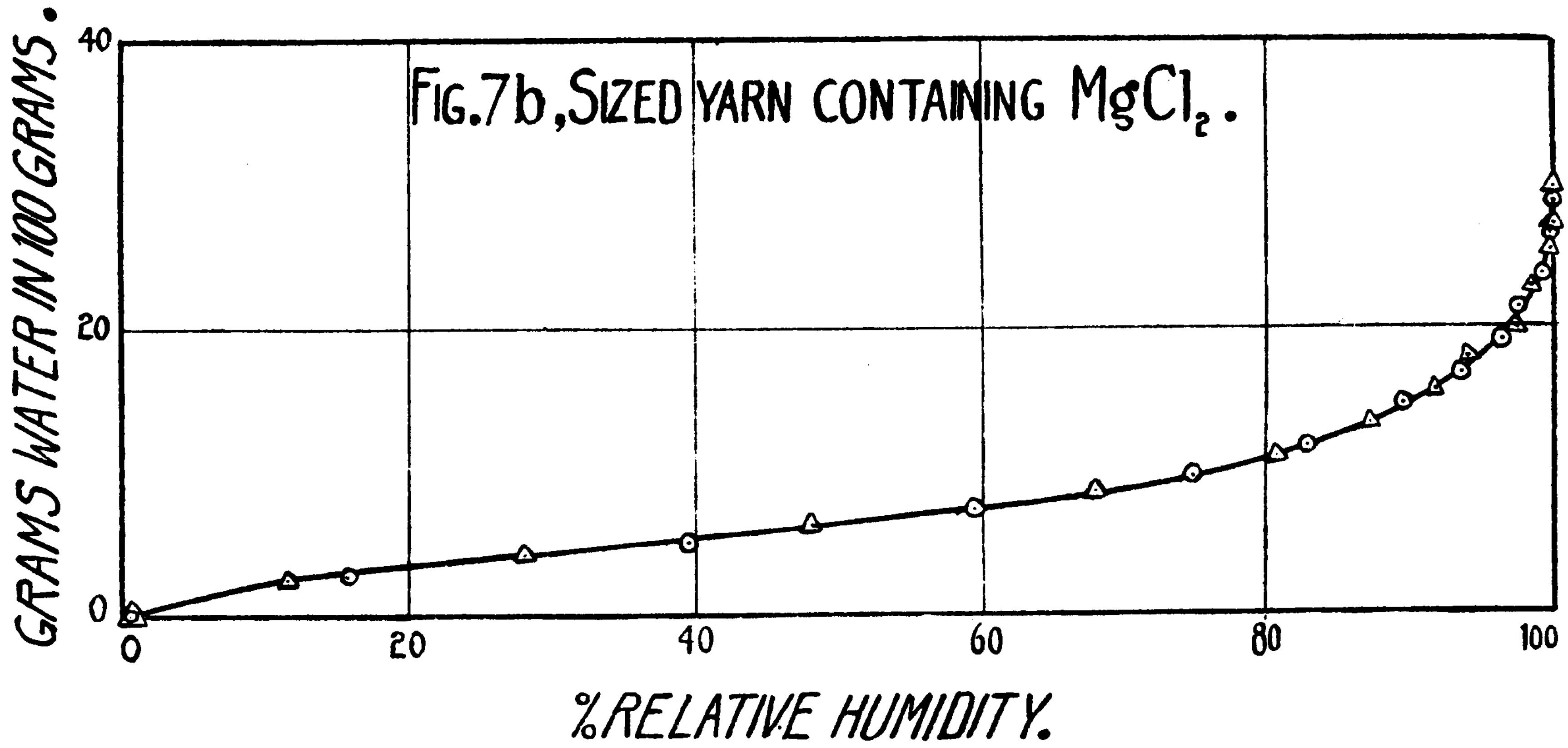


FIG. 7b, SIZED YARN CONTAINING $MgCl_2$.

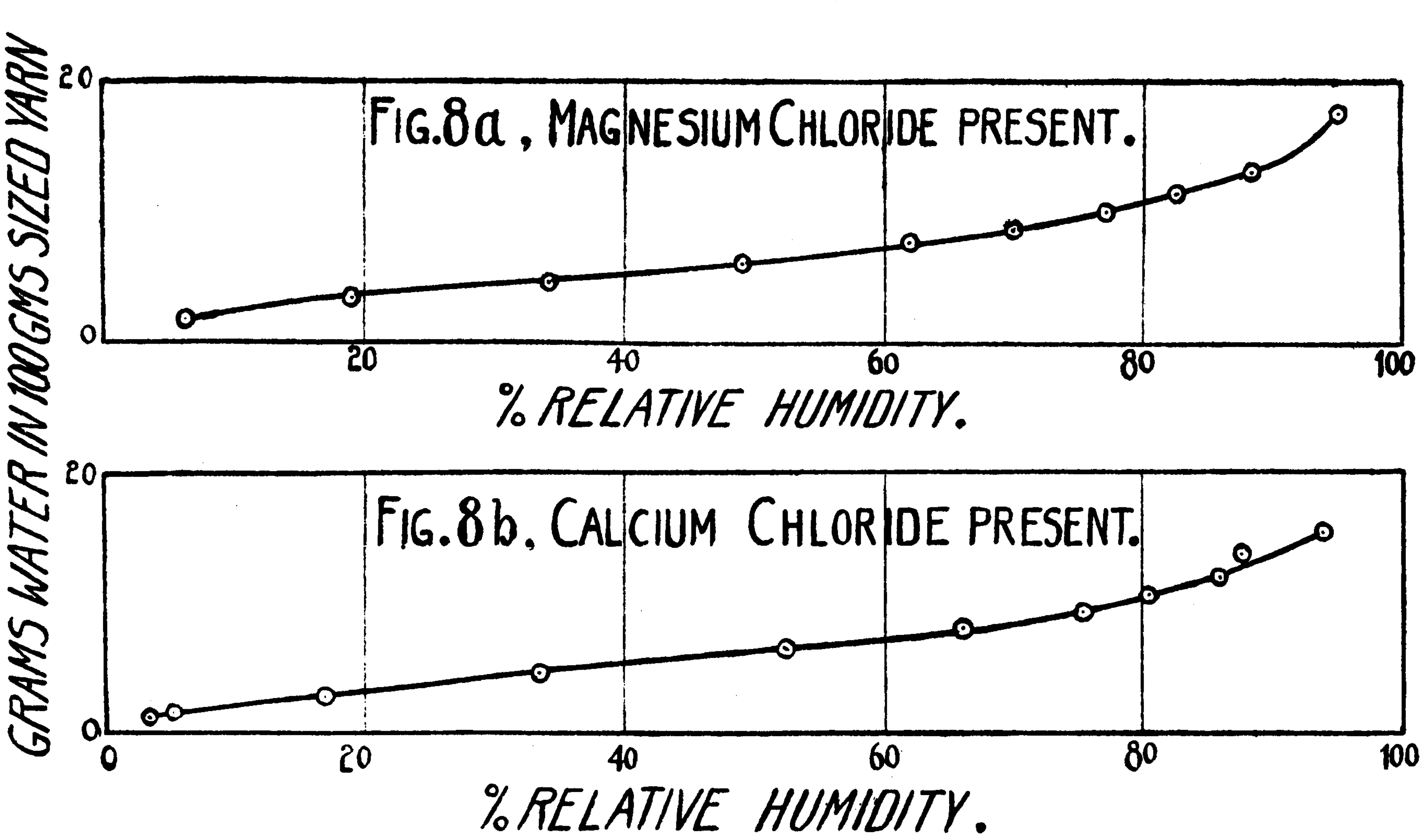


FIG. 8a, MAGNESIUM CHLORIDE PRESENT.

FIG. 8b, CALCIUM CHLORIDE PRESENT.

Table IV.

Regains of Size and Sized Yarn Found and Calculated (in brackets).

Substance	Composition			Figure	Relative Humidity						
	Cotton	Starch	Deliquescent		20	30	40	50	60	70	80
Raw cotton	100	—	—	4 (a)	3·3	4·1	4·9	5·7	6·8	8·0	9·5
Starch	—	100	—	4 (b)	6·2	6·2	10·1	12·0	14·3	17·2	20·7
Starch and glycerol ...	—	95·3	4·7	6	5·2 (5·9)	7·2 (7·8)	9·1 (9·6)	11·0 (11·4)	17·0 (13·6)	19·6 (16·4)	23·6 (19·7)
Starch and $MgCl_2$ ...	—	96·9	3·1	7 (a)	5·5 (6·0)	7·9 (7·9)	10·3 (9·8)	12·9 (11·6)	16·1 (13·9)	30·0 (16·7)	28·3 (19·9)
Starch and $MgCl_2$ ...	—	95·2	4·8	7 (a)	5·5 (5·9)	7·6 (7·8)	10·0 (9·6)	12·7 (11·5)	15·4 (13·6)	19·4 (16·4)	26·3 (19·7)
Starch and $MgCl_2$ ...	—	94·4	5·6	7 (a)	5·2 (5·9)	7·1 (7·7)	9·3 (9·5)	12·0 (11·4)	14·5 (13·5)	17·9 (16·3)	23·6 (19·6)
Sized yarn	90·58	9·42	—	4 (c)	3·8 (3·6)	4·7 (4·5)	5·8 (5·4)	6·9 (6·3)	8·0 (7·5)	9·2 (8·9)	10·9 (10·5)
Sized yarn and glycerol	92·7	6·95	0·35	5	3·6 (3·5)	4·5 (4·4)	5·7 (5·3)	6·7 (6·1)	7·9 (7·4)	9·5 (8·7)	11·5 (10·4)
Sized yarn and $MgCl_2$ ...	93·3	6·32	0·33	7 (b)	3·4 (3·5)	4·3 (4·3)	5·2 (5·2)	6·3 (6·1)	7·4 (7·2)	8·8 (8·5)	10·8 (10·2)
Sized yarn and $MgCl_2$ ...	91·1	7·56	0·75 Remainder tallow	8 (a)	3·4 (3·5)	4·2 (4·4)	5·1 (5·2)	6·1 (6·1)	7·3 (7·2)	8·5 (8·6)	10·9 (10·2)
Sized yarn and $CaCl_2$ ...	92·1	6·78	0·68 Remainder tallow	8 (b)	3·2 (3·5)	4·3 (4·3)	5·3 (5·2)	6·3 (6·1)	7·4 (7·2)	8·6 (8·5)	10·4 (10·1)

These observations are put forward with some reserve, but they are held to indicate that the addition of a soluble salt to size does not necessarily increase the percentage of water taken up by sized yarn. The weighting effect of salts, on this view, is exerted by their simple presence rather than by their capacity for attracting water, while their power of influencing favourably the mechanical properties of yarn may well be due to quite different causes from those usually assumed.

Table V.

Apparent Effect of Deliquescent in Increasing or Diminishing the Water taken up by Cotton and Starch.

Relative humidity, %	20	30	40	50	60	70	80
Substance—Composition as in Table IV.	Parts of water gained or lost						
4·7 parts glycerol in starch	−0·7	−0·6	−0·5	−0·4	+3·4	+3·2	+3·9
0·36 ,, glycerol in sized yarn ...	—	—	+0·4	+0·6	+0·5	+0·8	+1·1
3·1 ,, $MgCl_2$ in starch	−0·5	—	+0·5	+1·3	+2·2	+3·3	+8·4
4·8 ,, $MgCl_2$ in starch	−0·4	—	+0·4	+1·2	+1·8	+3·0	+6·6
5·6 ,, $MgCl_2$ in starch	−0·7	−0·6	—	+0·6	+1·0	+1·6	+4·0
0·33 ,, $MgCl_2$ in sized yarn ...	—	—	—	—	—	+0·3	+0·6
0·75 ,, $MgCl_2$ in sized yarn ...	—	—	—	—	—	—	+0·7
0·68 ,, $CaCl_2$ in sized yarn ...	−0·3	—	—	—	—	—	+0·3

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48—THE ABSORPTION OF WATER BY DRIED FILMS OF BOILED STARCH

ABSORPTION AND DESORPTION BETWEEN 20° C. AND 90° C.

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INTRODUCTION AND SUMMARY

In an earlier paper[1] it was shown that a graph of the "regain" of dry starch which is brought into successively more and more humid atmospheres is an S-shaped curve showing a rapid initial absorption at low humidities, a more gradual increase in the range from 20 per cent. to 80 per cent. relative humidity, and a very considerable increase in the amount absorbed as saturation is approached. An account is now given of experiments dealing with this absorption at higher temperatures than those previously employed, while the different final result (hysteresis) of bringing dry or wet starch into any given atmosphere is also examined over a fairly wide temperature range.

The general slope of the absorption curve at 20° C. is confirmed and a second curve is obtained when starch saturated at this temperature is brought back to dryness by a gradual process of removal of water by exposure in increasingly dry enclosures. This (desorption) curve is similar in shape to the absorption curve but lies above it (when regain is the ordinate), so that at any relative humidity starch may exist in one of two extreme states which differ in their water content according as the material has been brought from a state of dryness or from saturation, to the atmosphere in which it is observed. The maximum regain at any humidity is given by a point on the desorption curve, and the minimum by an equally well-defined point on the absorption curve which leads from dryness to saturation.

The above statement summarises the knowledge attained by consideration of the previous paper[1] and part of the present work. The phenomenon of hysteresis is more concretely illustrated by the figures (Table I.) showing the order of the difference of water content according as an upward or downward path of wetness is followed, the arrows showing the sequence of exposure. It must be understood that each of the figures quoted represents a steady state of the wet starch, which will not gain or lose water by further exposure to the humidity against which the regain figure stands.

Table I.

Parts of water to 100 parts of dry starch.

Relative humidity (per cent.)	0	20	30	40	50	60	70	80	100
Absorption ———→	0	6·7	8·6	10·4	12·2	14·2	16·3	19·0	——→ ↓
Desorption ←———	0	8·0	10·3	12·7	14·9	17·2	19·5	22·2	←——

These figures are for a particular sample of starch film evaporated at 70° C., but another specimen prepared at 100° C. and tested at the same time gave desorption figures appreciably higher than those in the table, and it is clear from these and other experiments that the retentive power of a starch film is greater the higher the temperature or the more prolonged the period of heating of its original preparation.

Absorption and Desorption at Temperatures above 25° C.

Direct determination of absorption at 30° C. showed that at the same relative humidity but at higher temperatures less water was taken up. Other experiments on the effect of temperature were conducted by measuring the pressure over the system at a series of temperatures by the method used on cotton by Urquhart and Williams[2]. Some of the experiments were made by adding water to dry starch and others by withdrawing water from the saturated material, so that observations were obtained which gave points on both absorption and desorption curves at various temperatures. Using a method of interpolation, which is described elsewhere[2], the data were employed in the construction of absorption and desorption isotherms at various temperatures. With regard to the former, measurements at high temperature suffer in accuracy from the sensitiveness of starch to heat, so that it is difficult to be certain that the same material was being experimented on at 90° C. as at the lower temperatures. Subject to this limitation the sheaf of the absorption curves obtained gives evidence of a similar behaviour to those obtained with cotton by Urquhart and Williams[2]. The decreased absorption noted at 30° C. as compared with 20° C. is reproduced by a further decrease for each successive step in temperature, except that at humidities above 80 per cent. there is a crowding together of the curves with a suggestion that the high temperature curves if continued would cross those of low temperature. It is unfortunately impossible, owing to experimental irregularities, to deal with any accuracy with the effects of high temperatures. The desorption isotherms obtained by a similar process are determined for a rather narrow range of humidities but they serve to show that the difference between the absorption and desorption value at any humidity is less the higher the temperature, so that at 90° C. there is no certainty that this hysteresis exists at all. At 20° C. the absorption and desorption curves obtained by the indirect method agree fairly well with those directly determined as the following table shows—

Table II.

		Regains at the relative humidities shown (Direct and Indirect methods).								
Relative humidity % ...		0	20	30	40	50	60	70	80	100
Direct	Absorption ...	0	6·7	8·6	10·4	12·2	14·2	16·3	19·0	→ ↓
	Desorption ...	0	8·0	10·3	12·7	14·9	17·2	19·5	22·2	←
Indirect	Absorption ...	0	6·7	8·5	10·2	11·9	13·8	16·2	19·0	→ ↓
	Desorption ...	0	8·7	10·7	12·8	15·0	17·4	19·5	22·3	←

It is not proposed to suggest any applications of these measurements at this stage. The work as conducted has been remote from practice but will conceivably be of utility in the future in investigations dealing more explicitly with the behaviour of starch-filled goods undergoing treatment at varying temperatures and with a wide variety of water contents.

EXPERIMENTAL

Desorption Isotherms at 20° C.

Experiments C, D, E, and F of the previous paper[1] were continued by exposing the weighing bottles containing the starch samples over water for some time, and then again in desiccators over sulphuric acid of the requisite concentration to control the atmosphere at the different stages of decreasing humidity desired. The complete results are given in Tables III. and IV., and those for experiments D and F are plotted in Fig. 1, the others being omitted in order to avoid confusion of the graph.

Table III.

Experiments C and E; desiccator experiments in the presence of air.

C	R.H.	23·8	25·3	46·8	47·7	73·2	73·2	100	73·3	73·1	47·8	47·6	24·6	24·0
	Regain	6·9	7·2	11·6	11·3	17·5	17·5	—	20·6	20·4	14·1	14·0	9·0	9.0
E	R.H.	23·8	24·5	47·3	47·3	72·8	72·9	100	73·2	72·9	47·6	47·6	23·6	23·6
	Regain	6·5	6·9	11·6	11·9	17·3	16·7	—	21·6	20·7	15·2	15·1	9·5	8·8

———Absorption———→ ———Desorption———→

In this and subsequent tables "R.H." indicates percentage relative humidity and "Regain" the weight in grams of the water held by 100 parts of dry starch.

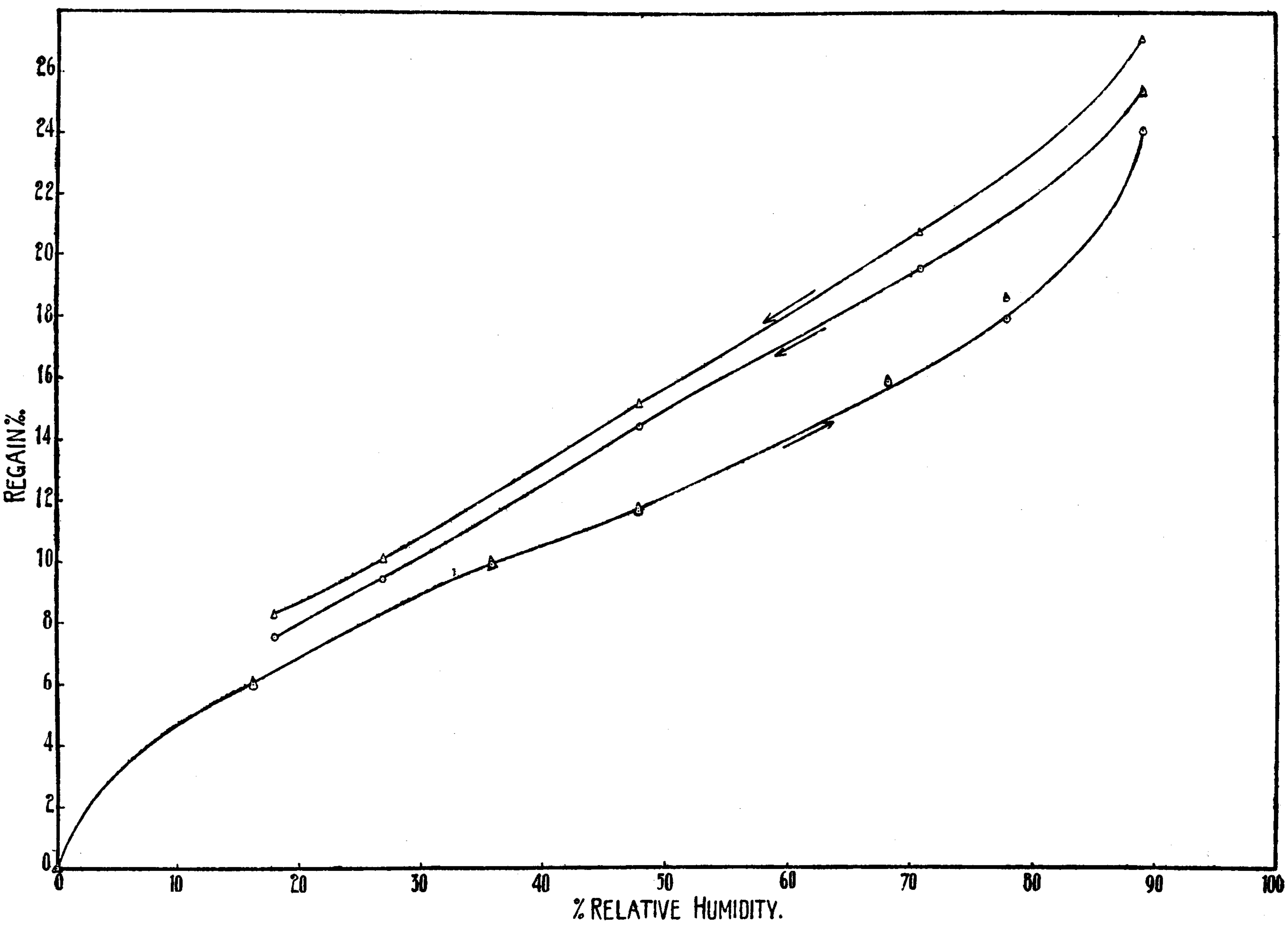

FIG. 1

Table IV.

Experiments D and F; desiccator experiments under reduced pressure (16 mm.)

Exp.	R.H.	0	16·4	35·8	47·8	68·3	78·0	89·2	100	89·2	70·9	47·8	27·0	18·2
D	Regain i.	0	5·8	9·3	11·5	15·8	17·9	23·9	?	25·2	19·4	14·4	9·4	7·6
	,, ii.	0	6·1	9·6	11·9	16·0	18·0	24·2	?	25·5	19·7	14·5	9·5	7·6
	Mean ...	0	6·0	9·5	11·7	15·9	18·0	24·1	?	25·4	19·6	14·5	9·5	7·6
F	Regain i.	0	6·1	9·5	11·8	16·2	18·8	25·4	?	27·4	21·2	15·6	10·5	8·6
	,, ii.	0	6·1	9·5	11·7	15·8	18·5	25·4	?	26·7	20·3	14·7	9·7	7·9
	Mean ...	0	6·1	9·5	11·8	16·0	18·7	25·4	?	27·1	20·8	15·2	10·1	8·3

——————Absorption————→ ————Desorption———→

It will be seen that though the absorption curves for the two experiments coincide there are two desorption curves, that for experiment F (and for E which is not plotted) lying above the other. The films for C and D were evaporated at 70° C., those for E and F at 100° C., and it appears that the higher temperature used in the preparation of the latter makes them more retentive of water than are those prepared at the lower temperature.

In addition absorption and desorption values given by different samples of starch treated according to the scheme indicated in Table V. give evidence of the existence of hysteresis at 20° C. at humidities as low as 8 and as high as 96·5 per cent.

Table V.

Hysteresis at high and low humidities.

Sample		Sequence of exposure. (1)	(2)	(3)	(4)
A	Relative humidity ...	0	8·2	100	8·5
	Regain...	0	4·0	—	6·1
B	Relative humidity ...	0	96·5	100	96·5
	Regain...	0	36·1	—	37·1

The conclusion that the hysteresis of a starch film is the greater the more it has been heated is supported by experiments on materials prepared in a variety of ways, and typical results are given in Table VI. The time and temperature of drying refer to the treatment employed to bring the starch into the film form, and in all cases it was necessary to complete the process by prolonged drying over phosphorus pentoxide in vacuo. The experiments were conducted in the usual way with desiccators, exposing the starch in weighing bottles, and weighing from time to time until constancy was attained.

Table VI.

Regain and hysteresis of starch film evaporated by different processes.

Method of evaporation	Humidity sequence 52	→68	→100	→68	Hysteresis at 68% R.H.
In vacuo over sulphuric acid ...	14·8	18·0	(40·1)	21·2	3·2
At 75° C. for 24 hours ...	12·9	16·1	(39·6)	20·3	4·2
At 110° C. for 24 hours ...	12·6	16·0	(38·7)	20·9	4·9

The change of hysteresis here is mainly dependent on the known effect of heating in reducing the absorptive power of starch[1], further evidence on which is afforded by experiments done by the volumetric method and tabulated below.

Table VII.

Regain of starch film evaporated by different processes.

Method of Evaporation	R.H.—	45·0	55·0	65·0	75·0	85·0
48 hours over P_2O_5 at 18° C....	...	12·9	14·7	16·6	—	—
2½ hours at 80° C. in air ...	...	12·2	14·1	16·0	18·5	22·2
20 hours at 100° C. in air ...	...	11·4	13·2	15·4	17·8	21·1

Absorption at 30° C.

An isotherm at this temperature was determined in the usual way by the volumetric method[1], known quantities of water being introduced into an evacuated vessel containing starch, and the pressure noted. The experiment is recorded in Table VIII. and graphically in Fig. 2, and some use is made of interpolated values at a later stage. Compared with the 20° C. isotherm which is plotted alongside it the absorption at 30° is less at any given humidity throughout the range investigated.

Table VIII.

Absorption isotherm at 30° C.

R.H.	9·5	... 26·8	... 44·8	... 59·3	... 67·8	... 86·4
Regain...	4·0	... 7·7	... 10·7	... 13·5	... 15·5	... 21·1
Starch sample	A	... A	... A	... B	... A	... B

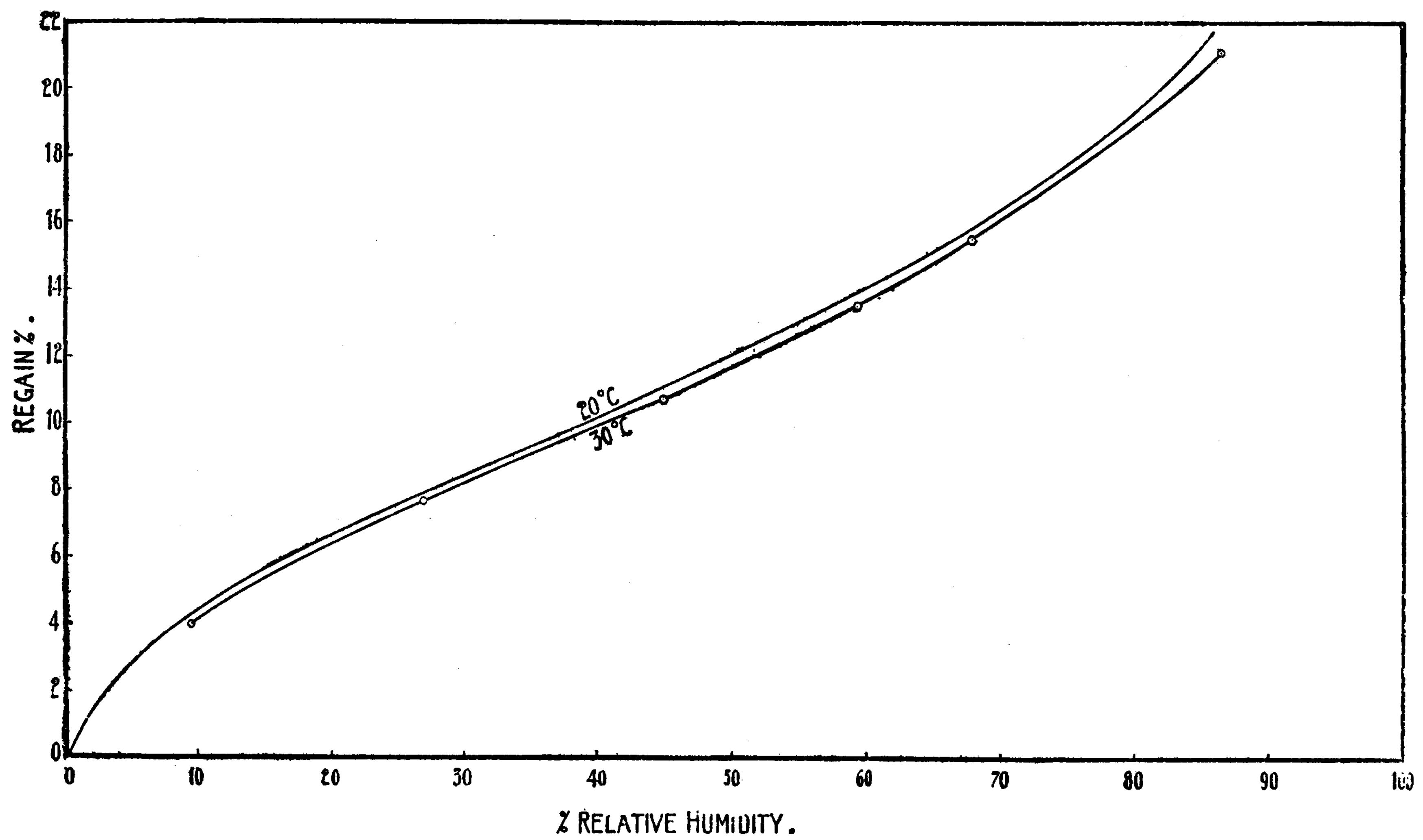

FIG. 2

Absorption and Desorption Isotherms at Higher Temperatures

The method of experiment employed for this section of the work was almost identical with that described by Urquhart and Williams[2] and it is

Table IX.

Vapour pressure over moist starch in evacuated vessels at various temperatures.
a=Regain (per cent.); p=vapour pressure.

Apparatus	A		B		C		D		E		F		G		H	
	Absorption		Absorption		Absorption		Absorption		Absorption		Desorption		Desorption		Desorption	
Temperature	a	p	a	p	a	p	a	p	a	p	a	p	a	p	a	p
20° C.	4·0	1·5	8·5	5·4	12·3	9·2	20·0	14·2	26·1	16·7	8·0	2·9	13·1	7·5	20·2	12·5
25° C.	4·0	1·9	8·5	7·4	12·2	13·0	19·9	19·4	26·1	22·3	8·0	4·4	13·1	10·7	20·1	17·7
30° C.	4·0	2·3	8·5	10·6	12·2	17·5	19·9	26·2	26·0	29·5	8·0	6·6	13·1	15·0	20·1	24·6
40° C.	4·0	4·2	8·4	19·5	12·2	32·0	19·9	41·8	26·0	50·4	8·0	13·5	13·0	29·3	20·0	45·3
50° C.	4·0	7·9	8·4	34·8	12·1	54·9	19·8	78·6	26·0	84·3	7·9	26·3	13·0	53·4	19·9	78·5
60° C.	4·0	14·1	8·3	61·2	12·1	93·5	19·6	128	25·8	140	7·9	49·1	12·9	94·8	19·8	130
70° C.	3·9	24·6	8·3	101	11·9	152	19·4	201	25·8	219	7·8	84·2	12·7	158	19·5	206
80° C.	3·9	40·3	8·2	162	11·6	239	19·2	304	25·6	331	7·7	138	12·5	247	19·2	309
90° C.	3·8	66·9	8·0	242	11·3	352	—	—	—	—	7·5	218	12·3	—	—	—
80° C.	—	40·5	—	163	11·6	239	—	—	—	—	—	146	—	255	—	—
70° C.	—	24·5	—	105	11·9	157	—	—	—	—	—	94·0	—	169	—	—
60° C.	—	14·2	—	64·5	12·1	99·2	—	—	—	—	—	56·5	—	105	—	—
50° C.	—	8·1	—	37·9	12·1	59·4	—	—	—	—	—	32·5	—	62·5	—	—
40° C.	—	4·7	—	21·5	12·2	34·4	—	—	—	—	—	17·9	—	35·5	—	—
30° C·	—	2·7	—	12·0	12·2	19·2	—	—	—	—	—	9·7	—	19·1	—	—
25° C.	—	—	—	8·9	12·2	13·9	—	—	—	—	—	—	—	—	—	—
20° C.	—	1·5	—	6·6	12·3	10·5	—	—	—	—	—	4·8	—	10·0	—	—

Reading down the columns the experiments are recorded in the order in which they were made.

therefore unnecessary to give any detailed account of it. Briefly, it consists in introducing a known weight of dry starch into an absorption vessel to which a gauge is sealed, admitting a definite amount of water to the evacuated space, and sealing the apparatus. For investigation of desorption a known excess of water was admitted, and a weighed quantity removed by means of a phosphorus pentoxide bulb before the apparatus was closed.

All heating was done in water thermostats, so that 90° C. was the highest temperature at which observations were made. Observed differences of mercury level were corrected for temperature, and allowance was made for the amount of water vapour in the free space, the corrected experimental figures being given in Table IX.

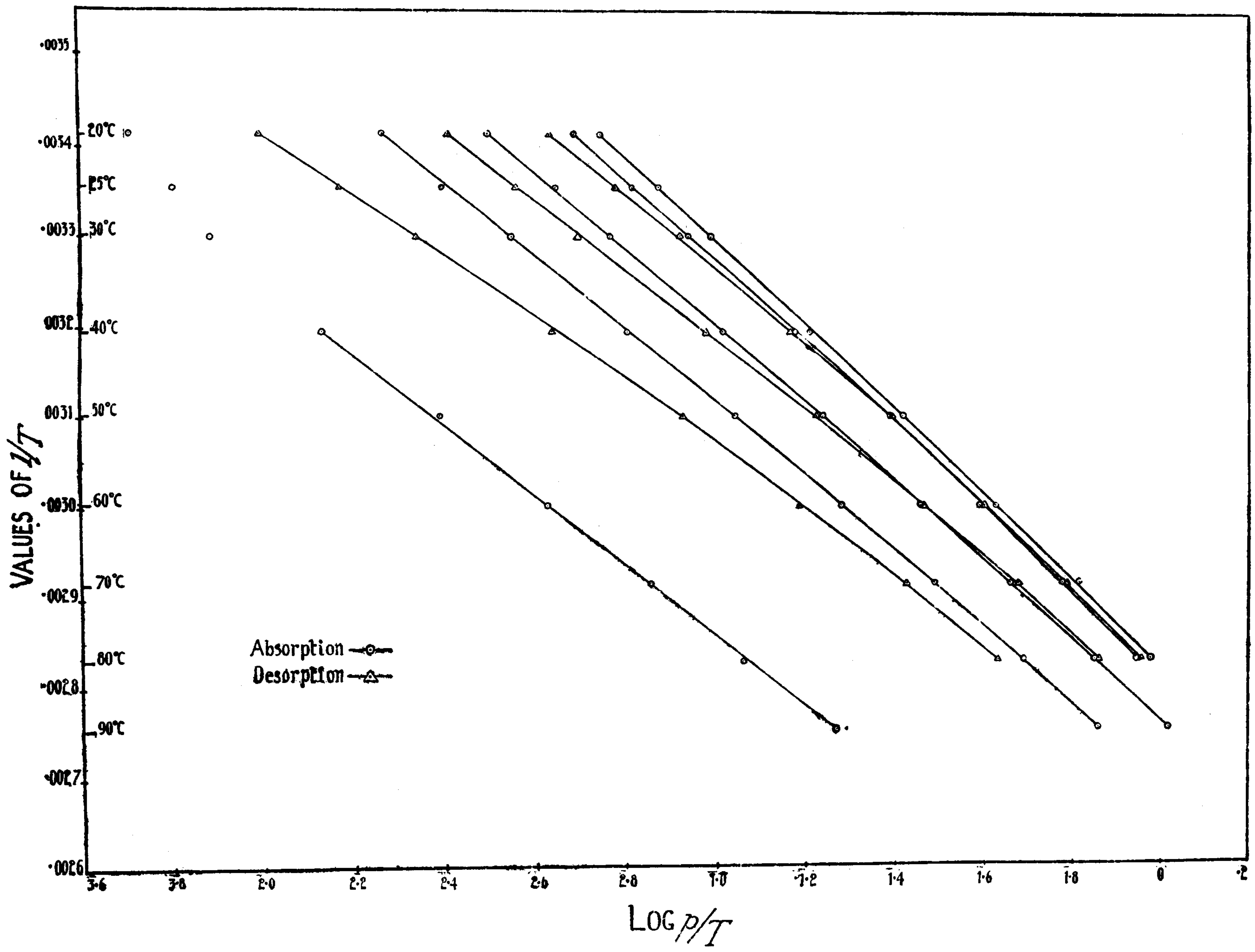

FIG. 3

It will be seen that where the absorption vessel after heating to its highest temperature was taken down stage by stage to 20° C., the pressure at the second passage of any temperature was considerably higher than the initial reading. This accords well with other observations that prolonged heating causes starch to lose some of its capacity for absorbing water, but it unfortunately renders it probable that the high temperature readings refer to a material whose properties have changed since the low temperature observations were made. There is no certain means of improving the significance of the figures which result from this type of experiment, and the data which are employed are those obtained from the first readings with the temperature rising. In the vessels where desorbing film was observed the divergence between the initial and final low temperature readings is more considerable than in the absorption vessels. This is to be expected, since the water lost owing to the diminished hygroscopicity at the higher temperature cannot be reversibly restored to the starch as it should be if an absorption curve were being considered.

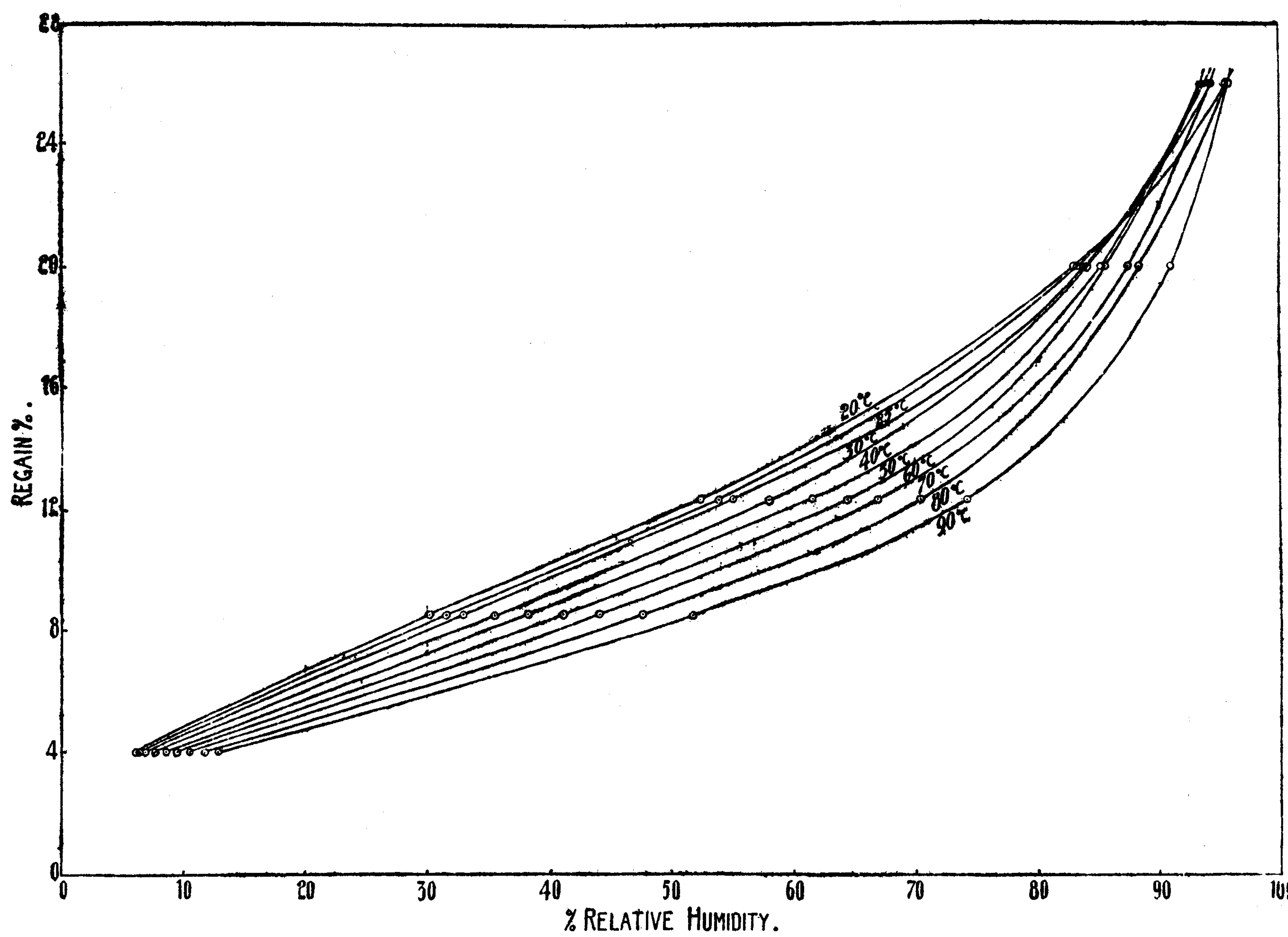

FIG. 4 (Absorption)

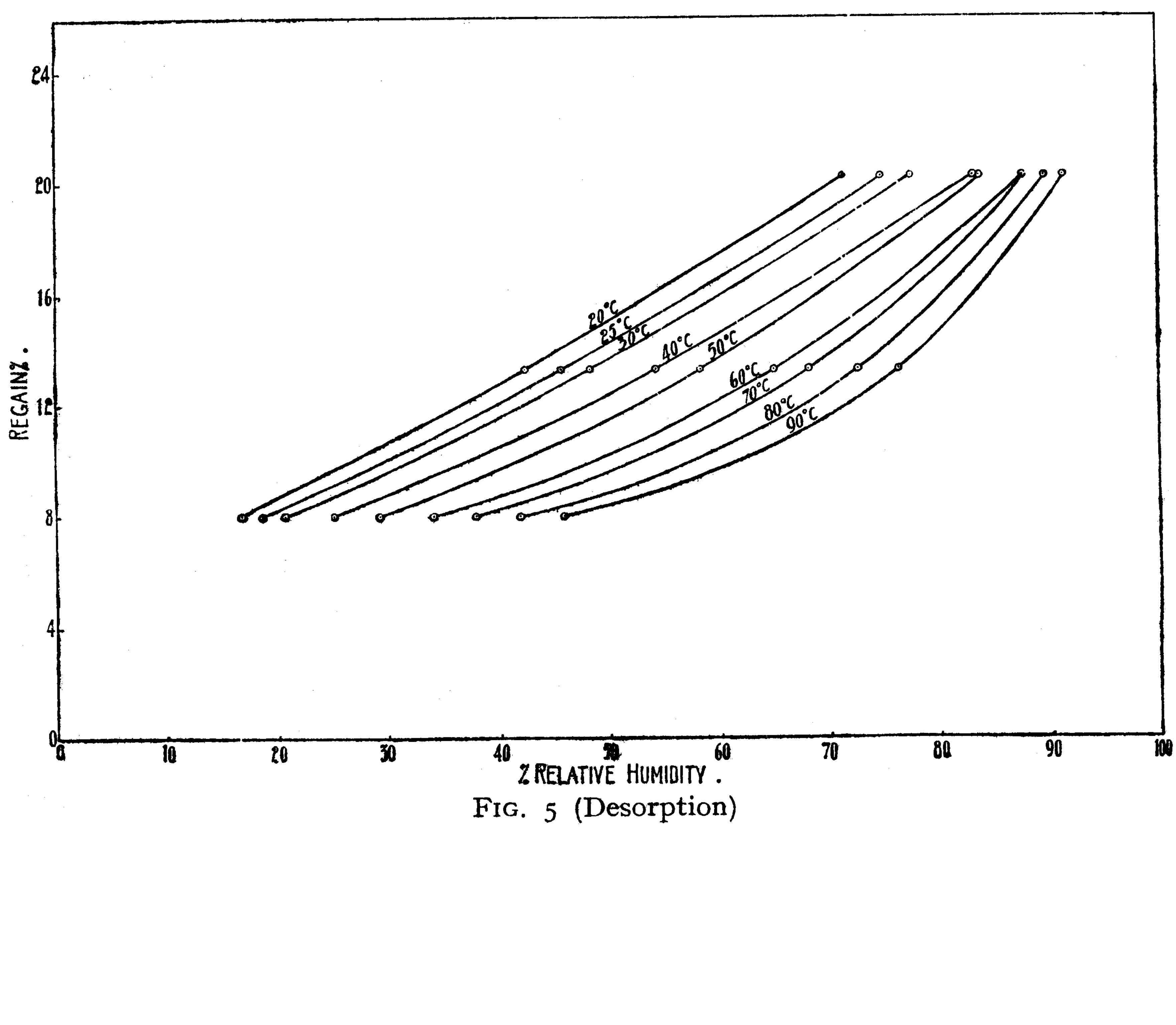

FIG. 5 (Desorption)

From the pressure and regain figures (p and α) of Table IX., isothermal curves were plotted, and from these were read off values of the pressure corresponding to the series of regains which defined the condition of the starch originally put into each apparatus. These initial isotherms were used merely for the purpose of correcting by a short extrapolation for the loss of water into the vacuous space as the temperature of the separate vessels was raised. The new set of figures consists, therefore, of eight series defining the relation between pressure and temperature, at constant water content, and from these, eight isosteres, or curves of equal regain, are plotted in Fig. 3. The graphs are those of $1/T$ against $\log p/T$ (T is absolute temperature, p is the vapour pressure of the starch/water system), following Urquhart and Williams[2], and it will be seen that they approach very closely to the straight lines which are to be expected from Williams'[3] theoretical treatment. Actually as in the case of cotton, the lines are slightly curved and have been drawn so, being used as the most suitable means of smoothing out irregularities of the experimental data. All have been extrapolated where necessary to 90° C., though this does not appear in the figure, and that for apparatus A to 20° C., since it seems probable that the lowest three points here are subject to some error, possibly on account of the difficulty of correcting adequately for the height of the meniscus in the pressure gauge at the lowest temperatures. Reading from these curves, and converting pressures to relative humidities, a new series of smoothed values is obtained relating regain to humidity at the various temperatures, and these are expressed graphically for absorption in Fig. 4 and desorption in Fig 5.

There are two possible checks on the validity of the methods employed, consisting in a comparison of the values at 20° C. and 30° C. obtained by this indirect method and by direct weighing or measurement at each point. The former comparison is shown in Table II. in the introduction to this paper, the 20° desorption isotherm in Fig. 5 having been extrapolated to widen the range of comparison. The figures at 30° C. are available for absorption only and are given below—

Table X.

Regains at 30° C.

R.H.	20	30	40	50	60	70	80
Direct Method	6·4	8·3	9·9	11·7	13·6	16·1	18·9
Indirect method	6·3	8·0	9·7	11·4	13·2	15·3	18·3

The differences between the regains given for the different experiments are no greater than are found between any two specimens of starch evaporated and dried at different times, and it is unfortunately impossible to regard any stated regain as having a less uncertainty than 5 per cent. of its value.

On this account the isotherms of Figs. 4 and 5 are of qualitative interest only, since it is improbable that they define the water content at any stage of an industrial process, of starch occurring in yarn or fabric. It is clear that at low and moderate humidities starch becomes less hygroscopic as the temperature is raised. It seems probable that as the humidity approaches 90 per cent. the high temperature isotherms cross those for low temperature so that at these high humidities starch is more hygroscopic at high than at low temperatures. This behaviour is similar to that observed for cotton[2], and whatever explanation is advanced for the phenomenon must be capable of application to the widely different types of structure possessed by evaporated starch pastes, and the mechanically intact cotton hair.

With regard to hysteresis it is seen that the gap between the absorption and desorption curves is wide at low temperatures but almost disappears at 90° C. It would be premature to speculate as to the practical significance of this for the conduct of any industrial drying process, since the experimental path has necessarily been one which is not traversed by material following the more complicated sequence of works treatments. It can only be suggested that the present results may be of some value as a guide to the phenomena to be looked for in some futuie examination of the sizing and finishing of cotton goods.

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49—THE IMPORTANCE OF HAIR WEIGHT PER CENTIMETRE AS A MEASURABLE CHARACTER OF COTTON AND SOME INDICATIONS OF ITS PRACTICAL UTILITY

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INTRODUCTION

It has already been shown that defects in yarns or fabrics may be due to factors which are inherent in the irregularity of the raw material, and which consequently lie outside control during a mechanical process.[14] This irregularity is reflected in the variability in the measurable characters of the single cotton hairs, the chief of these being length, width, strength, thickness of cell wall, and hair weight per centimetre. The range of variation in certain of these characters has also been shown.[1,5,7,8,13]

The present paper is an attempt to demonstrate the importance of one of these characters—hair weight per centimetre—both in relation to the quality of cottons and also as a means of assisting in their identification, more particularly when in the form of yarn or fabric.

Many text-books [2,3,11,12,16] dealing with textile fibres, give values for some of the measurable characters of cotton, but do not include hair weight per centimetre. Balls[2] first sketched a method of obtaining it by means of a torsion balance; while Clegg and Harland determined this quantity for five different cottons with no reference, however, to its practical application.[7] Balls[2] regarded the weight of the hair, depending as it does upon its width and thickness of its cell wall, as equivalent to its strength, and stated that "the breaking strain of a fibre is very largely determined, if not entirely, by its own weight, or, in other words, by the thickness of its cell wall." Burd[4] employed a torsion microbalance with a fine glass fibre in an attempt to determine the number of hairs on a single cottonseed; and, later, in a variety test of a number of pure strain Sea Island cottons he came to the conclusion from the results of spinning tests that "there appears to be no relation between the hair strength and the weight of single hairs." Denham[10] has described a method for the construction of a simple torsion microbalance for weighing cotton hairs. A modified balance of this type has been employed during the present investigation, and is described, together with the technique of sampling and weighing, in the Appendix.

RESULTS OF ROUTINE MEASUREMENTS

Preliminary tests were carried out on Sea Island, Texas, and Broach cottons at different stages of cardroom preparation, with the results shown in Table I.

Table I.

Hair Weight per Centimetre.*

	Sea Island	Texas	Broach
Mixing	—	202	252
Finisher lap	109	199	—
Card sliver	107	200	251
Comber sliver	107	—	—
Finisher sliver	—	200	—
Roving	107	—	—

There is no indication of fractionation by weight throughout the various processes, and presumably coarse hairs are just as liable to be broken as fine ones, since if it were otherwise a change in value would be expected after carding and combing. The useful practical issue of this is that the mean value for any given mixing may be found by sampling from cotton at any one of the cardroom processes, where the hairs have already been thoroughly well mixed and parallelised.

With a view to obtaining some idea of the range of weight within a given variety, tests were then made on random bales from the stocks of three mills using Texas, Sakel, and Uppers cotton respectively.

In the case of the Texas cotton, two bales of each of seven marks were at the time being put through separately to determine their relative spinning values. Tests were made, therefore, not only from the bale, but also from the slubbing, presuming that the latter is more likely to furnish an accurate average value for the bale, having been doubled 864 times in preceding processes. The results are given in Table II.

Table II.

Hair Weight per Centimetre.

Mark	Bale No.	From Middle of Bale	From Slubbing
A	1	196	204
	2	175	172
	3	182	—
B	1	207	209
	2	176	176
	3	209	—
C	1	187	196
	2	193	185
	3	193	—
	4	186	—
	5	167	—
D	1	186	196
	2	194	196
E	1	207	210
	2	190	191
F	1	171	176
	2	192	194
	3	207	—
	4	209	—
G	1	197	199
	2	196	201

From these figures two conclusions may be drawn.

(1) A sample taken from the middle of the bale does not necessarily represent the whole, but may differ by as much as $4\frac{1}{2}\%$ from the slubbing figure, which may be taken as most truly representing the bulk. Further

* Throughout this paper hair weight per cm. values will be quoted in mgms. $\times 10^{-5}$, i.e., 0·00001 mgm.

investigation confirmed this conclusion. Two bales, one of mark A and one of C, were taken at random, and tests made on samples from the top and from the bottom in each case. The results were as follows—

Hair Weight per Centimetre.

Mark		Top of Bale		Bottom of Bale
A	...	196	...	197
C	...	185	...	165

Thus, although the bale from mark A appeared to be uniform throughout, the bale from mark C showed that within one bale two samples taken from different parts of it might differ by as much as 10%.

(2) The variation from bale to bale in a given mark was found to be as great as that from mark to mark, and consequently it was impossible to assign any characteristic hair weight per cm. value to any given mark. From the bale figures for mark C it will be seen that the range is 167-193, which almost covers the range for all tests, viz., 167-209. This great variation is to be expected when it is considered that the industrial supply is drawn from a large area covering considerable variation in general growing conditions and cultivation. Owing to present marketing methods, cotton from any one grower (or group of growers) has generally lost its identity by the time it reaches the spinner, and the marks under which the latter buys it seldom bear any relation to the exact locality of origin. Consequently the question as to whether any mark can be relied upon to maintain a consistent quality depends entirely on the grader's judgment. This point can be emphasised by pointing out that the difference in fineness between two bales of Texas cotton of the same grade and staple length may, on occasion, be greater than that found between a good Sakel and a Sea Island cotton.

Results of similar tests carried out on Uppers and Sakel cottons are given in Table III.

Table III.

Hair Weight per Centimetre.

Cotton		Mark		Top of Bale		Bottom of Bale
Sakel	...	H	...	127	...	127
	...	J	...	131	...	134
	...	K	...	123	...	—
	...	L	...	126	...	—
	...	M	...	128	...	—
	...	N	...	128	...	—
	...	O	...	128	...	—
	...	P	...	129	...	—
Uppers	...	Q.1	...	187	...	173
	...	Q.2	...	177	...	178
	...	R	...	182	...	180

Although these observations may be too few to justify definite conclusions, they indicate, nevertheless, that in Egyptian cotton there is not such an extensive range of variation within one year's crop as in American. This is no doubt partly due to the much more uniform growing conditions that prevail in the Egyptian cotton areas.

In Table IV. is given a list of hair weights per cm. for 127 samples of cotton covering a wide range of varieties.

It will be seen that there are no definite dividing lines between the values for the main types of cotton, and that the range of each type is very considerable, as follows—

Sea Island	102—136
Sakel	113—151
Assili	144—170
Uppers	177—212
Texas	167—211
Indian	193—312
Indian American	145—226
African American	135—180

These figures are not intended to indicate the maximum range for the various types mentioned, since in most cases there have been only a few samples tested, but merely give the ranges so far observed.

Table IV.

Sample No.	Cotton	Hair Weight per cm. Mgms. × 10^{-5}	Staple Length mm.	Mercerised Diam. μ	Wall Thickness μ
	Sea Island				
327	St. Vincent	126	—	—	—
329	Tortola	118	—	—	—
326	Barbados	108	—	—	—
—	Porto Rico	114	—	—	—
328	Antigua...	121	—	—	—
330	Montserrat	136	—	—	—
29	Mill sample	112	44·3	11·50	3·25
331	Fiji	102	—	—	—
332	Gold Coast	108	—	—	—
	Egyptian				
H	Sakel—Mill sample	127	—	—	—
J	,, ,, ,, ...	131	—	—	—
K	,, ,, ,, ...	123	—	—	—
L	,, ,, ,, ...	126	—	—	—
M	,, ,, ,, ...	128	—	—	—
N	,, ,, ,, ...	128	—	—	—
O	,, ,, ,, ...	128	—	—	—
P	,, ,, ,, ...	129	—	—	—
S	,, ,, ,, ...	151	—	—	—
64	Sakel	132	38·5	—	3·70
202	,, F.G.F.	144	35·2	—	—
198	Sakel X (Domains)	136	38·0	11·79	—
407	,, X (Domains)	146	37·0	12·24	—
201	,, C/23 (Domains) ...	133	37·2	11·71	—
408	,, C/23 (Domains) ...	146	37·0	11·88	—
382	,, S.1	148	37·0	12·06	—
383	,, S.2	113	36·4	11·33	—
385	,, S.4	113	36·5	11·36	—
200	"310" X (Domains)	133	37·7	12·10	—
409	,, (Domains)	128	37·5	11·61	—
127	Jannovitch	138	39·5	12·24	—
199	Assili N/22 (Domains) ...	144	36·2	12·12	—
410	Nahda 24	159	33·3	12·62	—
411	Nahda 22/X	170	32·3	12·54	—
132	Pilion	178	—	—	—
68	Abassi	176	33·2	14·28	—
389	Zagora Z.1	199	28·0	14·14	—
203	Uppers, Government type 4	212	—	—	—
204	,, ,, ,, 15	190	26·0	—	—
Q.1	,, Mill sample	187	—	—	—
Q.2	,, ,, ,, ...	177	—	—	—
R	,, ,, ,, ...	182	—	—	—

Table IV—*continued*

Sample No.	Cotton	Hair Weight per cm. Mgms. $\times 10^{-5}$	Staple Length mm.	Mercer-ised Diam. μ	Wall Thickness μ
	American				
A.1	Texas Mill sample	204	—	—	—
A.2	,, ,, ,, ...	172	—	—	—
A.3	,, ,, ,, ...	183	—	—	—
B.1	,, ,, ,, ...	209	—	—	—
B.2	,, ,, ,, ...	176	—	—	—
B.3	,, ,, ,, ...	209	—	—	—
C.1	,, ,, ,, ...	196	—	—	—
C.2	,, ,, ,, ...	185	—	—	—
C.3	,, ,, ,, ...	193	—	—	—
C.4	,, ,, ,, ...	186	—	—	—
C.5	,, ,, ,, ...	167	—	—	—
D.1	,, ,, ,, ...	196	—	—	—
D.2	,, ,, ,, ...	196	—	—	—
E.1	,, ,, ,, ...	210	—	—	—
E.2	,, ,, ,, ...	191	—	—	—
F.1	,, ,, ,, ...	176	—	—	—
F.2	,, ,, ,, ...	194	—	—	—
F.3	,, ,, ,, ...	207	—	—	—
F.4	,, ,, ,, ...	209	—	—	—
G.1	,, ,, ,, ...	199	—	—	—
G.2	,, ,, ,, ...	201	—	—	—
94	Texas	208	23·0	14·83	5·03
162	,, ...	208	23·0	—	—
123	,, ...	211	26·0	—	—
85	Upland Mid. grade	235	—	—	—
144	Upland	186	25·0	14·41	—
165	Memphis	215	33·0	—	—
205	Memphis Extras	180	28·5	—	—
—	Salisbury Delta	178	—	—	—
	Indian				
10	Bengal	312	19·4	17·27	7·70
187	Surat 1027 ALF	235	28·5	—	—
197	,, ,, ...	249	26·6	—	—
188	Karunganni	210	19·6	—	—
191	Sircar No. 14	219	27·4	14·89	—
109	Broach	263	24·7	17·42	5·80
159	Bani	215	23·0	—	—
194	Cambodia	193	22·7	—	—
	African				
21	Ibadan-Nigeria	276	29·9	17·39	—
137	Quande	203	27·6	14·69	—
392A	Kenya Taveta 1	150	—	—	—
392B	,, ,, 2	128	—	12·65	—
392C	,, ,, 3	120	—	12·51	—
392D	,, Mivatati 1	166	—	12·73	—
	South American				
47	Peruvian Full Rough	256	30·3	16·06	6·10
168	Smooth Peruvian	165	33·3	—	—
119	Venus—Brazilian	186	36·0	—	—

Table IV—*continued*

Sample No.	Cotton	Hair Weight per cm. Mgms. $\times 10^{-5}$	Staple Length mm.	Mercerised Diam. μ	Wall Thickness μ
	Miscellaneous				
71	Malta	276	26·8	—	—
394	Trinidad No. 1...	283	30·1	17·01	—
395	,, No. 2...	273	29·0	16·41	—
396	,, No. 3...	162	28·0	13·28	—
474	Kidney—New Guinea... ...	188	30·5	—	—
459	Marie Galante	188	—	—	—
103	Bokhara	187	22·8	—	—
	Exotics				
	Egyptian Seed in America—				
T	Arizona Mill sample	167	—	—	—
U	,, ,, ,, ...	175	—	—	—
V	,, ,, ,, ...	168	—	—	—
	American Seed in India—				
186	Gadag No. 1	188	26·0	—	—
312	,, ,, ...	180	—	—	—
157	,, ,, ...	226	23·7	—	—
163	Indian-American	186	24·5	15·13	—
145	,, ,, ...	186	24·0	14·75	—
96	,, ,, ...	156	30·5	12·78	4·14
120	Punjab-American 285... ...	152	26·2	13·79	—
121	,, ,, 4... ...	201	22·6	15·07	—
195	,, ,, 289... ...	145	30·5	—	—
116	,, ,, AAA ...	155	28·2	13·63	4·39
117	,, ,, BBB ...	151	28·1	13·49	4·48
118	,, ,, CCC ...	151	29·8	13·29	4·36
	American Seed in Africa—				
93	Zaria	172	27·1	14·29	4·30
150	Uganda—Allen A.2	135	33·5	12·51	—
148	Uganda Nyassaland Upland N. 17	165	33·3	14·04	—
147	Uganda Nyassaland Upland N.21	138	30·8	13·34	—
151	Uganda Webber W.	135	30·5	14·01	—
149	,, Sunflower S.7 ...	148	31·8	12·88	—
416	S. Africa Improved Bancroft	171	27·5	—	—
417	,, Barberton Z.1 ...	180	29·8	—	—
	Miscellaneous—				
100	Queensland Durango	165	33·7	14·00	4·40
456	,, ,, ...	148	28·5	—	—
454	,, ,, ...	148	28·8	—	—
450	,, Acala	134	27·3	—	—
136	Queensland	189	29·0	14·85	—
52	Sudan—Sakel	156	—	—	—
360	New Guinea Durango ...	166	26·7	13·73	—
138	Ceylon Durango	154	30·0	12·67	—
139	,, Zululand Hybrid ...	138	31·7	12·83	—
140	,, Watt's Long Staple ...	136	31·0	12·54	—
141	,, Sea Island	116	38·0	11·84	—

Among these results there are several points of interest both to the grower and spinner. For example, in commercial samples of Sea Island cotton the hair weight per cm. would generally appear to lie between 101 and 120, yet the table includes three varieties for which the value exceeds the upper limit. Burd[4], in a variety test on ten Sea Island cottons, found only one with a hair weight per cm. falling outside this range, and that was strain H.23, which gave a value of 128 and which he describes as one of the original Heaton strains established in Montserrat. The Montserrat sample, the value of which is given in Table IV., was also fairly certainly of the Heaton variety; so that it appears as though a hair weight per cm. of 128 to 136 would be quite characteristic of this strain, which might therefore be regarded for practical purposes as a growth peculiar to Montserrat, and as differing considerably from ordinary Sea Island types.

In Egyptian cottons the most striking feature is the uniformity of the results for commercial samples (123-144). The samples of Sakel listed in the table as having values outside this range were in some way or other exceptional. For example, the two samples 383 and 385, with abnormally low hair weights per cm., had both suffered severely in the field from damage by the pink bollworm.

An inspection of the figures for American varieties is convincing of the lack of uniformity in commercial Texas samples. The characteristic range of hair weights per cm. for Texas is roughly 180-210, the lower values being probably accounted for by the presence of immature hairs in excess. This was the case, for example, with the sample C.5.

The Indian class has been made to include Cambodia, which might be regarded more strictly as an exotic. It does, however, differ from the several varieties of American origin grown in India in that its introduction to India was not direct, but after acclimatisation in French Indo-China.

The three East African cottons 392 –B, –C, and –D afford an interesting illustration of the effect of the presence of immature cotton. All three samples were precisely similar in hair width, the low hair weight per cm. of C and D reflecting the proportion of immature cotton present.

Although data are few at present, there are distinct indications amongst the exotic cottons that introduction to a foreign habitat tends to produce a finer hair. The Indian-American varieties, for example, are finer than the original Texas Upland types, although it should be pointed out that in certain cases selection has probably contributed in some measure towards this result. An illustration of this is provided by the Punjab-American cottons 285F, 289F, and 4F, the first two being selections from the last. This fineness is especially characteristic of the Punjab-Americans, but it is shown equally well by Durango grown in Queensland, New Guinea and Ceylon, where selection has played no part in the production of the result.

EMPLOYMENT OF HAIR WEIGHT PER CENTIMETRE IN THE IDENTIFICATION OF COTTONS

When employed alone the value of hair weight per cm. is strictly limited as a character for the identification of a cotton owing to the wide range of weight covered by different samples of the same cotton, and the consequent overlapping of range from class to class. In conjunction with other measurable characters, however, it has been repeatedly found to be a useful guide, not only to the identity of particular cottons, but also to the causes of sundry special cases of difficulty encountered from time to time in the spinning and manufacture of cotton.

The typical cases described below, in which determinations of hair weight per cm. have been involved, consisted not only of samples of raw cotton but also of yarns and fabrics in the grey as well as in variously finished states. It has been necessary therefore as occasion has arisen to determine experimentally the effect of different finishing processes upon the measurable characters of the cottons involved, and the steps to be taken to determine an approximately correct value of these.

As the result, the procedure briefly described below has been followed when it has been required to determine the hair weight per cm. of the cotton in sized or finished goods.

(1) *Grey Yarn or Cloth (Unsized).*—The yarn is carefully untwisted and pulled down, and the hairs obtained are collected into a sample and treated in the same way as a raw cotton sample. (See Appendix.)

(2) *Grey Yarn or Cloth (Sized).*—The size is removed by treatment with a 0·5% solution of diastofor for 20 hours at 40° C., iodine solution being used to indicate the completeness of the size removal. Any non-starchy materials present in the size were at the same time loosened to an extent which facilitated its removal by careful washing and agitation. After drying, the usual procedure for unsized yarn was followed.

(3) *Bleached Yarn or Fabric.*—A correction is necessary in the case of hair weight per cm. for the loss of weight in the bleaching process. This correction cannot be accurately determined, since it will largely depend on the effectiveness of the scour; but no serious error is involved if the loss in weight is taken as 6%.

(4) *Mercerised Yarn or Fabric.*—When mercerised under tension, yarn suffers no appreciable change in count, so that no change was expected in hair weight per cm. To test this point, a lea of unbleached Sea Island yarn (180's) was tested for both counts and hair weight per cm. before and after mercerisation, with the following result—

Grey	Counts		Hair Weight per Centimetre
Before mercerisation... ...	183	...	110
After mercerisation	188	...	108

Thus the value of hair weight per cm. obtained from a sample of mercerised material can be regarded as equivalent to that of the original raw cotton, subject, naturally, to a correction for bleaching when this has taken place.

The following are typical special cases—

Case 1

It was desired to ascertain the kind of cotton from which a very attractive soft spun yarn had been made. The yarn was white and very bright, full but harsh, and about 26's counts. The hair weight per cm. was 236, indicating that the cotton was probably either Indian, Memphis, or Rough Peruvian (see Table IV.). The staple was found to be full 1¼ in., thus ruling out Indian; while the Memphis was excluded on account of the harsh feel. Furthermore, Memphis is rarely found to be as long as this. It was concluded, therefore, that the cotton employed was Rough Peruvian.

Case 2

It was required to identify the cottons used in three fabrics manufactured and finished in India. The finish was so superior that it appeared very unlikely that a low grade raw cotton had been employed.

The staple length of the cotton in warp and weft of all three samples was about 15/16ths inch, while the six values of hair weight per cm. fell between 264 and 270. The evidence was therefore conclusive that in all samples the cotton was Indian, most probably of the Broach type (see Table IV.).

Case 3

Two cloths, A and B, of similar manufacture and quality, were submitted. A was a foreign competitive cloth which was underselling B. It was required to know whether inferior cotton was being used in A. In both the two warps and wefts the staple length was identical, so the hair weight per cm. was determined for all four yarns as follows—

	Warp		Weft
Cloth A	216	...	212
Cloth B	208	...	208

Thus there was no significant difference of hair weight per cm. throughout, and the variety and quality of cotton in both fabrics was probably the same.

Case 4

Here it was desired to know whether the cotton in a mercerised and dyed poplin was Sakel or Sea Island. The hair weight per cm. was found to be 136 in the warp and 138 in the weft, while in both cases the staple length was $1\frac{7}{16}$ in. Reference to Table IV. will show that, in exceptional cases, it is possible to obtain a Sea Island cotton with the above hair weight per cm., but the staple length ruled out this possibility and increased the probability that the cotton was Sakel.

Case 5

In this case a distinct bar, about one cop in width, of much darker shade, ran across the full width of a piece of grey cloth. Tests of the weft, both of the bar and of the lighter normal portion, gave the following results—

	Hair Weight per centimetre	...	Hair Width (μ)
Light portion	200	...	19·00
Darker bar ...	177	...	17·30

The cotton of the weft in the bar was therefore of a different character from that of the weft of the main body, the probability being that a cop of different yarn had accidentally found its way into the delivery of yarn at some stage previous to manufacture, or that it was a simple case of the mixing of weft in the weaving shed.

Case 6

Two batches of a grey poplin, A and B, presumed to be identical, had been finished in exactly the same manner during mercerisation and dyeing. The batch B, however, was found to have finished with an inferior lustre and to have dyed to an appreciably different shade. This difference might have been regarded as due to a difference either of cotton, mercerisation, or dyeing.

Determination of the measurable characters showed that both warps contained the same cotton, but the wefts were different, the hair weights per cm. being 182 and 199 for A and B respectively. The weft in B was therefore perceptibly the coarser, and, under mercerisation without tension, turned out to be less capable of swelling in the caustic soda than A. It was consequently of inferior mercerising quality.

Only speculation is possible as to the cause of such a difference, the most reasonable assumption being that a slight change had taken place in the marks of cotton used for the weft yarn. It is improbable that such a change would have been noticeable either in the raw cotton or during spinning.

These cases are sufficient to establish the fact that, so far as the differentiation and identification of cottons are concerned, the character of hair weight per cm. can be put to considerable practical use. At the same time there are distinct limitations to its applicability for the latter purpose, especially in the case of yarns spun from a mixture of two varieties. For example, it is possible to obtain a Tanguis and a Memphis cotton of the same staple length and also the same hair weight per cm.; so that a mixture of these two would be indistinguishable from either of the pure cottons. Again, a cotton with a hair weight per cm. of approximately 235 might either be a pure Indian or a mixture of a coarser Indian with an American cotton. The limitations imposed in this manner are well shown by the following example—

Case 7

Here it was desired to test whether a reputed super-carded Egyptian warp yarn was in accordance with its description. The staple length was found to be $1\frac{3}{8}$ in., but the hair weight per cm. was 148. This value is at the greatest extreme for Sakel (Table IV.), and comparatively seldom encountered. It is possible therefore that the yarn had been spun from a finer cotton adulterated with a small admixture of some other fairly long stapled but coarser cotton, such as Pilion or Assili. In other words, the methods employed are not yet fine enough to distinguish small adulterations. The limit of knowledge of the measurable characters of cotton has, however, by no means been reached, and the possibility of giving more definite information on points of this kind will no doubt increase as this knowledge is extended.

THE RELATION OF HAIR WEIGHT PER CENTIMETRE TO OTHER MEASURABLE CHARACTERS

In the discussion of the technique of measurement (Appendix) it is shown that in any one sample no significant relation exists between hair weight per cm. and hair length; nor is there any obvious biological reason for the contrary expectation. From elementary geometrical considerations a fairly close correlation is, however, to be expected between hair weight per cm. and both the width of the hair and the thickness of its cell wall.

In Fig. 1 the staple lengths of 59 cottons have been plotted against hair weight per cm. It is clear that although, broadly speaking, there may be, over the whole range of cottons, a general relation between these two quantities, it would be unjustifiable to apply this within narrower limits. In other words, the oft-repeated generalisation that the longer cottons are also the finer is true only in the above limited sense.

For ease of reference, some of the points in Fig. 1 are labelled. The cottons from which these points were obtained illustrate the lack of applicability of the above generalisation in practice. This is also shown by the data given in Table V.

Table V.

Cotton		Staple Length (Inches)		Hair Weight per Cm.
Karunganni ...	...	$\frac{3}{4}$	...	210
Trinidad Native 2	...	$1\frac{1}{8}$	...	273
Trinidad Native 3	...	$1\frac{1}{8}$	...	162
Brazilian-Venus	...	$1\frac{7}{16}$	...	186
Karunganni ...	...	$\frac{3}{4}$	...	210
Memphis ...	...	$1\frac{5}{16}$	...	215

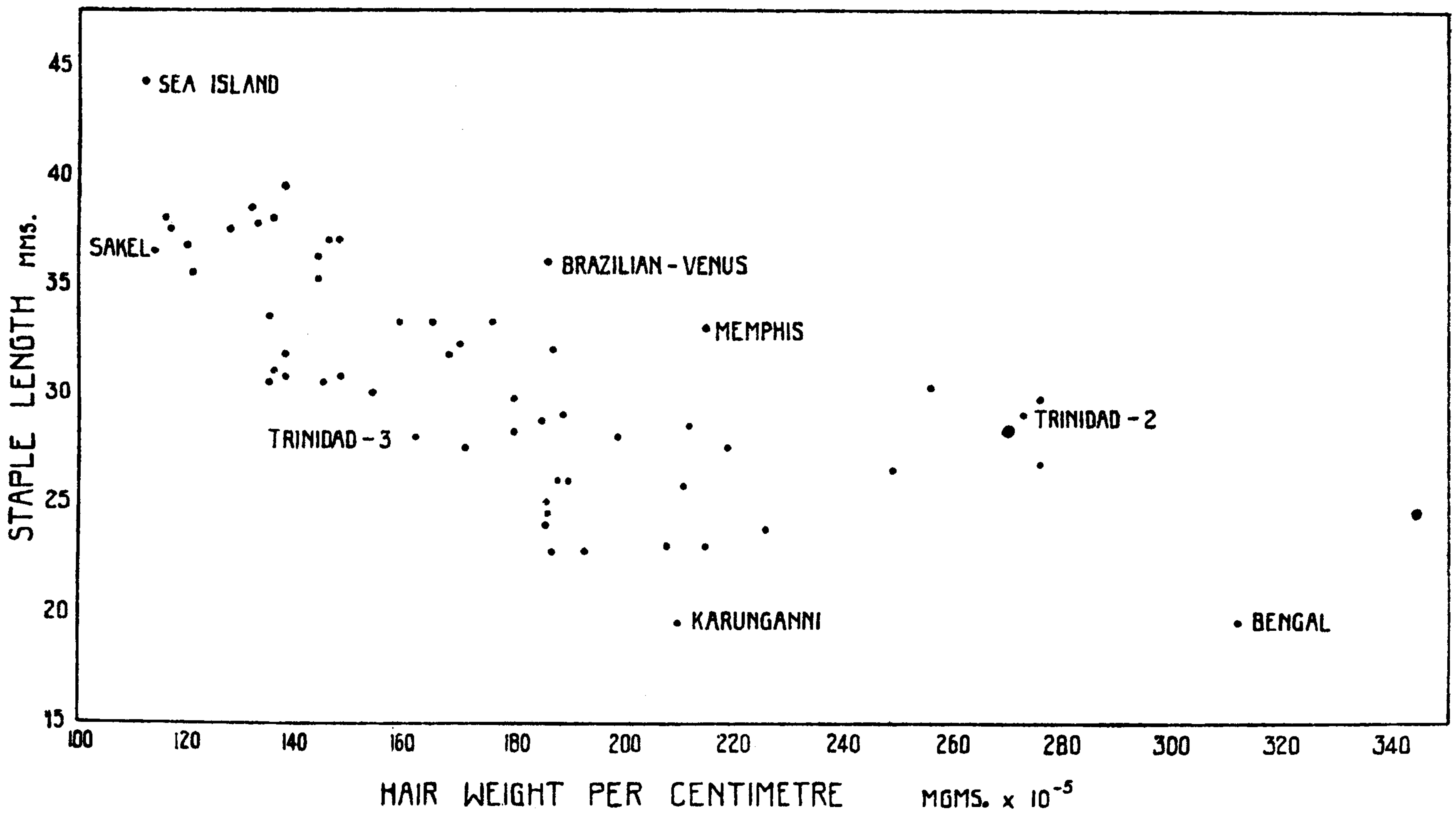

FIG. 1

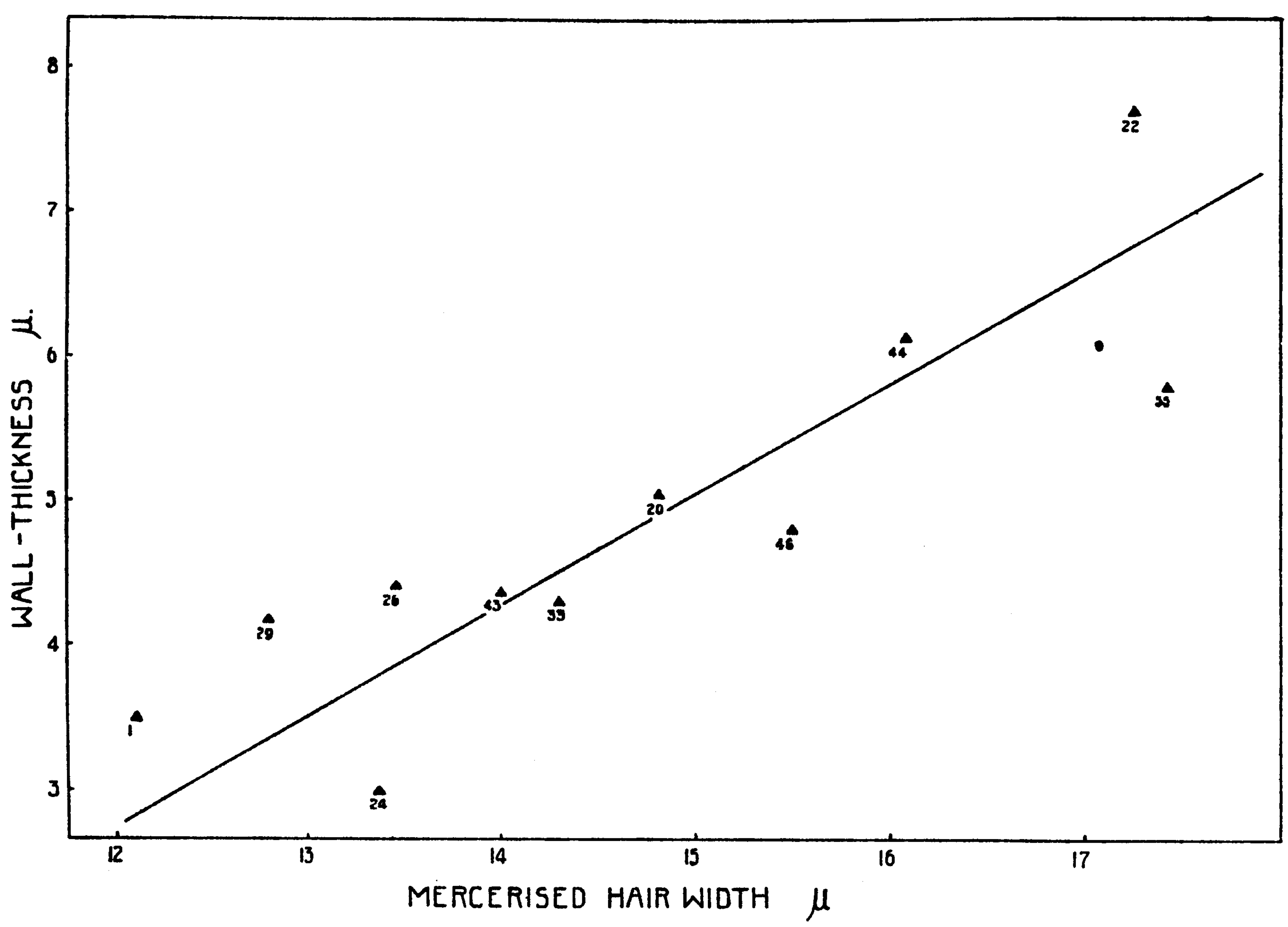

FIG. 2

For key to numerals see Fig. 3.

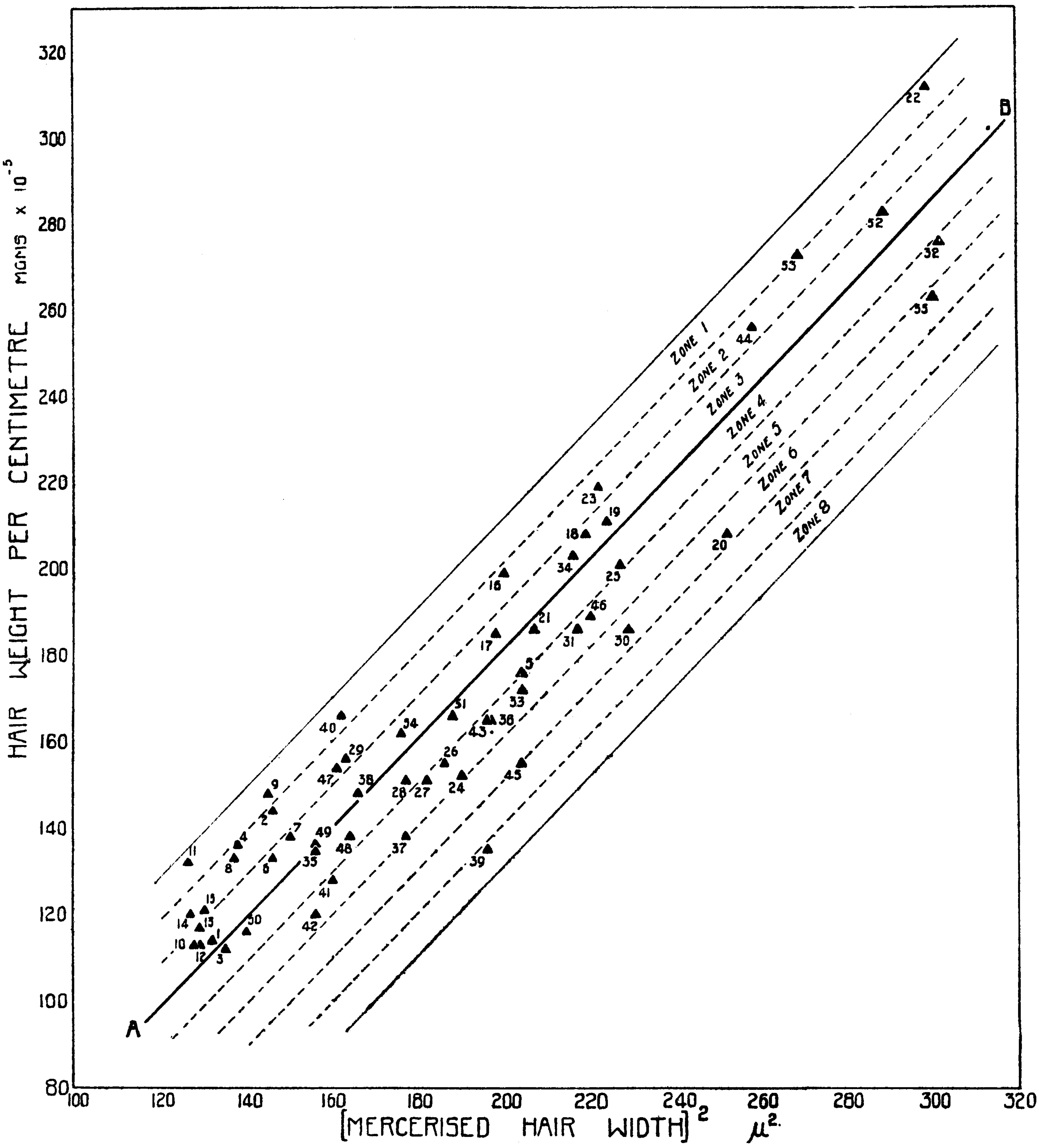

FIG. 3

1—Sea Island
2—Assili A/22, 1923.
3—Sea Island.
4—Sakel X, 1923.
5—Abassi.
6—"310 X," 1923.
7—Uppers.
8—Sakel C/22.
9—Sakel S.1.
10— ,, S.2.
11— ,, S.3.
12— ,, S.4.
13— ,, S.5.
14— ,, S.6.
15— ,, S.5a.
16—Zagora Z.1.
17— ,, Z.2.
18—Texas.
19— ,,
20—Texas.
21—Upland.
22—Bengal.
23—Sircar 14.
24—Punjab American 285F.
25— ,, ,, 4F.
26— ,, ,, AAA.
27— ,, ,, BBB.
28— ,, ,, CCC.
29—Indian American.
30— ,, ,,
31— ,, ,,
32—Ibadan-Nigeria.
33—Zaria.
34—Quande.
35—Uganda A.2.
36— ,, N.17.
37— ,, N.21.
38— ,, S.7.
39—Uganda Webber.
40—Kenya Mivatati 1.
41— ,, Taveta 2.
42— ,, Taveta 3.
43—Queensland Annual Durango.
44—Peruvian Full Rough.
45—Queensland Ratooned Durango.
46—Queensland.
47—Ceylon Durango.
48— ,, Zululand Hybrid.
49— ,, Watts Long Staple.
50— ,, Sea Island.
51—New Guinea Durango.
52—Trinidad 1.
53— ,, 2.
54— ,, 3.
55—Broach.

In order to evolve a working hypothesis as to the inter-relation between hair weight per cm. and the other properties of the cell, it is necessary first of all to determine whether or not there is any relation between the width of the original cell and the amount of cellulose laid down as secondary thickening. Calvert and Summers[6] have shown that the former bears a definite relation to the mercerised width, so this quantity has been correlated with the wall thickness* in the case of 12 cottons (Fig. 2). The number of points is admittedly small, but the correlation coefficient is

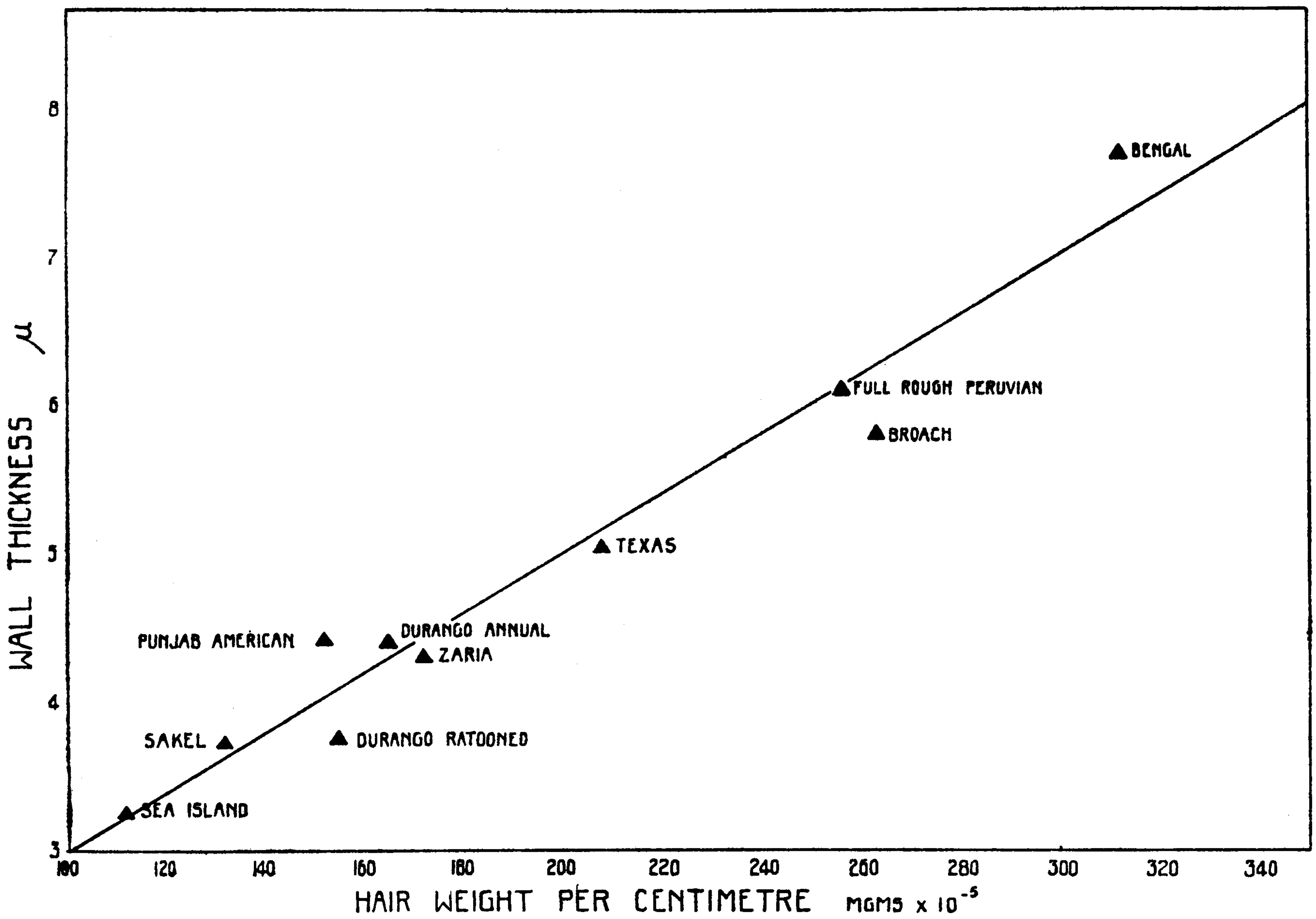

FIG. 4

$+0{\cdot}86$, so that there is no doubt but that an increase of one of the dimensions is generally accompanied by an increase in the other.

In plotting the points it has been assumed that the relation should be expressed by a linear equation, since there is no evidence to justify any other assumption. It is interesting to note that the rate of increase of wall thickness is greater than that of mercerised width, thus indicating that hairs with the greater widths tend to be the more fully developed.

The relation between hair weight per cm. and mercerised width is shown in Fig. 3. Here the square of the mercerised width is taken because not only do the points then fall more closely in a straight line, but also because it can be shown that weight per cm. should involve the second power of mercerised width, probably in quadratic form. The values of 55 cottons were taken, and the correlation coefficient found to be $+0{\cdot}95$.

It is clear that, assuming constant cellulose density, any variation from perfect correlation must be due to independent variation in wall thickness. Thus all points falling above the line AB which most fairly indicates the general relation between the two characters, would be expected to represent

* The wall thickness values quoted in Table IV. and used in this paper were obtained from hair sections, and are therefore greater than the real values owing to the swelling in gelatin.[6]

well-developed cottons, whilst those falling below should signify immaturity. To illustrate this the chart was divided up into arbitrary zones, and sections cut of four cottons from zones 1 and 2, and four from zones 6, 7 and 8.

These sections are shown in Plates I. and II., where it will be seen that the above deduction is justified.

It can also be shown that in a similar way hair weight per cm. should involve the square of the wall thickness. There were, however, only ten pairs of values available for showing the relation, so for correlation purposes there is no useful purpose served by plotting them in any other way than linearly, as shown in Fig. 4. Here the correlation coefficient is $+0{\cdot}98$, and although the number of observations is small, it is nevertheless clear that the relationship is relatively rigid.

This is of particular interest with reference to the work done by Clibbens and Ridge[9], who used the weight per cm. as an indication of wall thickness, and it will be appreciated that since the former varies as the square of the wall thickness, it can be considered quite a delicate test.

APPENDIX

The Technique of Hair Weight per Centimetre Determination

The first process is the preparation of a sample, for cutting into centimetre lengths, which represents in the correct proportion the whole range of hair weight per centimetre occurring in the bulk. This is done by taking at random a large number of wisps of hairs from the bulk; and, having divided them into four for convenience of working, each portion is thoroughly mixed by repeated drawing and doubling between the thumb and forefinger of each hand. In this way the hairs are more or less parallelised; but there still remain a considerable number of tufts and entanglements, so these are removed by careful combing with a fine steel comb. The parallelisation process is thus completed.

The four portions are still too large for cutting, so a small "staple" of four or five hundred hairs is pulled from the fringe of each. This process necessarily means the selection of the longer hairs, but it has been shown that for practical purposes the results are quite unaffected thereby, since the hair weight per centimetre of long hairs in a sample is the same as of short ones. This was demonstrated in the following way.

A sample of F.G.F. Sakel of $1\frac{3}{8}$ in. staple was split up by means of a Baer sorter into three groups as below, and the hair weight per cm. of each separately determined. The results showed that the value for the latter quantity is independent of length.

	Length	Hair Weight per Cm.
Group 1	2·5 to 3·5 cm. ...	151
Group 2	2·0 to 2·5 cm. ...	151
Group 3	Under 2·0 cm. ...	149

Each "staple" is then clipped to the edge of a piece of linoleum by means of an ordinary paper clip, and, having been smoothed out straight, is held in position by the tip of one finger. Centimetre lengths are then cut from the middle by means of a special cutter consisting of two razor blades set one centimetre apart in a brass holder. The setting is checked before each determination by cutting marks on a specially prepared waxed glass slide, and measuring the distance between the cuts so made by means of the vernier on the mechanical stage of a microscope. Care must be taken that the blades are sharp, so that the cutting is done cleanly and with no sign of pulling of the hairs, since this causes inaccuracies in spite of careful blade setting.

To determine the effectiveness of this method of cutting, thirty lengths were taken at random from a prepared sample and accurately measured. The mean length was found to be 9·97 mm. $\pm$0·008, the error in this case being 0·3%, which for practical purposes can be ignored.

The four bundles of centimetre lengths thus prepared are placed between two microscope slides so that a fringe of about 2 mm. protrudes. Lots of 200 lengths are then counted out into a black glass dish, taking 50 at random from each of the four cuttings. It has been found that the operation of counting is made much easier if both surfaces of the slides used for holding the sample are covered with black matt paper.

Having rolled each bundle of 200 hairs into a composite mass by means of a small piece of clean dry cork, they are weighed separately on the micro-balance. This consists of a glass beam mounted on an horizontal quartz fibre, which is carried by a brass frame possessing an adjustment for altering the tension (Fig. 5). To obtain reasonable deflections without the use of an extra fine fibre, the beam is made as long as possible consistent with the strength of the fibre, and rigidity is combined with a minimum of weight by using for its construction drawn-out glass tube.

When a load is applied, the deflection is measured by an optical arrangement and compared with that produced by a standard weight.

All determinations mentioned in this paper were carried out under natural atmospheric conditions, since it was desired to evolve a method for everyday use, and its scope of application would be seriously limited by the necessity of humidity control. Tests on the moisture content of the air, however, were carried out over a period of several months in order to make correction if necessary. It was found from moisture regain tables that under the conditions of testing, the maximum error introduced in the weighings was only of the order of 1·0%, and could therefore be ignored for the general purposes of this work. When it is desired to detect small differences in weight, or where a comparative test is to be made between two closely allied cottons, the effect of atmospheric moisture can be discounted by carrying out the weighings simultaneously, or by correcting for differences in moisture content by the use of such tables as are given by Urquhart and Williams.[15]

Clegg and Harland[7] found that a probable error of the mean of 3% could be obtained with 80-160 hairs, depending on the variability of the sample. This accuracy, however, was not considered sufficient for the purposes of the present work, and in order to reduce the probable error to the neighbourhood of 1%, it was calaculated that 1,000 hairs would have to be taken; i.e., five weighings of 200 hairs each. The result of any one test is therefore incapable of statistical treatment so far as significance is concerned, since the number of actual observations is not sufficiently large. This is shown by the following example of a duplicate test on Quande cotton, in which the significance of the second determination is indicated to be more than twice that of the first—

(*a*) Hair weight per cm.=202. M.D.=0·21%.

(*b*) Hair weight per cm.=204. M.D.=0·09%.

It is clearly impossible therefore to state accurately what the significance of a result may be, but experience has verified the conclusions arrived at by Clegg and Harland, so that after allowing for all possible sources of error, it is safe to regard any difference greater than 4% as real.

A list of duplicate determinations is given in Table VI., which shows that results can be repeated with a very close degree of correspondence.

Table VI.

Variety of Cotton	Hair Weight per Cm. (*a*)	(*b*)
Quande	202	204
Ceylon—Zululand hybrid	138	142
White Egyptian	168	165*
Cotton 310 X	128	127*
Assili Nahda 24	159	159*
Sakel C/24	134	135*
Uppers Egyptian	173	173
Sakel	131	134
Texas	195	197
Arizona	168	165

*From Yarn.

The soundness of the method has also been demonstrated by several independent observers, who, by following the instructions given above, have set up their own balances and have never differed significantly in the evaluation of the same samples.

The author is indebted to Miss G. G. Clegg for the measurements of wall thickness; to Miss M. Calvert for the hair width data; to Mr. C. W. Bradley for help in the routine determinations of hair weights; and to Mr. H. Gunnery for preparing and photographing the sections.

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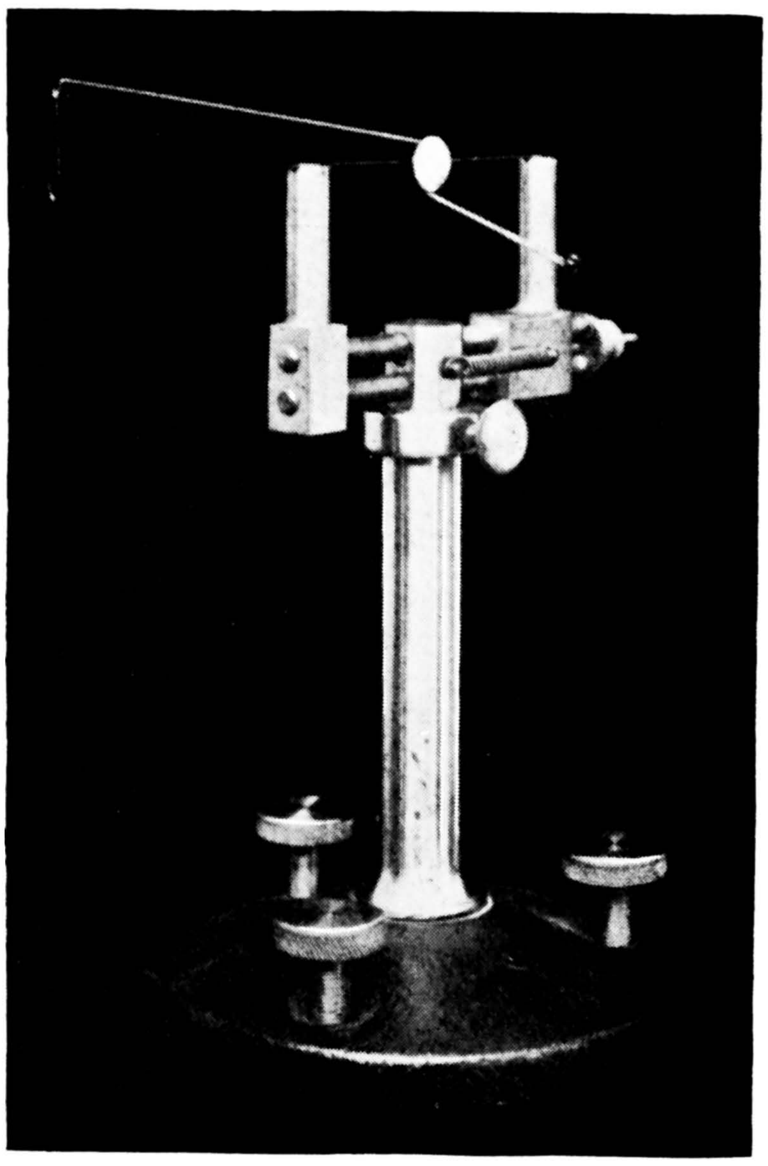
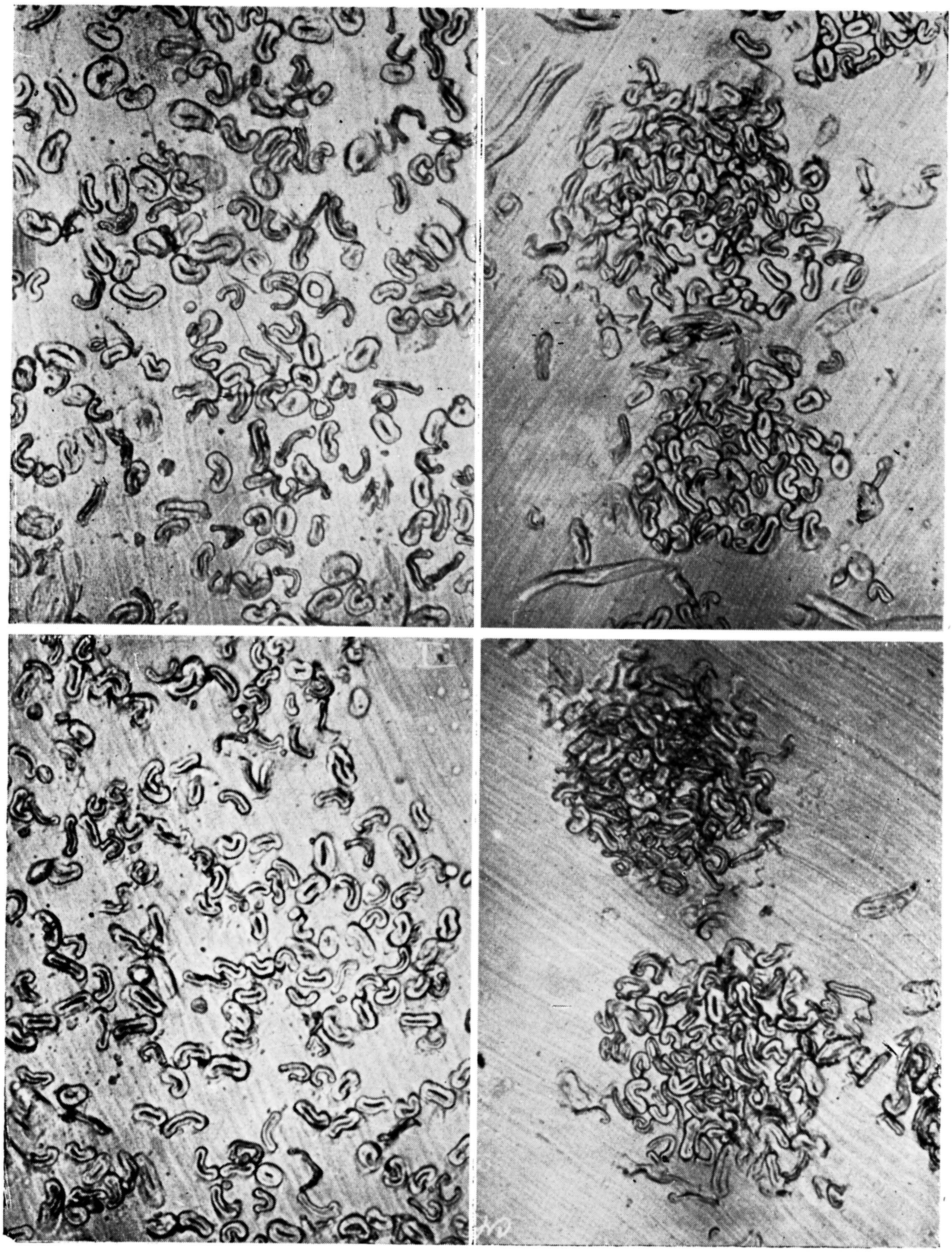


Fig. 5

face page T552

20
Texas

37
Uganda N21



45
Queensland Ratooned

39
Uganda W.

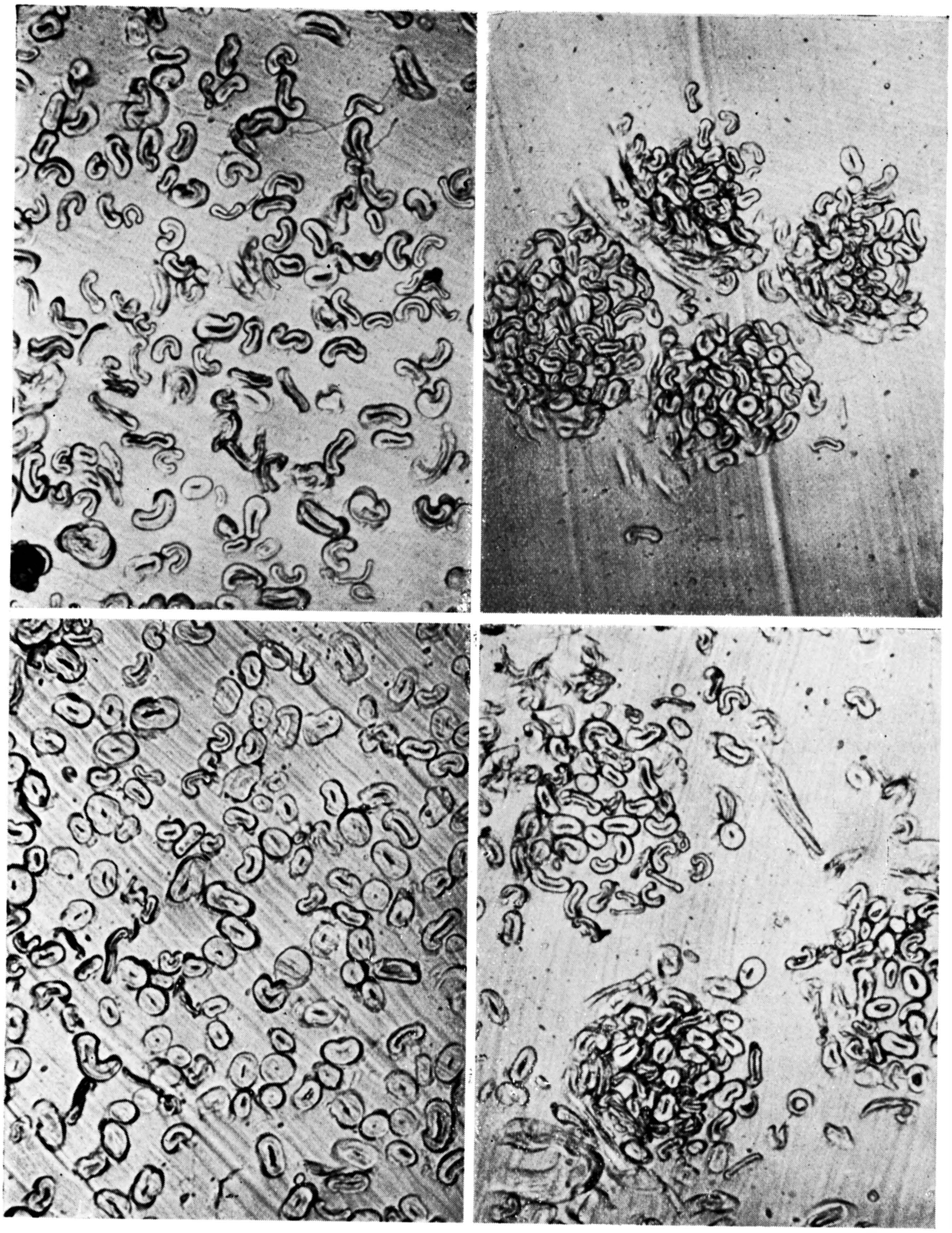
PLATE I.

Cross-sections of rather immature cotton hairs.

No. 20 falls within zone 6 of Fig. 3
,, 37 ,, ,, 5-6 ,,
,, 45 ,, ,, 6-7 ,,
,, 39 ,, ,, 8 ,,

53
Trinidad 2

9
Sakel S.1



22
Bengal

16
Zagora Z. 1

PLATE II.

Cross-sections of well-developed cotton hairs

No. 53 falls within zone 1-2 of Fig. 3
,, 9 ,, ,, 1 ,,
,, 22 ,, ,, 1 ,,
,, 16 ,, ,, 2 ,,

50—AN EXPERIMENTAL METHOD FOR INVESTIGATING THE THERMAL PROPERTIES OF COTTON FABRICS

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Summary

The essential requirements of fabrics for maintaining the body at normal temperature under tropical conditions are shown to be high reflecting and emissive powers, low transmitting power for radiant energy, and high permeability to moisture.

Some experimental methods are described by which the thermal properties of fabrics may be studied. Using one typical fabric made for export to the Tropics, it is shown that the total heat reflected is approximately equal to the total heat transmitted, thus indicating the relative importance of these two modes of heat transference. A method is described by means of which the amounts of heat transmitted by fabrics may be compared, and the results of tests on a range of materials typical of those exported to the tropics are given to indicate the scope of the method.

Testing the fabrics in the dry state, it was found that the most transparent allowed about five times as much heat to pass as the least transparent, this being due to differences in construction, involving such matters as filling, weave and so forth. There was a certain degree of irregularity from place to place along the length of a fabric in the heat transmitted, but this irregularity was independent of the amount of heat transmitted.

The effect of washing the fabric has been determined in relation to the loss of weight and the amount of heat transmitted. The greatest increase in heat transmitted occurred when most filling was removed, and heavily filled fabrics lost their heat insulating value almost entirely on washing. Some fabrics which had not been filled transmitted less heat after washing, owing to shrinkage.

The most suitable of the fabrics tested for tropical use appeared to be one which was heavy and affected little by washing.

A method for comparing the total heat reflecting powers of fabrics has yet to be devised.

The effect of the moisture content of a fabric on its transmitting and reflecting powers has been studied. The heat transmitted decreased, with the four fabrics examined, in direct proportion to the increase in relative humidity of the atmosphere with which the fabric was in equilibrium. The mean decrease on changing from dryness to saturation was 22·7 per cent., but the decrease was greatest with those fabrics which transmitted least heat when dry. The effect of moisture content on the heat reflecting power was only examined in one case, but appeared to be insignificant.

INTRODUCTION

The object of this investigation is to consider the influence of the structure of various types of fabrics on the transference of heat. It is intended to examine the thermal properties of cotton fabrics used as clothing with special reference to their possibilities in maintaining the body at normal temperature under tropical conditions. The choice of fabrics for clothing in tropical countries appears to be determined more by considerations of price or custom than by their heat protecting qualities, but whilst the subject of what constitutes suitable clothing is extremely complex, certain essential properties may be stipulated if the material is to provide an adequate outlet for the heat of the body.

Before proceeding to a more detailed consideration of the problem it is necessary to indicate the meaning of the terms employed and the manner in which heat transference may take place.

In the science of heat, those phenomena are investigated which are revealed by the sense of warmth or cold. The words hot or cold are used to describe the conditions of external bodies which correspond to the sensations received through the skin on touching or approaching them, and bodies are compared with respect to the sensations so received, one being described as hotter or colder than another. The number which expresses on some definite scale how hot a body is, is termed its temperature.

Heat itself is a form of energy which, increasing in a body, causes a rise in temperature, and, escaping, causes a fall.

It is a matter of common observation that bodies in contact with each other, and not subject to changes of external condition, after a time get neither hotter or colder, that is, heat does not pass from one to another, and they are then said to be in "thermal equilibrium."

Transference of Heat

There are two modes by which heat is transferred from one portion of matter to another—conduction and radiation. In conduction the matter receiving the heat is in contact with the matter from which it receives it, and the temperature falls continuously along the course by which the heat is flowing.

In radiation the matter receiving the heat is not in contact with the matter from which it receives it. In fact, any matter through which the radiation passes may be hotter or colder than either or both the bodies between which it is passing. It must not be supposed, therefore, that the energy passes from one to the other as heat, but that, on leaving the sender, it is converted from heat energy into another form, which is termed radiant energy, to be reconverted into heat on reaching the receiver. The warmth received from the sun or a glowing fire is a familiar example of this heating effect.

The emission of radiation is not confined to bodies at high temperatures, but takes place continuously from all bodies at all temperatures. A body losing more heat by emission than it receives by absorption of radiant energy is said to lose heat by radiation, the magnitude of the effect being denoted by the term "emissive power."

The problem of maintaining the body at normal temperature under conditions of tropical heat is one of thermal equilibrium. In addition to the heat generated by the natural functions of the body, a considerable amount of heat is received from the sun either directly or through the medium of the clothes. If the temperature of the body is to remain normal an amount of heat must be dissipated equal to that due to the above causes. The amount of heat received by the body from the sun must be as small as possible, and consequently a fabric possessing a high reflecting power for radiant energy is required. Since the clothes are exposed to heat loss by the emission of radiation and contact with cooler air, as well as loss of heat by evaporation of the moisture in the clothes, as much as possible of the heat from the sun remaining after reflection should be absorbed by the clothes. Any heat received by the body must be dissipated through the medium of the clothes. If the condition of the air as regards relative humidity, rate of movement or temperature, is insufficient to cause the required heat loss, cooling can only be obtained by the evaporation of the moisture generated by perspiration. This evaporation must not be obstructed, and takes place through the medium of the clothes, or may be brought about by suitable arrangement of a loose garment which provides a bellows action through the movement of the body. If the body is at a higher temperature than the outer surface of the clothes, a certain amount of heat will be lost by conduction, and it will be advantageous if the clothing is a good conductor of heat. This advantage is offset by an increased tendency to chill, ruling out high conductivity therefore as being a doubtfully advantageous quality.

The requirements of a fabric in order that it may provide efficient clothing under tropical conditions of heat can therefore be summarised as follows—High reflecting and emissive powers, low transmitting power for radiant energy, and in addition high permeability to moisture.

In addition to direct transmission of heat through the interstices of a cotton fabric, a considerable amount of heat is transmitted owing to internal and external multiple reflections from the walls of the individual cotton fibres. The manner of heat transmission and reflection by a fabric is therefore most complex. If a determination of the transmitting or reflecting power is to prove of practical application, it is necessary that the conditions of test should bear a direct relationship to the conditions under which the fabric is to be employed. The nature of the radiant heat used in testing must be specified, and also the state of the fabric regarding moisture content.

The measurement of the total amounts of heat reflected and transmitted presents many difficulties. It is possible to measure the intensity of heat at a large number of points around a small area of fabric on which radiant energy is incident, and from these observations to calculate the total energy transmitted and reflected, but in the measurement of the transmission of heat it will be shown that it is necessary to test a considerable area of fabric owing to the variation of heat transmitted from point to point on the fabric. Consequently the above method, in addition to manipulative and experimental difficulties, would prove impracticable owing to the time occupied by testing a single type of fabric. The method described below for the determination of the heat transmitted by a fabric enables a factor to be determined by means of which the amount of heat transmitted by different fabrics may be compared.

Concerning reflection of heat by fabrics, the variation in intensity of reflected heat in a given direction from point to point on the surface of a fabric is found to be small, but apart from the laborious method indicated above a scheme for comparing the powers of total reflection of heat by fabrics has not yet been evolved.

EXPERIMENTAL METHODS AND RESULTS

Owing to the necessity for the maintenance of the fabric under controlled conditions of temperature and humidity, and in addition the prevention of both draughts and stray radiation from disturbing the thermopile (the instrument used for measuring the heat), both the fabric and thermopile are placed in an airtight glass vessel. The temperature of the vessel is controlled by immersion in a water bath maintained at a constant temperature of 25° C. The inside of the glass vessel is protected from stray radiation by means of blackened metallic screens, the stream of radiant energy being admitted by a window in the top.

The source of heat employed is one that fulfils approximately the conditions for the emission of total radiation. The furnace is heated by a steady current from a 40-volt accumulator, and consists of a silica tube fitted with suitable diaphragms and wound with resistance wire. The outside of the tube is lagged with magnesium oxide, and the containing cylinder is water-cooled, whilst the lower end of the tube is fitted with a water-cooled, blackened copper diaphragm maintained at constant temperature. The diaphragm serves as a screen for the hot furnace, and limits the beam of radiation to the required extent. A water-cooled blackened copper shutter is used to intercept the stream of radiation as required, the temperature being maintained constant by first passing the water through a copper coil immersed in the large water bath. After passing through the shutter the water is circulated through the copper diaphragm and containing cylinder of the furnace.

The instrument employed for the detection and measurement of the radiant heat is a Moll thermopile, a central cross section of which is indicated in Figs. 1 and 4. The receiving surface of the thermopile is protected by a fluorite window, which is transparent to radiation. The brass body of the thermopile may be fitted with either of two caps, one possessing a cylindrical opening and the other a slit of variable width. A galvanometer of the D'Arsonval type is used in conjunction with the thermopile, the deflection consequent on the falling of radiant energy on the receiving surface of the thermopile being indicated by the movement of a spot of light on a millimetre scale.

Relation between Amounts of Heat Reflected and Transmitted by a Fabric

In order that the relation between the amounts of heat reflected and transmitted might be determined approximately, and to indicate the manner in which the heat intensity is distributed, a test was made on a specimen of fabric (No. 2) permanently fixed on a wire frame two and a half inches in diameter. The radiant energy was incident in a direction normal to the fabric, while the thermopile was capable of rotation about an axis contained in the plane of the fabric. The cap of the thermopile was furnished with an extension of brass (Fig. 1), blackened on the inside, and of such dimensions that the sensitive surface of the thermopile received heat from a limited area of fabric. The deflections of the galvanometer were noted corresponding to positions of the thermopile when rotated through successive angles of nine degrees. With angles of reflection less than eighteen degrees, the body of the thermopile obstructs the radiant energy incident on the fabric, and in this range observations are not possible.

By plotting intensities of reflected heat as ordinates and angles of reflection as abscissæ, a curve is obtained which indicates the distribution of heat intensity from a constant area of fabric at a fixed distance from the fabric in a given plane of incidence (Fig. 2). An estimate of the amounts of energy reflected and transmitted may be arrived at on the assumption that the intensity curve is the same for all planes of incidence. In Fig. 3 the amounts of energy corresponding to definite small ranges of angles of reflection are plotted as ordinates against the angles of reflection as abscissæ. Consequently the area under the curve represents the total energy dissipated by the fabric.

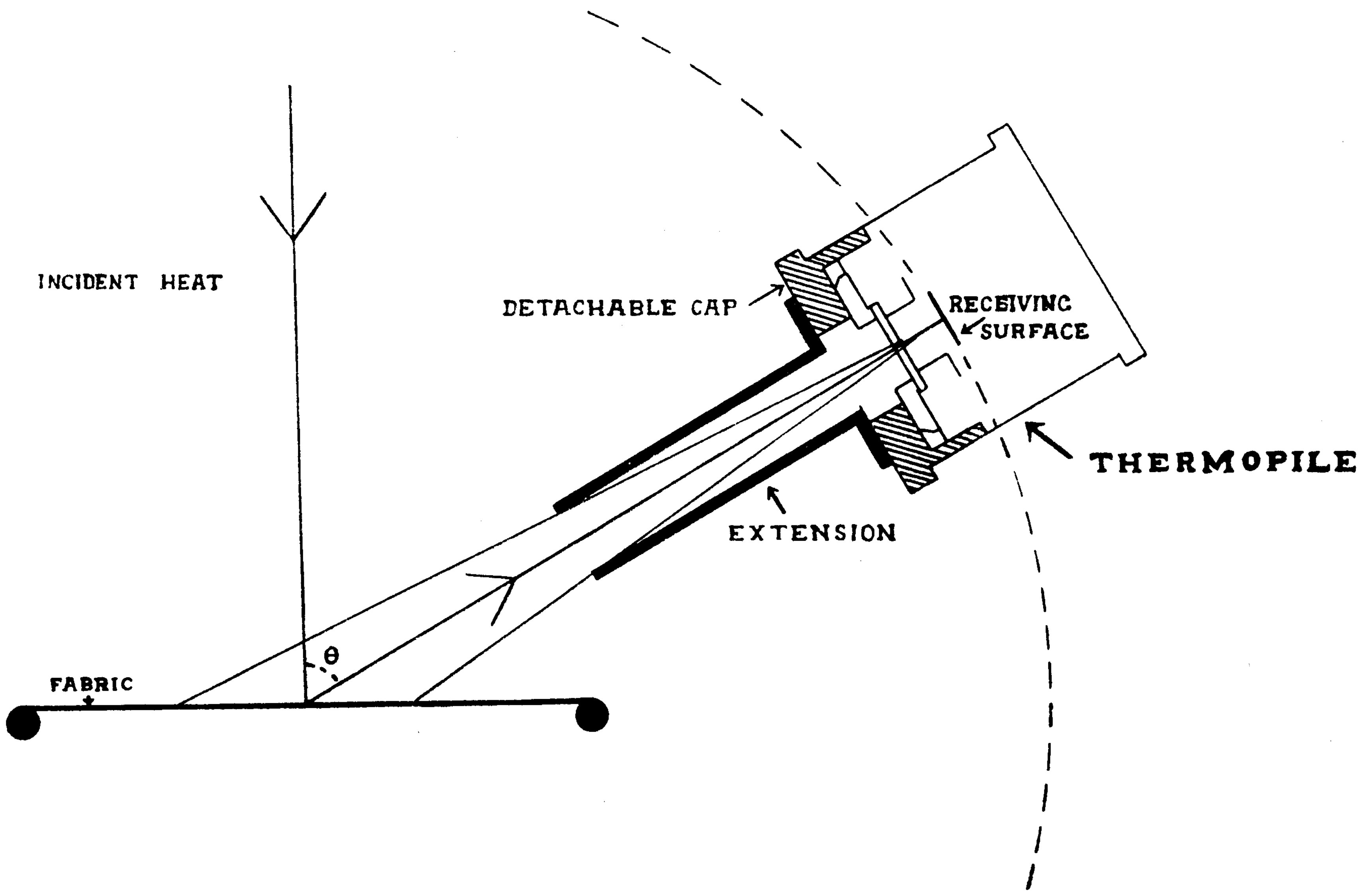
INCIDENT HEAT
DETACHABLE CAP
RECEIVING SURFACE
THERMOPILE
EXTENSION
θ
FABRIC

FIG. 1

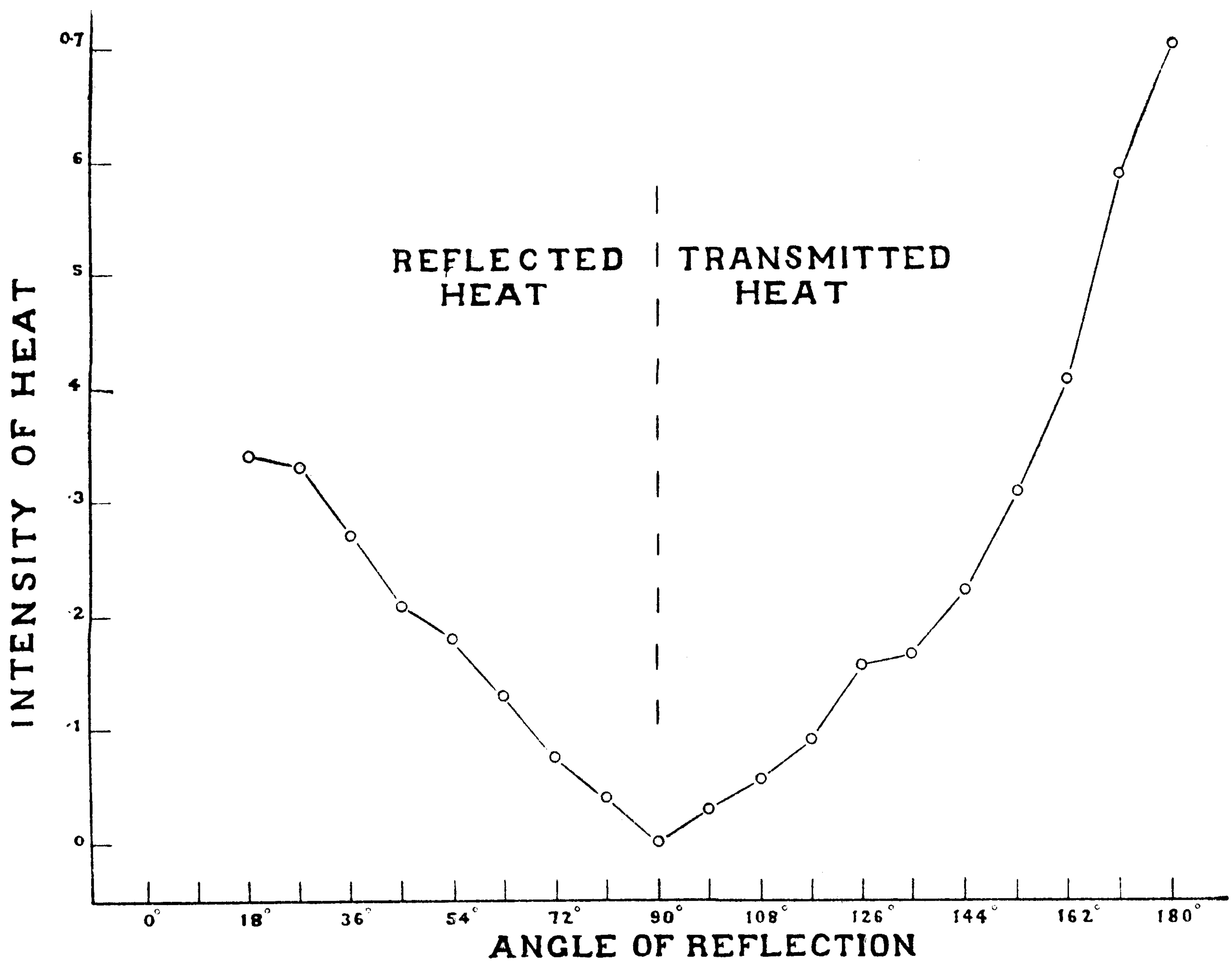
INTENSITY OF HEAT
0·7
·6
·5
·4
·3
·2
·1
0
REFLECTED HEAT
TRANSMITTED HEAT
0°
18°
36°
54°
72°
90°
108°
126°
144°
162°
180°
ANGLE OF REFLECTION

FIG. 2

Since the total area represented by the range 0°-90° is approximately equal to that represented by the range 90°-180°, the total heat reflected is approximately equal to that transmitted.

Although the accuracy of this determination is not high, owing to the small amounts of heat received by the thermopile, it serves in a general way to indicate the relative magnitude of the amounts of heat reflected and transmitted. In this determination the humidity of the atmosphere surrounding the fabric was that of the room.

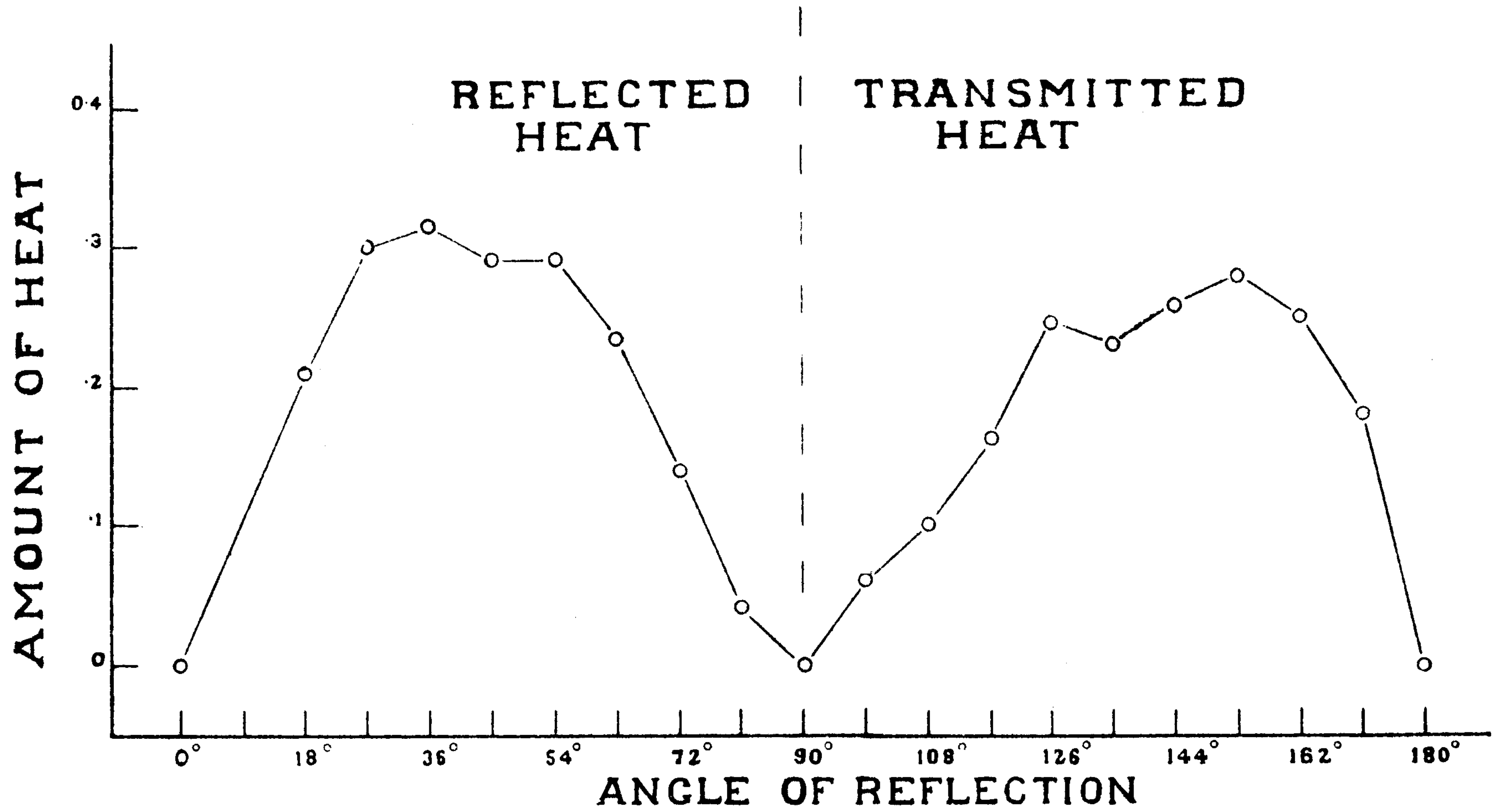

FIG. 3

Transmission of Heat

The method adopted for the comparison of transmitting powers for radiant heat of various types of fabrics is as follows. The fabric to be tested is placed with its surface towards the source of heat, so that the radiant energy is incident normally (Fig. 4). On the opposite side of the fabric is placed the thermopile, a short distance away. The relation between the amounts of heat received by the surface of the thermopile at various distances from the fabric over the range $\frac{3}{4}$ to $2\frac{1}{2}$ inches, has been shown to be linear. Any given portion of the thermopile receiving surface receives heat from an area of 8 sq. cms. of fabric when in the position shown in Fig. 4. No ray which makes an angle greater than 35 degrees with the normal to the fabric reaches the thermopile receiving surface, this angle being independent of the distance of the thermopile from the fabric.

It is found necessary to maintain the fabrics under a constant tension which is insufficient to cause appreciable stretching. A strip of the fabric, $2\frac{1}{2}$ inches wide and 36 inches long, is wound on two rollers RR, and in addition passes over a fixed bar S and a rubber-covered roller T, the number of revolutions of which indicates the distance of the portion under test from a fixed point on the fabric. The axles of the rollers RR are subject in turning to a frictional force applied by small slabs of cork pressed against the axles by means of a strip of springy steel. Different portions of a fabric may be examined by winding from one roller on to the other. Several strips of fabric may be joined when it is desired to test a number of fabrics under the same conditions. Between successive strips are placed short strips of paper in the centres of which holes are cut two inches in diameter so that the radiant energy received by the thermopile direct from the source may be measured without removing the fabric from the rollers. Since the thermopile is in close proximity to the fabric, any change in temperature of the fabric due to absorption of radiant energy or other cause, is evidenced in the slow movement of the galvanometer coil. In order to eliminate this effect the following procedure is adopted. With the shutter closed, the reading of the spot of light on the galvanometer scale is noted, and immediately afterwards the shutter is opened. After a fixed time interval of one minute, in which the galvanometer has reached its maximum deflection, the reading is observed and the shutter closed. After a further interval of one minute the final reading is observed. The mean of the initial and final readings is the zero from which the deflection is determined. The creep of the zero reading is small compared with the deflection measured but cannot be neglected.

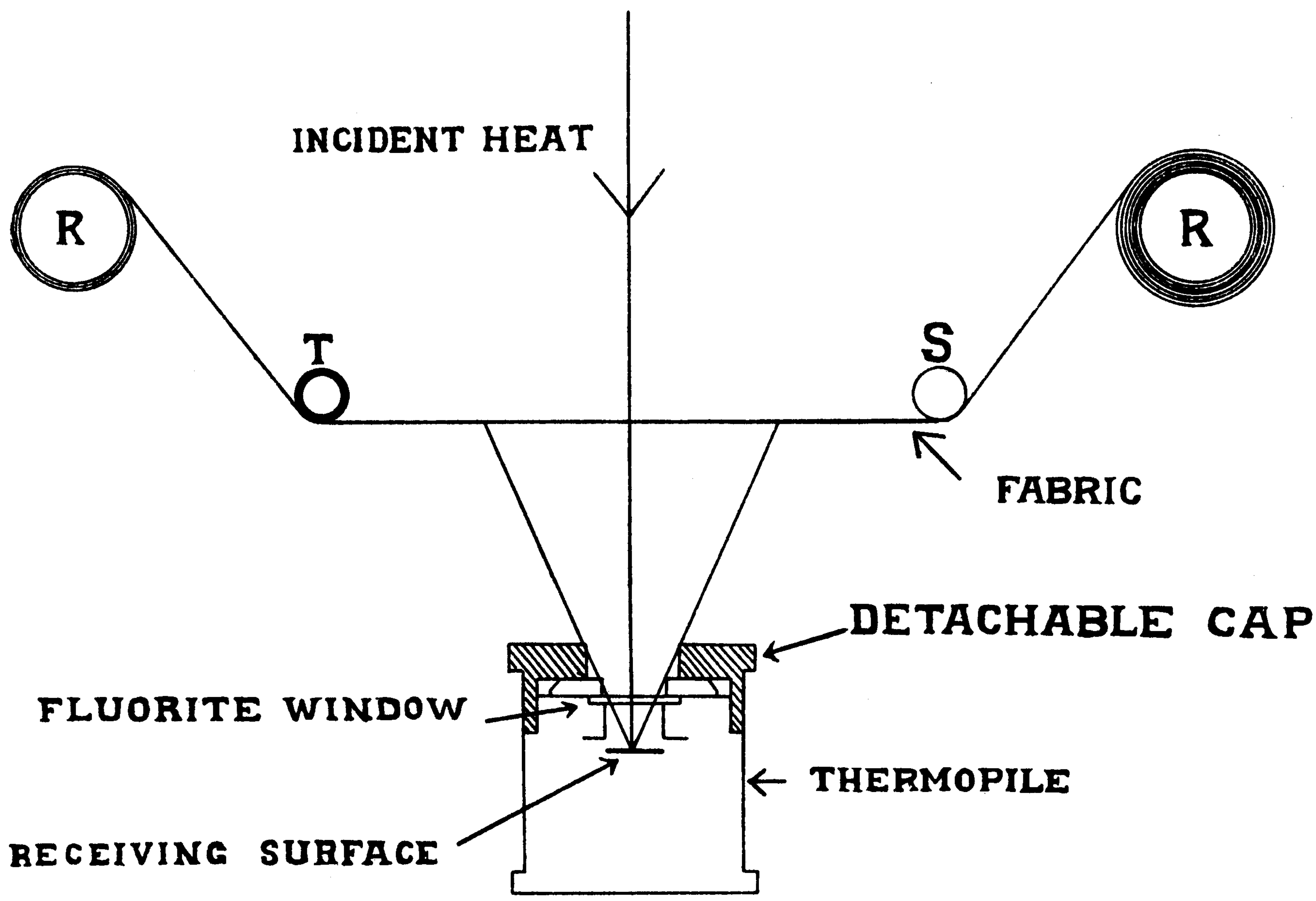

FIG. 4

In the present series of tests, the deflection due to transmitted heat is observed at intervals of one inch along the length of the fabric (corresponding to one turn of the rubber-covered roller), twenty-eight observations being taken successively on each fabric. Before and after each set of observations the deflection due to heat received by the thermopile is observed when exposed direct to the source of heat.

For each section of the fabric tested, the percentage heat transmitted P is calculated as follows—

$$P = \frac{\text{Deflection due to heat received through fabric}}{\text{Deflection due to heat received direct}} \times 100$$

If the relative positions of thermopile, fabric, and source of heat remain unaltered, the percentage P may be employed to compare the transmitting powers of fabrics. In order to indicate the variation from point to point along a fabric, a curve may be plotted in which P is ordinate and the distance along the fabric abscissa. Such curves are given in Fig. 5.

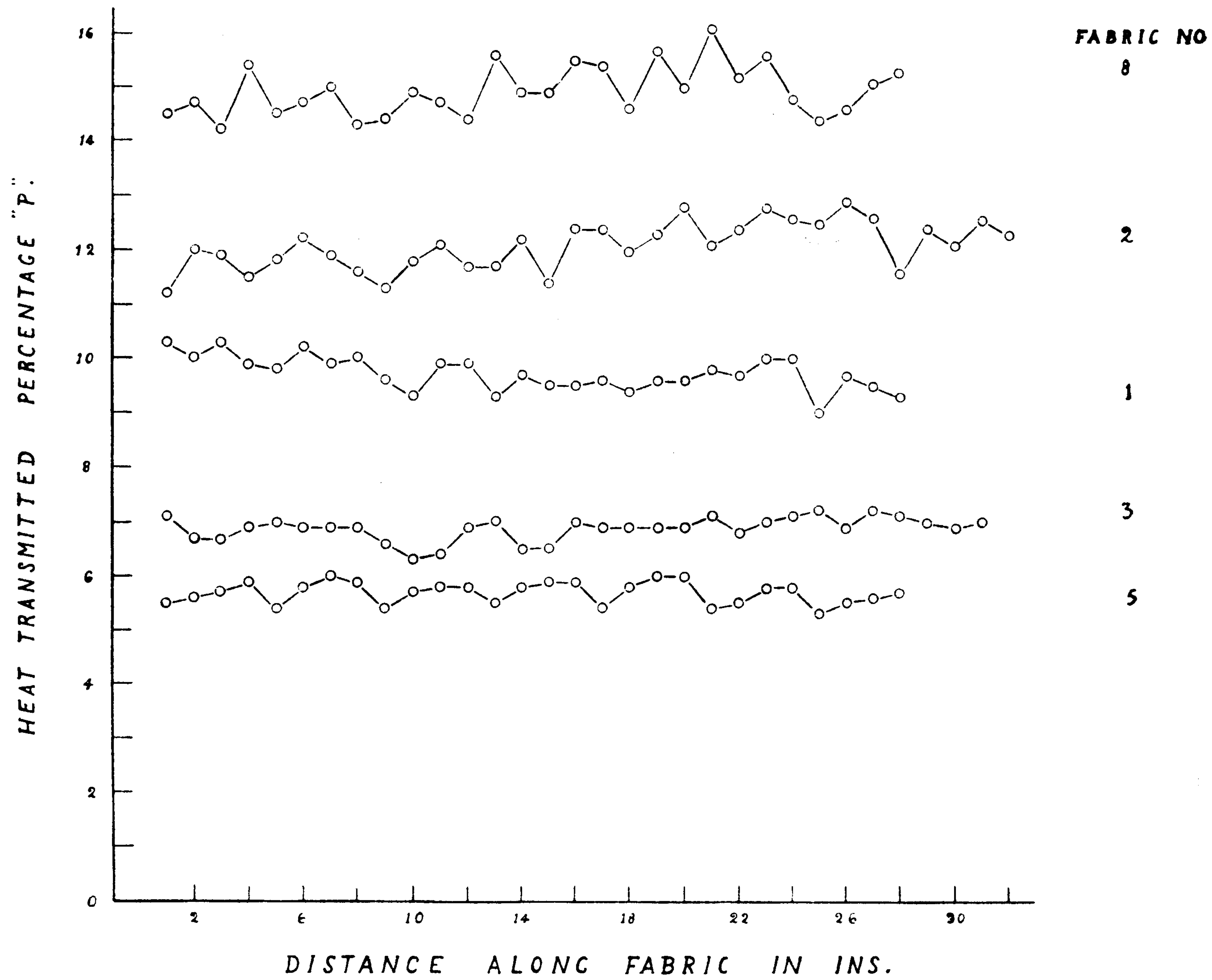

FIG. 5

Effect of the Moisture Content of a Fabric on the Transmission and Reflection of Heat

If the results of tests on fabrics are to be applicable to the conditions under which they are employed in actual practice, account must be taken of the effect of the moisture content on the transmission and reflection of heat. The influence was studied with fabrics conditioned by allowing them to come into equilibrium with atmospheres of known relative humidities, beginning with the fabrics in the dry state and continuing in definite stages to the state of saturation.

Transmission of Heat at Different Relative Humidities.—In this study four types of fabrics were employed (Tables I. and II.) and tested with the arrangement previously described and indicated in Fig. 4, as follows. Specimens of each fabric $2\frac{1}{2}$ inches wide and 7 inches long, cut with the selvage parallel to the length of the specimen, are joined in pairs, the two pairs being separated by a strip of paper in which a circular hole 2 inches in diameter is cut. The compound strip is wound on the rollers RR, and passes over the bar S and the rubber-covered roller T. The same portion of the fabric may be brought into position over the thermopile as required, by counting the number of revolutions of the roller T from the zero position of the fabric. Each specimen is tested four times at intervals of 1 inch along the length of the strip, the same portions of each specimen being tested at the different humidities so that the factors obtained for heat transmission at the different relative humidities are comparable. The fabrics remain throughout the whole series of tests in the same relative positions on the rollers, and the furnace is not disturbed. The radiation is admitted through a thin glass window, the remainder of the apparatus being screened as previously described. The fabrics are first tested in the dry state, the drying being accomplished in five days by placing in the test chamber trays containing phosphorus pentoxide, replenished after the first day. The method adopted for the production of atmospheres of definite relative humidities was that of maintaining the glass vessel in which the fabrics are placed, at a fixed temperature of 20° C., and circulating air which had been conditioned by passage through a series of six wash bottles containing solutions of sulphuric acid giving the required vapour pressures. The solutions were tested before and after use with a hydrometer, and the relative vapour pressure found from the tables of density given by Kaye and Laby[1], and from the vapour pressure curves given by Wilson.[2] A U-tube packed with glass wool prevented particles of the acid solution from entering the glass vessel, and a sulphuric acid trap prevented diffusion of water vapour against the stream of air maintained by means of a filter pump. The moisture content of the fabrics is that due to absorption. The least period employed for the attainment of equilibrium was 24 hours, this period being considerably exceeded on two occasions.

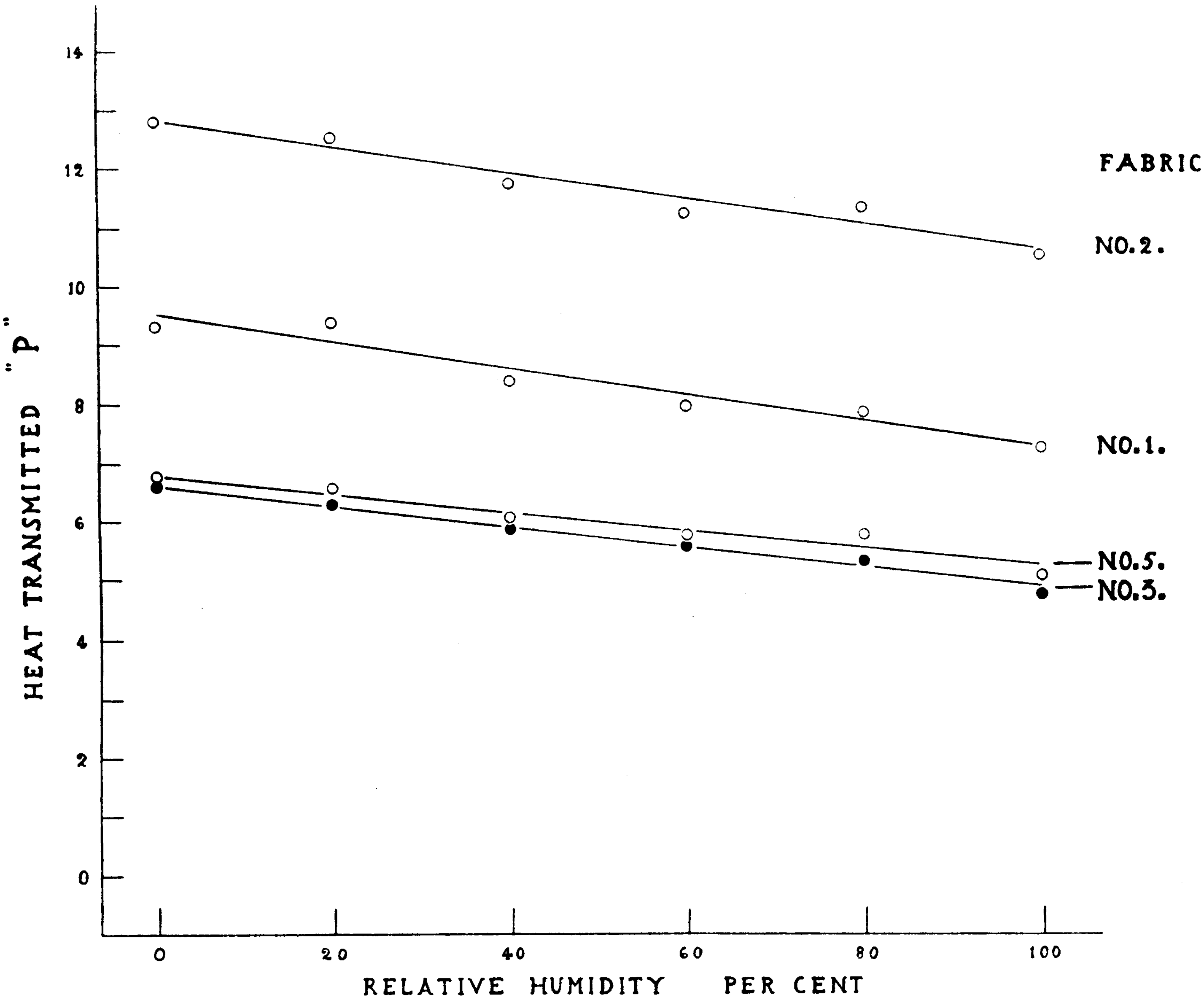

FIG. 6

Results of tests are indicated in Fig. 6 by plotting heat transmitted, P, as ordinate against relative humidity per cent. as abscissa. The percentage P of heat transmitted is the mean of the four determinations on each specimen of fabric. A longer length of each fabric was not tested because in each case the fabric would be coiled on the rollers RR to a greater extent, and equilibrium would not be readily attained. The accuracy of the separate determinations is not very great owing to the comparatively large change in the factor P from point to point along the length of the fabric (indicated in Fig. 5), and consequently a small error in setting the position of the fabric induces a larger error in the determination of the factor P. At the end of the series of tests the fabrics were dried and tested again. All showed a slight increase in heat transmitted, which is probably due to the stretching of the fabrics, since in the course of the series of tests they are wound from one roller on to the other a large number of times.

The relation between the relative humidity of the atmosphere with which the fabrics are in equilibrium and the heat transmitted P is approximately linear for the four fabrics tested.

The chief feature to be remarked is that if the fabrics are arranged as in Table I., the percentage decrease in P (expressed as a percentage of the heat transmitted in the dry state) going from the state of dryness to that of saturation, is found to increase as P decreases.

Table I.

Fabric Number	"P," Dry State	% Decrease in P
2	12·8	17·2
1	9·5	21·5
5	6·8	25·0
3	6·6	27·3
		Mean 22·7

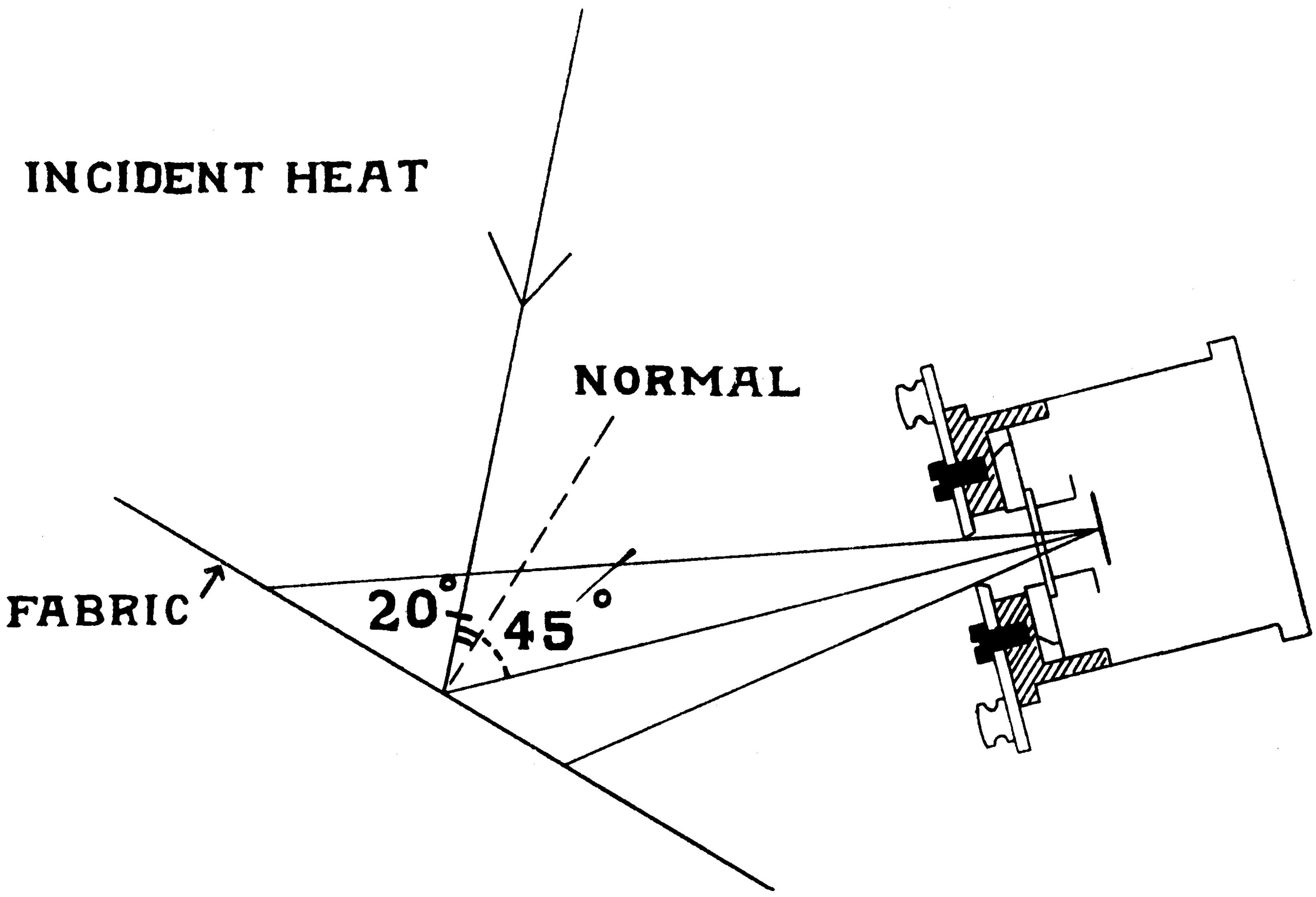

FIG. 7

Reflection of Heat at Different Relative Humidities.—An arrangement similar to that indicated in Fig. 7 is used for determining the intensity of reflected heat, the angles of incidence and reflection remaining fixed. The thermopile is placed a short distance from the surface of the fabric on which the radiant heat is incident, so that the angle of reflection of radiant heat falling on the centre of the fabric is 45°. The receiving surface of the thermopile is protected by a cap which possesses a slit 4 millimetres wide and 8 millimetres long, the length of the slit being perpendicular to the plane of incidence. The fabric to be tested is mounted on a glass plate, the fabric being backed by a sheet of dull black paper. A mask of similar paper is placed over the fabric, so that a circle of radius $2\frac{3}{4}$ inches remains exposed. Since the thermopile cannot be placed in such a position that it receives heat direct from the furnace, the intensity of heat reflected by the fabric is compared with that reflected by a matt white screen of opal glass. This screen may be lowered into position as required just over the fabric, since it is secured to a pivoted arm. The angle of incidence is 20°. The arrangement is enclosed in a glass vessel, the usual precautions as to screening and temperature control being observed. It is assumed that the reflection of heat from the glass screen is unaffected by changes in relative humidity of the surrounding atmosphere. It was only possible to test one fabric at once, and in view of the time occupied by a complete test, one was considered sufficient to indicate the magnitude of the effect.

At each relative humidity four tests are made, comparing the reflection of heat from the fabric with the reflection from the standard surface, the mean of the four tests being recorded as a measure of the intensity of reflected heat. The results of tests are shown in Fig. 8, in which intensity of reflected heat is plotted against relative humidity per cent. of the atmosphere with which the fabric is in equilibrium.

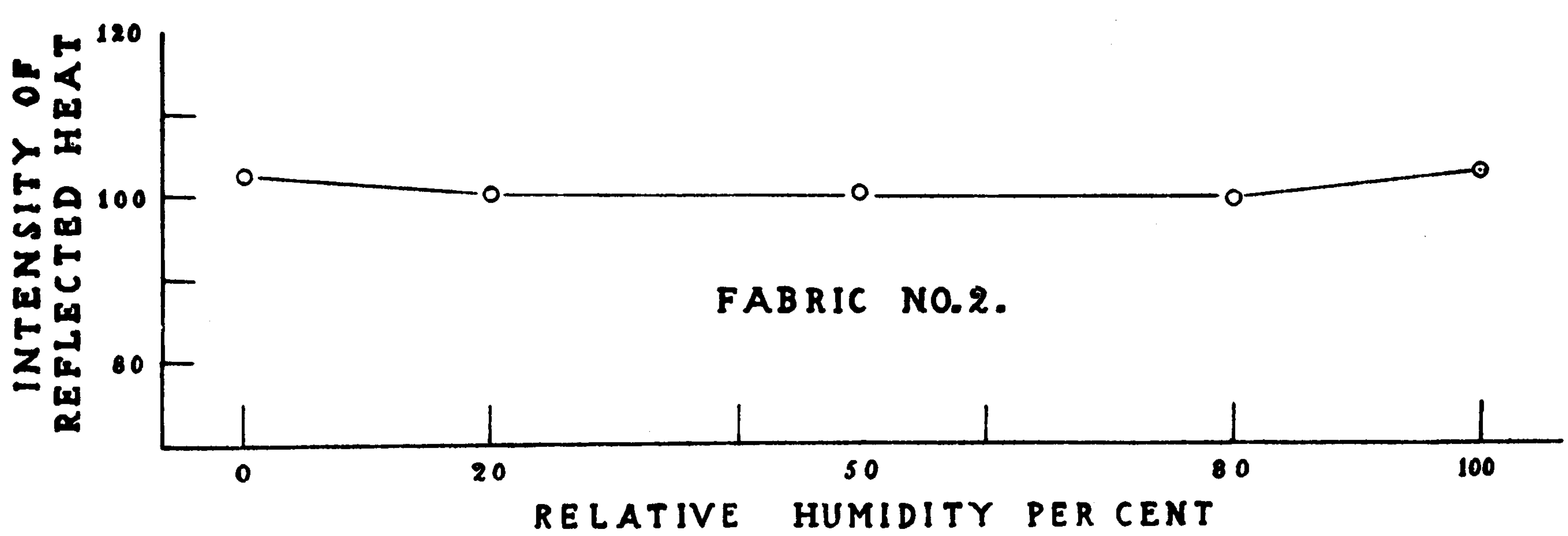

FIG. 8

The maximum change in intensity of reflected heat between the different humidities is hardly significant, being only slightly greater than the experimental error. The whole change is small, and is of far less importance than in the case of heat transmission.

The effect of change in relative humidity may be expected to be the same on the total amount of heat reflected as on the intensity of heat reflected in any one given direction.

Results of Transmission of Heat Experiments

The fabrics tested were bleached white goods supplied as being types exported to the tropics. All the available particulars are given in Table II., and point paper diagrams illustrating some of the types of weaves are given in Figs. 9, 10, and 11, in which a blank space represents the warp passing over the weft on the surface of the fabric. The strips tested were cut with the length parallel to the warp threads of the fabric, and were dried before testing for at least two days over phosphorus pentoxide. The results are collected in Table II.

There exists, as might be expected, a considerable variation in the amount of heat transmitted by the different fabrics, one transmitting almost five

Table II.

Fabric Number	Ends per Inch	Counts of Warp	Picks per Inch	Counts of Weft Yarn	Type of Cotton	Type of Weave	Market	Finish (All Fabrics Finished White)	Weight in Grams of Approx. 25 sq. Inches of Fabric	% Loss in Weight after 1 hour's Washing	Heat Transmitted Percentage "*P*" Mean of 28 Tests			% Mean Deviation of "*P*" before Washing
											Before Washing	After 1 hour's Washing	After Prolonged Washing	
1A	73	36	81	38	American	Plain	India	Starch filled, well beetled, and calendered	1·44	1·4	9·8	11·6	12·7	2·6
2A	72	36	68	38	American	Plain	India	—	1·29	3·1	12·1	13·2	14·0	3·2
3A	100	20	54	24	Best American	See Fig. 9	Far East	Chalk, clay & starch filling, well singed	2·07	7·0	6·9	8·0	9·0	2·3
4A	53	36	55	54	Low American	Plain	Burma	Dextrin, clay and glycerin filling	1·15	36·4	9·8	28·9	29·3	2·8
4AA	—	—	—	—	—	—	—	—	—	—	10·0	27·7	—	3·2
5A	72	30	79	36	Low Amer.	Plain	China	Filled, well singed	2·27	33·2	5·7	11·4	13·1	3·1
5AA	—	—	—	—	—	—	—	—	—	—	6·4	11·2	—	2·6
6A	84	80	63	78	Good Egyptian	See Fig. 10	China India Argentina	No filling, singed	1·24	3·6	12·6	13·9	14·4	2·6
7A	26 52	50 32	77	32	Super Combed Egyptian	See Fig. 11	—	No filling	1·38	1·1	14·0	13·1	12·2	2·2
8A	96	55	97	55	Egyptian	Plain	—	No filling	1·20	1·2	14·9	13·9	13·0	2·6
9A	119	78	131	122	Egyptian	Plain	—	No filling	0·93	1·6	18·4	16·8	15·7	2·6
10A	112	120	117	132	Egyptian	Plain	—	No filling	0·68	1·5	27·4	25·0	22·8	2·6

$$P = 100 \times \frac{\text{Galvanometer deflection due to heat received through the fabric}}{\text{Galvanometer deflection due to heat received direct}}$$

times that of another. This is due to the difference in construction of the fabrics involving such matters as filling, amount of cotton per unit area, weave &c.

It will be noted, however, that there is considerable variation in heat transmitted, from point to point along the length of the fabrics (see Fig. 5), but it is obvious that the percentage mean deviation of P which varies from 2·2 to 3·2 does not depend on the amount of heat transmitted (Table II.).

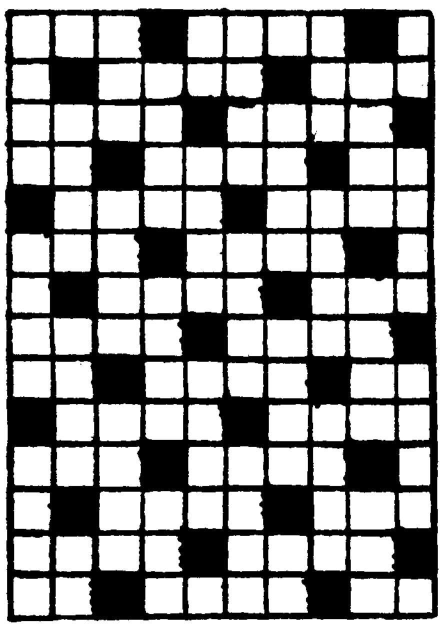

FIG. 9

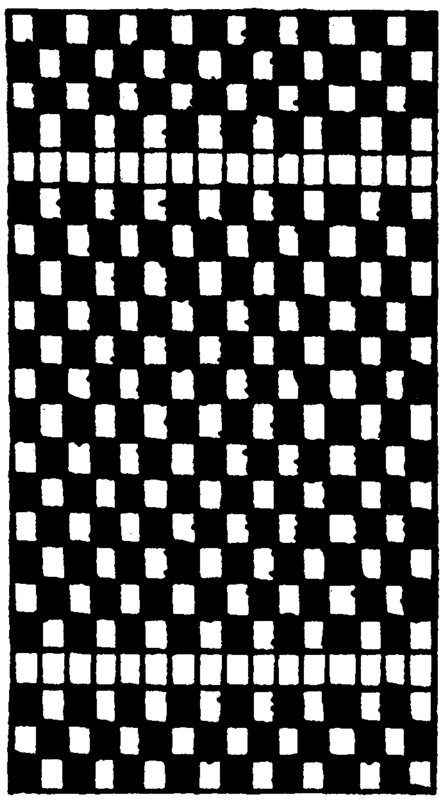

FIG. 10

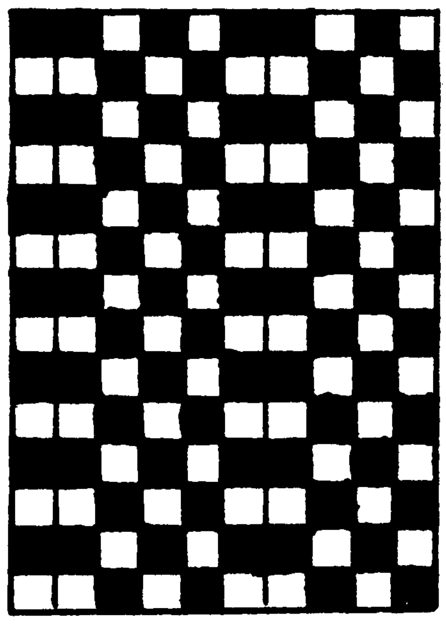

FIG. 11

With regard to the details of the fabrics indicated in Table II., Nos. 3, 4 and 5 are more or less heavily filled. An idea of the amount of filling which is removable by washing is obtained by weighing samples (about 25 square inches in area) before and after boiling for half an hour in soap solution and half an hour in clean water. The fabrics are dried in an oven, maintained at 105° C., previous to weighing. The percentage losses in weight (expressed as a percentage of weights before washing) are given in Table II., together with the weights of the various samples of fabrics previous to washing. These weights give an approximate indication of the relative weights of the different fabrics.

The effect of washing on the transmission of heat has also been determined, using in this instance a gas-filled electric lamp instead of the furnace as the source of heat, since equilibrium was more rapidly reached. The fabrics were tested for heat transmission after one hour's washing as previously described, and then after prolonged washing, usually 20 hours in soap solution. It will be noted from Table II. that fabrics Nos. 4 and 5, which lose in weight on washing a considerably greater amount than the other fabrics, show the greatest increase in heat transmitted. This is apparently due to the removal of filling matter. Both fabrics are entirely changed in appearance, especially No. 4, which becomes a mere rag.

In connection with the discussion of these results, the remarks of Band[3] are interesting. Referring to the heavily filled cheap type of cotton shirting used in India, he states that "the coolie class who wear shirts made of this cloth rarely wash them, and the starch or china clay keep them warm or cool as the case may be." The writer justifies the manufacture of such goods in that the market is extended owing to the cheapness of filling material as compared with cotton, the filling in addition changing the fabric like a rag into quite a presentable material. It is obvious, however, that a fabric consisting chiefly of filling is equal in heat protective value to the average unfilled fabric only so long as it remains unwashed.

With fabrics Nos. 7, 8, 9, and 10 the result of washing is to cause a decrease in the amounts of heat transmitted. Since all four fabrics were without filling, this decrease can only be ascribed to shrinkage. The effect is not very large, and is not observed with the other six fabrics. This may be due to incomplete removal of filling matter at the first washing process, or to the fact that the six fabrics have reached the limit of shrinkage during previous treatment.

Of the fabrics tested, a heavy type such as fabric No. 3 appears to be most suitable for use as clothing in the tropics, since in addition to the small amount of heat transmitted even after prolonged washing, the heavy fabric affords better protection against possibility of chill.

It will be noted that although fabric No. 1 transmits almost twice as much heat as No. 5 before washing, after prolonged washing there is little difference. The two fabrics are similar in construction as regards the number of picks and ends per inch and counts of warp and weft yarn.

Further work on the lines of the present investigation will consist in the development of a method for determining the total amount of heat reflected from a fabric and an examination of the various processes which go towards the making of a finished fabric, so that the essential features of the best type of fabric for use as clothing in the tropics may be determined.

Mr. H. Wardle has rendered valuable assistance in taking observations during the progress of the work.

REFERENCES

[1] Kaye and Laby, "Physical and Chemical Constants," p. 25, 6th ed., London 1921.
[2] Wilson, J. Ind. Eng. Chem., 1921, **13**, 326-331.
[3] Band, Dyer and Calico Printer, 1926, **55**, 30-31.

Shirley Institute
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ABSTRACTS

1—FIBRES AND THEIR PRODUCTION

(B)—Animal

Sericulture in Portland, Oregon *Silk J.*, 1926, **2**, No. 21, p. 66.

The Columbia Silk Farm reports that worms thrive there as well as they do in China or Japan; 80,000 worms were fed during 1925, and with the feeding of 400,000 this year it is expected that the enterprise will be placed on a paying basis. —F.G.P.

(C)—Vegetable

Cotton Anthracnose: Control. S. G. Lehman. *Rev. App. Mycol.*, 1926, **5**, 90 (from *North Carolina Agric. Exp. Sta. Tech. Bull.*, 1925, No. 26, 71 pp.).

A detailed account of investigations on the control of cotton anthracnose by heat treatment of the infected seed. In a machine for treating cotton seed in bulk with dry heat the effective treatment for the control of anthracnose without serious reduction of germination consists of 20 to 24 hours' desiccation at 60 to 65°, followed by 12 hours' heating at 95 to 100° C. The moisture content of cotton seed was found to be a decisive factor in its ability to withstand temperatures effective in anthracnose control. When the moisture content after drying amounted to 3·9% of the oven-dry weight, the viability of the seed was seriously impaired by 12 hours' heating at 95°. When the moisture content did not exceed 3·62% of the dry weight there was no serious loss of activity. When the water content was not greater than 3·19% the seeds heated at 95° for 12 hours germinated more rapidly than untreated seed. The control of the fungus by dry heat is due, not to desiccation, but to the direct action of the heat on the protoplasm of the organism. —B.C.I.R.A.

Boll Weevil Control in S. Carolina. G. M. Armstrong, R. W. Moreland, and R. C. Gaines. *Rev. App. Entomol.*, 1926, **14**, Ser. A, 74 (from *S. Carolina Agric. Exp. Sta. Bull.*, 1925, No. 223, 64 pp.).

Calcium arsenate dust, applied after 10% of the squares were found to be punctured by the weevil, made 2·6 times the increase of seed cotton that was made with the Florida method, 3·1 times that with one pre-square application of molasses mixture, 1·6 times that with molasses mixture applied with both mop and sprayer, and 2·2 times that with molasses mixture applied with a mop throughout the season. Early applications of calcium arsenate dust, both of which were followed by calcium arsenate dust after 10% infestation, made practically the same increase of seed cotton as calcium arsenate dust applied after 10% infestation. One pre-square application of molasses mixture followed by calcium arsenate dust after 10% infestation made 2·8 times the increase of seed cotton that was made with one pre-square application of molasses mixture alone. One pre-square application of calcium arsenate dust followed by calcium arsenate dust after 10% infestation made 2·2 times the gain of seed cotton that was made with one pre-square application of calcium arsenate dust alone. Molasses mixture applied with both mop and sprayer, and nicotine dust made practically the same increase of seed cotton.—B.C.I.R.A.

Cotton Anthracnose: Control. C. A. Ludwig. *Bot. Abs.*, 1925, **14**, 1392 (from *South Carolina Agric. Exp. Sta. Bull.*, 1925, No. 222, 1-52).

Anthracnose (*Colletotrichum Gossypii*) is one of the most important cotton pests and occurs in most of the cotton growing regions of the world. It is largely transmitted, from season to season, by infected seed. Attempts to develop a quick, practical method of destroying the fungus in the seed have not been successful. Effective control measures consist of such means as the selection of seed from healthy stalks not growing near diseased ones, ploughing in of diseased stalks in the fall or following a rotation, ginning in a clean gin, delinting with strong sulphuric acid, and storing infected seed for at least two years before planting to allow the fungus to die. The experimental work reported is a study of some of the environmental features which affect the life of the fungus in stored, infected seed. The results show that the seed becomes free of infection in storage. Under laboratory conditions the action proceeds very slowly at first but becomes rapid when the seed is about a year old. By the second spring after picking, the infection has practically disappeared. Storage in a very moist atmosphere leads to the early death of the fungus, but the seed becomes musty and fails to germinate. Storage in a very dry atmosphere greatly prolongs the life of the fungus. Alternate storage in very dry and very moist air was of no advantage. Delinted and sterilised seed has the initial infection cut down to a low figure and that remaining in the seed seems to become eliminated a few months sooner than in untreated seed. —B.C.I.R.A.

Flax Growing in South Dakota. A. N. Hume, E. W. Hardles, and C. Franzke, *Exp. Sta. Rec.*, 1926, **54**, 34 (from *S. Dakota Sta. Bull.*, 1925, No. 213).

The information and experimental data presented supplement those recorded earlier. Further tests at Highmore, Cottonwood, and Eureka indicated April 15 as the best seeding date for highest yields. A rate of not less than 20 qt. per acre is suggested. During two years one acre seeded to clear flax produced a larger total yield of flax than did two acres seeded in mixture with wheat, while the reverse was true with wheat. The combined production from two acres seeded in flax-wheat mixture was greater in both years than where flax and wheat were seeded separately, each on one acre. Greater gross financial receipts for flax came from one acre of clear flax seeded along with one acre of clear wheat than from the flax in two acres of flax-wheat mixture, whereas the opposite was true of wheat. The highest gross financial return in the experiment was received from land seeded into flax-wheat mixture in 1924, and the highest average return in the two years came from land seeded in flax-wheat mixture. The usual records of the annual precipitation by months at the station and sub-stations are appended. —L.I.R.A.

Cotton Boll-rotting Bacteria. J. C. Hopkins. *Ann. App. Biol.*, 1926, **13**, 260-265.

Two organisms have been isolated which are capable of producing an internal rot of at least five varieties of cotton bolls. Inoculation experiments and resulting physiological phenomena are described and the similarity between the two rots demonstrated. The association of one organism with the anthracnose fungus is pointed out and dual infection of a number of varieties of cotton bolls discussed; the resistance of Sea Island and Cauto varieties to the disease is suggested. Detailed descriptions of both organisms and their reactions to various standard media are given. —B.C.I.R.A.

Cotton Cultivation in Brazil. B. G. C. Bolland. *Ann. App. Biol.*, 1926, **13**, 266-273.

The paper gives an account of the formation of the cotton service in Ceara, one of the north-eastern states of Brazil, the lines on which the work of improving the cotton crop is to be conducted and some figures showing the composition of the crop prior to any selection. Because of the large number of types represented and the long period of time during which cross-fertilisation has taken place, several years must elapse before any pure selected strains can be marketed. —B.C.I.R.A.

Photoperiodic Plants and Cotton Plant: Effect of Temperature and Humidity on Vegetative Activity. B. E. Gilbert. *Ann. Bot.*, 1926, **40**, 315-320.

This paper is an account of the results obtained with certain plants, known to respond to relative day length, when grown under two controlled sets of temperature and humidity. The plants investigated included cotton as likely to be very sensitive to temperature variations. Marked results were obtained in the modification of the length of the vegetative activity. Soya beans and cotton exhibited definite reactions to the higher temperature and lower humidity conditions. Definite retardation of flowering was noted with the lower temperature and higher humidity conditions. *Cosmos* was definite in reaction, but *Salvia* and Buckwheat exhibited no reaction. —B.C.I.R.A.

Seed Pods and Vegetable Fibres: Flexion. S. Rywosch. *Biochem. Z.*, 1925, **166**, 24-46.

Observations on the curling of seed pods and vegetable fibres in water and under varying conditions of humidity show that flexion depends, not only on the difference between the rates of imbibition or desiccation of the hygroscopic organs on each side of the tissue, but also on the degree of swelling of the tissue as a whole. The rate of imbibition depends on the permeability of the epidermal layer and the humidity of the atmosphere, and the degree of flexion is also influenced by the pressure to which the layer of cells on the concave side of the tissue is subjected by the swelling of the cell-layer on the convex side. —B.C.I.R.A.

Kapok: Application. *Bull. Imper. Inst.*, 1926, **24**, 18-36.

A survey of the production of kapok, its cultivation and uses. —B.C.I.R.A.

Weeds; Diluted Sulphuric Acid as a Spray for——. A. Aslander. *Bot. Abs.*, 1926, **15**, 674 (from *Nordisk Jordbrugsforskning*, 1925, 126-146).

Used at a rate of 90 gallons per acre 2% sulphuric acid killed plants of *Sinapsis arvenis* with 3-4 leaves, while plants which had wintered over in the field required a 5% solution. The acid penetrates into the plant, killing the protoplasm, and destroying the chlorophyll and chloroplasts. In winter-grown leaves the thick cell walls will absorb a considerable quantity of acid and the lower layers eventually escape killing. Barley, oats, and peas are protected by means of a wax coating; red clover, by hairs. The leaves of *Chenopodium album* are protected by glandular hairs, but the plants may be killed when the field is rolled previous to spraying, by which procedure the unprotected stems are killed. Added to water cultures sulphuric acid in concentrations no stronger than 1-20,000 seems harmless. —L.I.R.A.

Cotton Variety Trial in U.S.A. (Arkansas). J. O. Ware. *Exp. Sta. Rec.*, 1926, **54**, 33 (from *Arkansas Sta. Bull.*, No. 197, 1925).

Early varieties have a somewhat lower ginning outturn and smaller bolls, but they average more lint per acre during a period of years. Gin outturn did not appear a safe criterion for a variety. Earliness seems necessary for high production under boll weevil conditions, and on the average total yields are proportional to the size of the first picking. Long staple accompanies a lower lint percentage, but as indicated by Express and Delfos not necessarily low yield. Length and quality of lint appear to be affected by soil and season.

—B.C.I.R.A.

Cotton Seed: Disinfection. E. Ferreira. *Chem. Abs.*, 1925, **19**, 3345 (from *Gaceta Algodonera*, 1924, **1**, 21-25, and *Rev. internat. renseign. agric.*, 1925, **3**, 556-557).

The author concludes from the results of tests in which he used 400 grams of carbon disulphide per cu. m. of seed for 24 hours, that the carbon disulphide treatment in no way injures the germinative power of the seed. It prevents fermentation of weak seeds which, though they do not germinate, might cause the development of a harmful vegetation. Disinfection should be carried out a short time before sowing; the seed should be quite dry and quite ripe when disinfected. The method of determining germinative power is described.

—B.C.I.R.A.

Egyptian Cotton: Effect of Summer Fallow. E. McK. Taylor. *Ministry Agric. Egypt, Bull.* No. 57, 1926.

The yield from land which has been subjected to a long summer fallow is considerably greater than that from land which has had a short summer fallow. The theory that the decline in the yield of Egyptian cotton is directly attributable to the fact that the summer fallow period has been almost entirely eliminated is confirmed. As this elimination is largely due to the early sowing of maize, the postponement of the sowing date of maize until about August 10th is suggested. The water now stored in the Aswan Dam is used to supplement the early stages of the flood in July. It has been shown that it is economically possible to employ this water in ensuring the rice crop in the northern areas. The loss on the maize crop to the fellah in the south by this alteration would be compensated for by an increased yield of cotton. The prosperity of the northern portion of the Delta would be considerably increased as the result of the increase in the available water. —B.C.I.R.A.

Soil Heterogeneity and the Use of Probable Error Concept in Plant Breeding Studies; Control of——. H. K. Hayes. *Bot. Abs.*, 1926, **15**, 727 (from *Minnesota Agric. Exp. Sta. Tech. Bull.*, 1925, **30**, 3-21).

A method of computing an average probable error for the experiment which was called "the deviation from the mean method" was given. Essentially the same method was used as in the ordinary formula for standard deviation, except that the deviation of each plot of each variety from the variety mean was expressed in percentage. Similar results were obtained as by the use of numerous check plots of a standard variety distributed systematically throughout the experimental field. Various methods were tried of using calculated probable errors as a means of estimating the significance of the results. The deviation of the mean and Student's method were compared. A method was given of computing a coefficient of soil heterogeneity when conducting a strain or variety test.

—L.I.R.A.

Cotton Cultivation in S. Africa. G. F. Keatinge. *Emp. Cotton Grow. Rev.*, 1926, **3**, 193-199.

Suggestions are made as to the means of developing a stable cotton growing industry in Swaziland, Transvaal, Natal, and Portuguese East Africa. Cultivations, pests, rotational cropping, and alternative crops are discussed. —B.C.I.R.A.

Cotton Cultivation in Papua. G. Evans. *Emp. Cotton Grow. Rev.*, 1926, **3**, 200-214.

A survey of Papuan cotton growing possibilities leads to the conclusion that the dry belt lying to the East and West of Port Moresby has a normal rainfall suited to cotton growing and the necessary dry season for harvesting. Disappointing results with Upland American in 1925 were partly due to abnormally heavy rains in April and May and partly to the lack of experience among the cultivators. Pest damage in all instances was severe. Sea Island and Kidney cotton are thought worth trial. Seed treatment against pink bollworm is essential and a closed season of three months must be instituted. Recommendations for the organisation of the agricultural department and for the appointment of an entomologist are made.

—B.C.I.R.A.

Cotton Cultivation in New Guinea. G. Evans. *Emp. Cotton Grow. Rev.*, 1926, **3**, 215-234.

The climate is generally unsuited to cotton growing on account of the excessive and evenly distributed rainfall and the high atmospheric humidity. There is, however, a dry area in the Markham Valley, possibly 1,000 square miles in extent, which may prove climatically suitable. Preliminary trials with Durango are encouraging but because of uncertainty as regards climate, seed distribution to the natives is undesirable until thorough tests have been made. Selection work on native varieties is recommended. The Sea Island variety also deserves trial. Precautions should be taken to see that all introduced seed has been efficiently treated prior to entering the valley in order to prevent infection with the pink bollworm. —B.C.I.R.A.

Cotton Cultivation in U.S.A. (N. and S. Carolina). W. Brown. *Emp. Cotton Grow. Rev.*, 1926, **3**, 268-275.

Generally throughout the U.S.A. belt, new strains are sought by straight selection from the almost endless series of cotton varieties already existing, and hybridisation is less in favour because it takes seven years longer to establish a chosen strain. Nakedness of the seed was once held to have certain disadvantages over fuzziness, but now nakedness is sought because of easier disinfection and sowing and of earlier germination, which are useful qualities where pests are serious. The first results on the inheritance of fuzz indicate nakedness as dominant. Wet years and wet situations favour the boll weevil and rank growth, overcrowding, horizontal and low branching favour attack. Early maturing, maximum bolling in the early season, rapidly growing and hardening bolls are desirable characteristics in new selections, and cultivations are adapted to reduce shedding of early bolls, to encourage upright growth with few spreading branches and to develop smaller but more numerous plants to the row, and to allow the maximum exposure of the soil to sunshine. The Florida method is to some extent effective against the weevil, but it is expensive in comparison with calcium arsenate dusting. The Dixie variety was resistant to wilt but late for boll weevil, and the Dixie Triumph cross was made to correct lateness. It was fixed in 1919, nine years after the original hybridisation, and is now grown on the light sandy soils where wilt is prevalent. Immune cow peas and the velvet bean are useful rotation crops for wilt land, but on wilt-free soils the soy bean has preference. —B.C.I.R.A.

Cotton Pests Control in Queensland. E. Ballard. *Emp. Cotton Grow. Rev.*, 1926, **3**, 276-279.

An account of the means adopted to counteract pest attack in the 1925-26 cotton growing season. —B.C.I.R.A.

Cotton Production in Peru. *Internat. Cotton Bull.*, 1926, **4**, 383-392.

The 35 separate cotton growing valleys included in the official Government list fall naturally into three areas, namely, the Piura and Chira Rivers in the Department of Piura, the central coast region from Chimbote to Ica, and in the extreme south the Camana, Majes Ocona, and Tambo valleys in the Department of Arequipa, and the Moquenqua district. The second and third areas are practically continuous, but are separated because of the far greater production of the central portion. Cotton does not thrive well north of the Santa River (near Chimbote) until the Piura is reached, sugar and rice being the substitute crops. Each valley has its peculiar characteristics and there is considerable variation in seasons, varieties, and average yields. The distribution and the quantity of each type grown, the climatic conditions, methods of cultivation, labour conditions, pests, ginning production costs, markets and export taxes are all discussed. —B.C.I.R.A.

Cotton Production in Puerto Rico. *Internat. Cotton Bull.*, 1926, **4**, 392.

The 1925 crop amounted to 1,930 bales, or about twice the exports of the previous year. A dry spring interfered with planting, but pink bollworm was not serious. Highly successful trials were made for the first time in Bayamon and Comerio. —B.C.I.R.A.

Cotton Cultivation in India (Sind). T. F. Main. *Internat. Cotton Bull.*, 1926, **4**, 403-411.

The uncertainties of cotton cultivation under the old irrigation system are detailed; and the prospects of cotton growing in the area commanded by the Lloyd Barrage Irrigation Scheme are discussed. Early attempts to improve the quality of production by the introduction of exotics are reviewed; and the required characteristics for successful varieties in Sind conditions are given. —B.C.I.R.A.

Cotton Cultivation in Java. *Textielind.*, 1924, **5**, 151-152.

The main factors which are considered to have hindered cotton growing in Java are unsuitable climate and insect pests. The chief pest is the stem and boll borer which is a concealed enemy, but leaf caterpillars appear more or less commonly and, in isolated cases after a long drought, the white aphis. The stem borer comes at the beginning of the rainy season to young shoots of mature cotton plants and bores into the stems causing the tips to die off. The insecticides employed against the coffee bean pest in Java are effective. The boll-borer is similar to the stem-borer and can be similarly treated. If spraying is done in time the borer can be prevented from reaching beyond the first loculus of the boll, and the remaining loculi ripen normally. The climate is less unfavourable to mature cotton plants than to first year growths, and the possibility of cultivation from suckers, &c., is discussed. Plants were seen which produced 200 bolls with a cotton weight of 2 grams and a seed weight of 6 grams per boll. The yield per acre on an experimental plantation is high. —B.C.I.R.A.

Cotton Cultivation in Trinidad. *Tropical Agric.*, 1926, **3**, 119.

Experiments are discussed in which an area of about ¾ acre of ground of low fertility (previously in abandoned savannah and scrub) was put under Sea Island cotton. The bank method of cultivation was employed and a minimum of after-cultivation was practised. Of the six spacings adopted, the widest, 24 in., gave the lowest yield and the closest, 12 in., gave the highest. The yields were at the rate of 1,210 lb. and 1,575 lb. of seed cotton per acre respectively, the difference being statistically significant. There was no marked difference between the yield obtained by direct planting at 12 in. and that obtained by continuous planting and subsequent thinning out to 12 in., on the appearance of the first flower bud. —B.C.I.R.A.

Seedling Cotton: Inherited Chlorophyll Deficiency. S. C. Harland. *Tropical Agric.*, 1926, **3**, 150.

The two types of chlorophyll deficiency have been observed in the second generation of Acala (Upland) by Pima (Egyptian) crosses. Two yellow seedlings have been raised to the flowering stage and will be crossed with Upland and Egyptian respectively. —B.C.I.R.A.

Cotton Cultivation in Cuba. *Tropical Agric.*, 1926, **3**, 150.

It is reported that a very satisfactory cotton is being grown on a trial scale, and that it is intended to increase the area very considerably if the pests can be controlled. The pests at present met with are the Mexican boll weevil (*Anthonomus Grandis*) and the cotton stainer (*Dysdercus ondræ*). Other species of *Dysdercus* are known to occur in Cuba. —B.C.I.R.A.

Pink Bollworm and Cotton Stainers Control in Papua and New Guinea. E. Ballard. *Rev. App. Entomol.*, 1926, **14A**, 206 (from *Queensland Agric. J.*, 1926, **25**, 23-30, and 53-55).

Accounts of the binomics and control of the pink bollworm in Papua and New Guinea and of cotton stainers and the harlequin bug in New Guinea. —B.C.I.R.A.

Pink Bollworm Control in U.S.A. (Texas). *Rev. App. Entomol.*, 1926, **14**, Ser. A, 294 (from *Qtrly. Bull. State Plant Bd. Mississippi*, 1926, **5**, 1-3).

There was a general increase in the damage done by pink bollworm in the western irrigated sections of Texas during 1925. The pest has recently been found hibernating in cocoons in the ground where it can withstand frost, snow, and other unfavourable conditions. Infestations occurring at distances of 25 to 40 miles from the previous year's cotton fields are probably due to moths drifting on wind currents blowing from infected areas. —B.C.I.R.A.

Cotton Weevil: Peru. H. S. Barber. *Rev. App. Entomol.*, 1926, 14, Ser. A, 251 (from *Proc. Entomol. Soc. Washington*, 1926, **28**, 53-54).

Eulechriops gossypii is described from Peru, where it attacks the stem of cotton at the surface of the ground. The larvæ bore into the centre of the stalk, causing the plant to fall over. —B.C.I.R.A.

Cotton Stem Borer Parasite in Sudan. J. Waterson. *Rev. App. Entomol.*, 1926, **14A**, 223 (from *Bull. Entomol. Res.*, 1926, **16**, 309-313).

Lathromeris johnstoni, reared from the eggs of the Buprestid *Sphenoptera gossypii* in the Sudan is described. It is found wherever this stem borer of cotton occurs, up to 100 miles south of Khartoum. —B.C.I.R.A.

Helopeltis SPP. **in Nigeria (S.): Life History.** O. B. Lean. *Rev. App. Entomol.*, 1926, **14A**, 223 (from *Bull. Entomol. Res.*, 1926, **16**, 319-324).

Some observations on the life history of *Helopeltis* in Southern Nigeria where they are minor pests of cotton. —B.C.I.R.A.

Tectocoris lineola **in Queensland: Life History.** E. Ballard and F. G. Holdaway. *Rev. App. Entomol.*, 1926, **14A**, 223 (from *Bull. Entomol. Res.*, 1926, **16**, 329-346).

A paper on the life history of *Tectocoris lineola* and its connection with internal boll rots in Queensland. —B.C.I.R.A.

Boll Weevil Control in India. F. P. Mackie. *Rev. App. Entomol.*, 1926, **14A**, 233 (from *Rep. Bombay Bact. Laby.*, 1924, pp 30-31).

Tests have been made with hydrogen cyanide gas with a view to fumigating American cotton to prevent the introduction of the boll weevil into India. Various native weevils were used including *Calandra*, which proved the most resistant. The time of exposure appeared to be of greater importance than the concentration of the gas; thus all individuals of this weevil were killed after exposures for 19 hours or more to a concentration evolved from ½ oz. each of sodium cyanide and sulphuric acid, whereas concentrations obtained with 1 oz. had no effect even after 6 hours. With formaldehyde vapour all the weevils were killed in 4 hours by a concentration of 10 parts per 100,000, or in 2 hours by 20 parts per 100,000. Cotton absorbs hydrogen cyanide gas. —B.C.I.R.A.

Cotton Insect Pests in Martinique. *Rev. App. Entomol.*, 1926, **14A**, 240 (from *Agron. Colon.*, 1925, No. 96, pp. 296-298.

A general account. Native cotton is cultivated to some extent, especially in the south and west, but is considerably damaged by insects. The chief pest is *Dysdercus delauneyi*. —B.C.I.R.A.

Cotton Pest in China. F. C. Woo. *Rev. App. Entomol.*, 1926, **14A**, 292 (from *J. Econ. Entomol.*, 1926, **19**, 412-413).

A species of *Boarmia* is a serious cotton pest in China and the possibility of its introduction into the United States is emphasised. —B.C.I.R.A.

Boll Weevil and Aphids: Control. W. E. Hinds. *Rev. App. Entomol.*, 1926, **14A**, 266 (from *J. Econ. Entomol.*, 1926, **19**, 112-121).

A permanent system of agriculture for the cotton belt is now being followed. Dusting by aeroplanes will probably become an important method of boll weevil control in the near future. *Aphis gossypii* can be controlled simultaneously by adding nicotine sulphate to the calcium arsenate dust. —B.C.I.R.A.

Cotton Root Borer in Brazil. G. Bondar. *Rev. App. Entomol.*, 1926, **14A**, 238 (from *Correio-agric.*, 1926, **3**, 241-248).

Notes on the weevil *Gasterocercodes gossypii*, a native of S. America, occurring throughout Brazil. Its larva bores into the roots and underground parts of the stem. —B.C.I.R.A.

Boll Weevil: Dispersion. D. Isely. *Rev. App. Entomol.*, 1926, **14A**, 266 (from *J. Econ. Entomol.*, 1926, **19**, 108-112).

The dispersion of the cotton boll weevil in a field after the hibernating weevils have become established is periodic. Each period of dispersion coincides with the emergence of a new brood of weevils. The spread of weevils across a field is usually direct from plant to plant and row to row, and is not the result of long flights. Newly emerged weevils do not usually migrate until sexual maturity has been attained. This information has been used in locating infestations at the beginning of the second and third periods of dispersion and in timing dust applications. Small infested areas dusted before weevils reached sexual maturity resulted in apparent extermination of infestation. —B.C.I.R.A.

Cotton Flea-hopper in U.S.A.: Distribution. H. H. Knight. *Rev. App. Entomol.*, 1926, **14A**, 266 (from *J. Econ. Entomol.*, 1926, **19**, 106-108).

The natural food plants of the Capsid, *Psallus seriatus*, which has recently been recorded as injuring cotton in Texas and other southern States, are various species of *Croton*, especially *C. texensis*. The adult is described and its distribution in the United States is discussed. —B.C.I.R.A.

Cotton Boll Shedding: Puerto Rico. R. A. Toro. *Rev. App. Mycol.*, 1926, **5**, 299 (from *Rev. Agric. Puerto Rico*, 1926, **16**, 17-18).

The abnormal fall of cotton bolls (up to 20%) in coastal districts of Puerto Rico has been traced to purely physiological causes and is interpreted as a means by which the plant adjusts itself to changes of weather. Should a period of heavy rains, with high temperature and vigorous transpiration, be followed by drought, the plant may find itself with insufficient nutrient to develop completely the flowers produced. Consequently a certain number of bolls are shed so that the rest may mature normally. Suggestions are given for securing conservation of soil moisture as a precaution against boll-dropping. —B.C.I.R.A.

Flax in North America; Browning Disease of——. A. W. Henry. *Rev. App. Mycol.*, 1926, **5**, 302 (from *Phytopathol.*, 1925, **15**, 807-808).

The browning disease of flax was first observed by the writer of Saskatoon, Saskatchewan (Canada) in 1920, and in 1923 it was reported to be capable of causing severe injury in the same locality. The fungus was found to remain viable on diseased leaves for over four years and attention is drawn to the danger of its transmission on infected seed. In August 1925 specimens of flax infected by *P. lini* were received from Michigan. Part of the seed from which this crop was grown came from Ontario. This is believed to be the first record of browning in the United States. The stem break phase of the disease has not been much in evideuce. —L.I.R.A.

"Pasmo" Disease of Flax. W. E. Brentzel. *Rev. App. Mycol.*, 1926, **5**, 365 (from *J. Agric. Res.*, 1926, **32**, 25-37).

The disease of flax and linseed caused by *Phlyctæna linicola* and known in South America under the name of "pasmo" is stated to have been probably introduced some the years ago into the United States with imported seed. During the past three years it has been observed on seed flax at various points in North and South Dakota, Minnesota, and Michigan. The symptoms of the disease and the various stages in the life history of the causal fungus are described in detail. In the author's opinion the disease should be easily controlled in farm practice by seed disinfection with formaldehyde, burning the infected straw, and crop rotation, since the fungus overwinters on the remains of the previous crop and viable spores were also found on the seed. —L.I.R.A.

Egyptian Cotton-894: Development. *Rev. Text.*, 1925, **23**, 1155 (from *Le Phare Egyptian*).

A new cotton has been developed by Parachimonas in Egypt which is said to possess all the good qualities of Sakellaridis without its inconveniences. This cotton is known at present only by the number 894. —B.C.I.R.A.

Improved Indian Cottons; Cultivation of——. *Review of Agricultural Operations in India*, 1924-1925; pub. 1926; pp. 11-23 and 62-63.

Progress in the introduction of improved varieties is reported from all cotton growing districts. Punjab American is now grown on practically a million acres in the Punjab and on 20,000 acres in Sind. Seed for 100,000 acres each of Kumpta and Dharwar American was issued; but in the Dharwar tract owing to the spread of wilt disease the substitution of Dharwar with immune Kumpta strains is under consideration. In the Central Provinces fungus isolated in a pure state from wilted cotton plants failed to infect healthy plants. It was also observed that wilted plants showed internally the same characteristics as mature plants do when they are reaching the end of their season's life. Trials of Dharwar-American cotton in Hill Tippera, Midnapur, Bankura, and Birbham districts of Bengal are said to have met with some success. —B.C.I.R.A.

Cotton Plant Diseases Occurrence in Sierra Leone. *Rev. App. Mycol.*, 1926, **5**, 345 (from *Ann. Rep. Lands and Forests Dept.*, *Sierra Leone* for 1924; 1926, 17-19).

Angular leaf spot and black arm of cotton were found on the imported Allen's Long Staple variety in several localities. —B.C.I.R.A.

Cotton Cultivation in Uganda. W. H. Himbury. *Text. Merc.*, 1926, **74**, 560-561.

The policy of erecting small ginneries every few miles has not, in the author's opinion, been an entire success. Government control of the cotton industry in Uganda is, for the present at least, necessary. In the Eastern Province, excepting Busoga, the yield per acre is not good and in the Buganda area where it is better it is still low. The low yield is attributed to improper cultivation, faulty selection of land, and general lack of instruction. The quality of Uganda cotton is good. It varies in staple from $1\frac{1}{8}$ to $1\frac{3}{16}$ in. The most fertile soils are in Buganda and the Busoga districts. Uganda has no serious insect pests. Bud, flower, and boll shedding owing to heavy rains and low temperatures is a serious trouble. The weather in Uganda is uncertain and in the Eastern Province severe hailstorms are prevalent. Labour is scarce, but there is, at present, considerable wastage of labour. —B.C.I.R.A.

Kapok. *Text. Rec.*, 1926, **44**, No. 521, pp. 45-46.

A survey of the production of Kapok within the British Empire with notes on its cultivation and uses. The chief producing and exporting country is Java. The hairs of Kapok are cylindrical, 0·6-1·2 in. in length, are very porous and light, have very thin cell walls and being impermeable to moisture are buoyant and therefore especially suitable for upholstery and the manufacture of life-saving appliances. Kapok hairs are weak and owing to their smooth slippery surface are not suitable for spinning. Kapok is obtained from pods of a tree which grows to a height of about 50 ft., but the hairs are attached to the inner wall of the capsule and not to the seeds as in the case of cotton. The pre-war price was 7-9d. per lb.; prime Java Kapok is now 1/3½ per lb. Machinery is employed for separating Kapok from the pods and the resulting fibre is usually graded into four classes—(1) Superior or extra, containing less than 0·5% of seed, (2) prime containing not more than 2% of seed, (3) fair average, with not more than 3·5% of seed, and (4) damaged Kapok. —A.J.H.

Hemp Fibres; Strength and Extensibility of——. W. Muller. *Leipziger. Monats. Text. Ind.*, 1926, **41**, 213-214.

An account is given of an examination of various kinds of fibre, the tensile strength, extension under load, &c., being measured. Specimens of hemp fibre from Russia, Italy, and Yugo-Slavia were found to give real differences in breaking strength, this being due partly to the differences in the material and partly to the methods of dressing. The extension also varied widely. The colour of the hemp was found to have no relation to its tensile properties and a microscopic examination showed that the fibre structure was the same in all specimens. —L.I.R.A.

Cell Membranes: Microscopy and Structure. J. König. *Biochem. Z.*, 1926, **179**, 261-276.

The paper is a summary of previous researches of the author and others on the structure of the cell membrane and the chemical composition of its constituents and decomposition products. Slides are reproduced in which cellulose, lignin, and cutin are clearly distinguishable, and a number of analyses are given. —B.C.I.R.A.

Lignocellulose: Stone Cells of the Pear. C. Dorée and E. C. Barton-Wright. *Biochem. J.*, 1926, **20**, 502-506.

The stone cells of the pear are lignified cellulose resembling in composition the forest woods rather than the annual lignocelluloses such as jute. They consist of 80% lignocellulose which contains 60% cellulose and 20% lignin. The cellulose contains 73% α-cellulose and 27% β-cellulose. —L.I.R.A.

Cell Membranes: Dye Penetration. H. Fischer. *Ber. Deut. Bot. Ges.*, 1926, **44**, 208-212.

Starch flour was placed in Congo Red solution and after periods of 36, 52, and 92 days was found to be paler in colour than the surrounding solution. Cellulose behaves quite differently; cotton wadding is deeply coloured and after 24 hours the colour is deeper than that of the solution. Congo Red penetrates sections of oak wood more slowly; after three days the colour is evident but pale, after 8 days it is, however, intense and deeper than that of the remaining solution which after several weeks is completely decolourised. Congo Red penetrates parchment paper which, according to the micellar hypothesis, has very narrow "interstices," comparatively readily. The penetration of water-soluble Aniline Blue into potato starch grains and sections of oak wood is similar to that of Congo Red. Thin sections of cork cell walls are coloured by water-soluble dyes (Gentian) in ½ min., deeper in 1 min., but the penetration into cork layers 1 to 2 mm. in thickness is very slow, after the first surface penetration. That a number of liquids with wetting powers for dry surfaces at least as high as that of water cause wetting but no swelling in starch grains, cell walls, &c., is urged as an objection to the micellar theory. Some deductions are drawn regarding the factors determining the diffusion of liquids into colloidal membranes. —B.C.I.R.A.

Cellulose: Estimation. See Section 6.

(D)—Artificial

Viscose: Ripening. R. O. Herzog. *Papier-Fabr.* (Fest-u. Ausland-Heft), 1926, 94-97.

In order to determine the relation between the rates of the separate processes taking place in viscose ripening, formulæ for these were devised. The indication is that the ripening process is probably one of slow coagulation and that the secondary particles are rod-shaped (series of micellæ). —B.C.I.R.A.

Cellulose: Diffusion Experiments with Solutions of, in Copper Ammonia Solution. R. O. Herzog and D. Krüger. *Kolloid-Z.*, 1926, **39**, 250-252.

Diffusion experiments have been conducted with solutions of cellulose in Schweitzer's reagent, varying the concentration of copper, ammonia, and cellulose, and more particularly using cellulose from various sources. The rates of diffusion of cellulose show that the original cellulose crystallites, whose size depends on the nature and history of the material used, are always degraded to particles of the same size in these solutions. Viscosity determinations indicate the same dispersion. —L.I.R.A.

Cellulose: Constitution. J. C. Irvine and G. J. Robertson. *J. Chem. Soc.*, 1926, 1488-1501.

By acetolytic degradation of cellulose, deacetylation and subsequent methylation, the authors reached the conclusion that cellulose can be degraded to a mixture of acetates derived from the following compounds in the proportions stated—Dextrins 6%, anhydro-triglucose 35%, tri-glucose 15%, di-glucose 20%. Although the evidence is not conclusive, it appears probable that at least one-third of the cellulose aggregate is based on the tri-glucose unit. —B.C.I.R.A.

Alkali-soluble Cellulose: Preparation. T. Lieser. *Cellulosechem.*, 1926, **7**, 85-88.

In an investigation of β-cellulose, it was found that washed cellulose on treatment at 0° with super-saturated hydrochloric acid is converted as it were quantitatively into alkali-soluble cellulose without a simultaneously occurring rise in the reducing power as measured by the Schwalbe copper number. The nature of the cellulose degradation is not yet known, but it is not a case of hydrolysis. The ability of the cellulose degradation product to dissolve in caustic soda solution (8%) probably depends on the formation of an additive compound with sodium hydroxide. —B.C.I.R.A.

Fine Filament Viscose Silk: Manufacture. *Leipziger Monats. Text.-Ind.*, 1926, **41**, 188-190.

Patents for the manufacture of fine filament viscose silk are surveyed and reference is made to a process of the Spinnfaser-A.G., by which the fine material is produced under the conditions ordinarily used for viscose. The material has a remarkably soft feel and is very pliable. It is much more like real silk than is ordinary viscose. It is particularly applicable to the manufacture of washing silks. —B.C.I.R.A.

Artificial Silk: Identification. P. Krais. *Leipziger Monats. Text.-Ind.*, 1926, **41**, 187-188.

A comparison has been made of Rhodes' method, Götze's method, and the method recommednded by the Cassella Co. in which the material is dyed with Naphthylamine Black 4B in a hot, neutral bath. The tests were made on the following artificial silks—Viscose 7-8 den., visccose 4 den., viscose from linters 7-8 den., cuprammonium silk 12 den., nitro silk, acetate silk. The differences shown by Rhodes' method were more decisive than by Götze's method and the Cassella method was at least equal to Rhodes' and more definite than Götze's method. It is suggested that in Götze's method it would be better not to boil, but only to warm the test mixture. —B.C.I.R.A.

Artificial Silks; Some Characteristic Properties of the—— E. Clayton. *J. Soc. Dyers and Col.*, 1925, **41**, 375-376.

Means for distinguishing between the various varieties of artificial silk are described. —L.I.R.A.

Constitution and Swelling of Cellulose. See Section Ic.

Cellulose Dispersion. See Section Ic.

Cellulose: X-ray Structure. See Section Ic.

α-Cellulose: Estimation. See Section 6.

Patents

Viscose Distributing Motion. E. Robinson. F.P.596,314.

This motion comprises two gear wheels mounted in a frame and gearing one with the other. The viscose is introduced under pressure in the gearing of one of the wheels, carried away with it along a definite course, and lastly directed to the spinning nozzle by the action of the other wheel.

This latter is mounted on a movable support so that the two wheels can be brought nearer. The movable support is under the action of a spring. —Bur. Text.

Spinning of Artificial Silk. O. Leuks and E. Hubert. U.S.P.1,558,375 (from *Text. Colorist*, 1926, **48**, No. 565, p. 58).

The apparatus for spinning cellulose acetate fibre is freed from air by boiling and subsequent immersion under water or other precipitating liquid. —F.G.P.

Process of Manufacturing Artificial Silk Threads from Viscose. I. Lams. U.S.P. 1,558,265 (from *Text. Colorist*, 1926, **48**, No. 565, p. 58).

The coagulating medium is an aqueous solution of 13-15% ammonium formate and 13-18% sodium formate. The threads are then converted into cellulose hydrate. —F.G.P.

Process of Manufacturing Artificial Silk and Other Products from Nitrocellulose. E. Bindschedler. U.S.P.1,562,076. Lansdowne, Pa.

Nitrocellulose hydrate is dissolved in alcohol and ether and extruded from an orifice. The thread is passed through a coagulating bath of 40-75 parts ethyl alcohol and 25-60 parts glycerine at a speed greater than its exudation. —F.G.P.

Cellulose Ester and Ether Solutions: Preparation. I.G. Farbenindustrie A.G. E.P.245,469. Frankfurt-on-Main.

Di-*n*-butyl phthalate is proposed as a solvent or gelatinising agent for nitrocellulose and other cellulose derivatives. The solution may be used in the production of films, plastics, varnishes, &c. —B.C.I.R.A.

Macarthy Gin Rollers. C. W. Russell, Fort, Bombay, India. E.P.251,674, 251,812, and 251,813.

Ginning rollers for a Macarthy gin are formed from a mixture of coir or like fibre and paper or wood pulp moulded by hydraulic pressure into the form of a roller which can be mounted on a square spindle. The roller, when dry, is trued on a lathe. The mixture may be moulded as a sleeve to be secured to a wooden roller. Alternatively, the rollers are formed by placing strips or fillets of the mixture in longitudinal grooves in a wooden roller; the mixture is compressed between rollers and formed into the strips which are secured in the grooves by cement, &c., or wedges. Thirdly, the rollers are formed by winding spirally on a wooden roller strips of material formed by embedding a woven band of cotton in a mixture of coir fibre and paper pulp. The woven band is covered with the mixture and passed through calender rollers. —B.C.I.R.A.

Artificial Silk Filaments: Spinning. L. A. Levy, London. E.P.251,680.

In a process of semi-dry spinning of artificial filaments, the filaments are extruded into a closed or nearly closed chamber through which is circulated air which may be heated. After leaving the chamber, the solvent remaining in the filaments is removed by passage through a setting-bath which may be heated. —B.C.I.R.A.

Insoluble Cellulose Ethers; Preparation of——. I.G. Farbenindustrie A.-G., Frankfurt-on-Main. E.P252,176.

Alkyl ethers of cellulose which do not swell in water or are soluble therein with difficulty, are prepared from water soluble ethers by mixing with an aqueous solution of the latter a substance which is soluble in the colloidal state in the solution. Suitable substances are water insoluble ethyl-cellulose, bakelite, latex, linseed oil, and benzyl alcohol. The solutions obtained may be used in the manufacture of artificial threads, films, and plastics. —B.C.I.R.A.

Cellulose-xanthic Acid Esters: Preparation. L. Lilienfeld, Vienna. E.P.252,654.

Esters of cellulose-xanthic acids are prepared by acting on a cellulose-xanthic acid or a cellulose xanthate with an ester of an inorganic acid under faintly alkaline or neutral or acid conditions. The parent material may be crude or purified viscose, or even the product of the reaction between carbon disulphide and alkali-cellulose; the purification may consist in precipitation with a salt solution or with alcohol or by carbon dioxide, or in treatment with sulphurous acid or a bisulphite. The reaction occurs without extraneous supply of heat, but it may be initiated or accelerated by heating. The products tend to separate as jellies, except in cases where the reaction mixture is dilute when they appear as fine or coarse precipitates. The products which are suitably washed are soluble in dilute alkali and in many organic solvents such as an aqueous solution of pyridine, and the solutions may be worked up into films, artificial silk filaments, and the like. In examples, a crude viscose diluted with water and rendered faintly alkaline, neutral or acid with acetic acid, is treated with diethyl or dimethyl sulphate, ethyl or methyl iodide, and ethyl bromide. —B.C.I.R.A.

Artificial Silk Spinning Nozzles. C. L. Walker, Aberdeen. E.P.253,209.

Nozzles for use in spinning artificial filaments consist of a capillary tube of noble metal, preferably of platinum or of iridio-platinum, formed by dissolving by chemical or electrochemical means a core of relatively soluble metal. Directions are given for preparing the capillary tubes. The core may have a section other than circular, when the shape of the core is retained in the finished tube. The cylinder from which the wire is drawn may be provided with a plurality of cores so as to form a multiple nozzle and the wire may be twisted to produce helical passages through which the solution to be spun is extruded. The lengths of capillary tube may be secured by cement in apertures in porcelain or iron nozzle plates. Alternatively, the nozzle may be formed by inserting plugs of noble metal into the apertures in plates of porcelain, molybdenum, &c., the plugs being secured by pressure and finally drilled to form capillary passages. A simple single-jet nozzle is made by sealing a length of capillary tube of noble metal into the end of a glass tube by a method indicated or into a porcelain or metal tube. A nozzle having a plurality of fine passages may be placed in front of the actual spinning nozzle so that solid matter suspended in the spinning solution will be prevented from reaching and choking up the actual spinning nozzle. According to one of the Provisional Specifications the capillary tubes may be formed by heavily plating with platinum, &c., wire of soluble metal which eventually constitutes the core to be dissolved away. —B.C.I.R.A.

Hollow Viscose Filaments. British Enka Artificial Silk Co. Ltd., London. E.P. 253,477.

Hollow artificial textile filaments are prepared by employing a thin fluid viscose and by avoiding the usual precautions for preventing retention of gases in the fibre during the coagulation process, that is, by omitting the degassification of the viscose solution and by employing a bath that coagulates the viscose rapidly. It is preferred to add a small quantity of a zinc salt to the coagulation bath. The thin fluid viscose may be one that contains less than 8% of cellulose or one that is prepared from a strongly bleached cellulose, or from a soda cellulose mercerised in the presence of an oxidising agent, or which has been subjected to an extended ripening process. To the viscose solution may be added pulverised solid material such as pumice powder, which promotes the separation of gas bubbles. —B.C.I.R.A.

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

Production of Artificial Fibres

252,033. J. Brandwood and Twyver Works, Ltd. Spring device for spinning box.

252,328. I.G. Farbenindustrie A.-G. Modification of E.P.245,469. (*See above*).

252,344. R. Pictet and F. Tharaldsen. Preparation of wood cellulose.

2—CONVERSION OF FIBRES INTO FINISHED YARNS

(A)—Preparatory Processes

Bast Fibres: Cottonisation. M. Halama. *Faserforschung*, 1926, **5**, 179-186.

A general discussion dealing with the purpose of cottonisation, chemical disintegration processes, the spinning of cottonised material and raw materials suitable for cottonisation. —B.C.I.R.A.

Flax for Seed and Fibre. M. L. Griffin. *Chem. Abs.*, 1926, **20**, 2069 (from *Pulp Paper Mag. Canada*, 1926, **24**, 299-301).

The author recommends devising simple apparatus for the conversion of the straw into a clean and reasonably uniform tow which can be transported readily. At the pulping plant it would be cut up, shredded, and dusted, then passed continuously through a kiln drier at relatively low temperature to embrittle the woody, pithy, and bark tissues, and thence directly, before the stock could regain its normal water, into a special attrition mill where the brittle woody shive would be refined and dislodged, and thence into another screen, specially designed to separate again all dislodged refuse. At this stage the product will be more or less balled or wadded and should be run over a scutching or carding machine to form it into a crude sliver according to textile processing. If it can be formed into a loose rope by some twisting of several of the sliver strands, the stock is treated as in the textile industry; if not, the treatment becomes a rag stock process for paper. —L.I.R.A.

Opening, Picking, Carding, and Drawing. Southern Textile Association, Carding Division. *Cotton* (U.S.A.), 1926, **90**, 620-628.

Answers to questionnaires on these processes are reported which form a record of mill practice in the Southern States of America. —B.C.I.R.A.

Use of Snia-fil. *Silk J.*, 1926, **2**, No. 21, p. 62.

This form of artificial fibre is carded, combed, and spun in ways said to be identical to those employed for wool. The makers advise twisters to use the following oiling mixture for the sliver going through the comber—Rape oil 30%, arachis oil 50%, petroleum 20%, in the proportion of 1½% of the top. —F.G.P.

Card Clothing: Supply. *Leipziger Monats. Text.-Ind.*, 1926, **41**, 168.

A plea is made for the support of the German machine making industry as against purchase from England and other countries. German-made card clothing is said to be as good, and in some instances better than the English product whilst the cost, when freight and taxes are included in the cost of the imported product, is not greater. The

author recommends that spinners should purchase their cards without card clothing and acquire the clothing from their usual German makers, or stipulate to the card maker the German firm from which the card clothing is to be obtained.
—B.C.I.R.A.

Card Flats: Deflection. E. Baltz. *Leipziger Monats. Text.-Ind.*, 1926, **41**, 180-182.

A mathematical consideration of the deflection of the flats in revolving flat cards has shown that, though hollow flats are about 15% better than solid flats as regards actual deflection, when other factors are taken into account solid flats are preferable. Ingot iron is slightly superior to Duralumin and the latter is further at a disadvantage on account of its price. The deflection of ingot iron flats is about one-half that of cast-iron flats where the flats have the normal ⊥-shaped profile.
—B.C.I.R.A.

Sliver Combing Device. F. Kirschleger. *Rev. Text.*, 1925, **23**, 1003.

A small bronze ring, screw-threaded on the inside, has eight steel needles set obliquely into it, their free ends converging and approaching each other more or less nearly according to the quality of the cotton, the number of the passage through the device and the roving number, e.g., they may be spaced 3 mm. apart at the first passage through the card and 1 mm only at the last passage through the drawing frames. The device is equally easily fixed to the sliver trumpet or the coiler head of the sliver can. It is still more easily fixed to the drawing frame, the points being brought as closely as possible to the drawing rollers without touching them. The device exerts a combing and straightening action on the fibres. Sliver which has passed through it is said to be rounder, more uniform, silkier, better condensed, free from fly and, due to compression, occupies only one-half the volume of the untreated sliver so that a sliver can contains about 30% more cotton. The strength of the finished yarn is said to be increased by more than 10% and its coefficient of regularity may be increased by as much as one-half.
—B.C.I.R.A.

Unshrinkable Processes for Wool. E. R. Trotman. *Text. Mfr.*, 1926, **52**, 310.

Wool immersed in an aqueous of chlorine is capable of absorbing 30% of its weight of the gas, the wool being thereby changed to a yellow translucent gelatinous substance while hydrochloric acid is simultaneously formed. Unshrinkable wool produced by mild chlorination will wear satisfactorily, provided that not more then 20% of the fibres have been damaged (during chlorination) by removal of the epithelial scales. After chlorination wool is the more likely to be damaged by bleaching with hydrogen peroxide. —A.J.H.

Carding Engine: Control. R. Belshaw. *Text. Rec.*, 1926, **44**, No. 518, pp. 77-80.

The mechanism of the carding engine and its control is discussed from the author's own experience. —B.C.I.R.A.

Combs: Modern Flax and their Setting. C. R. Carter. *Text. Rec.*, 1926, **44**, No. 519, pp. 54-55.

New models of flax combing machines are described and detailed instructions for starting and setting given. The Gruen Comb 1924 Model is stated to have a higher working speed than older models, its output varying from 15½ lb. to 26½ lb. per hour. The P.A.E. Tow Combing Machine made by N. Schlumberger & Co., deals with flax tow up to 13¾ in. long. The production varies from 13 lb. to 17½ lb. per hour.
—L.I.R.A.

Flax Retting: New Methods and their Influence of the Wool Industries. *Text. Rec.*, 1926, **44**, No. 521, p. 53.

A new process for decorticating flax, ramie, and similar fibres within 2 hours is reported (but not described) which it is claimed will put these fibres in competition with artificial silk and cotton. It is predicted that the effect of this process, whereby linen fibres will be cheapened, will be felt less by the woollen than by the cotton industry. —A.J.H.

Blending Wools for Top-making. *Text. Rec.*, 1926, **44**, No. 522, p. 51.

A discussion on blending wool for "tops."
—A.J.H.

Merino Wool Classing. P. D. Rose. *Text. Rec.*, 1926, **44**, No. 522, pp. 52-53.

A description of methods for grading South African merino wools. —A.J.H.

Removal of Incrustations from Flax Fibre. See Section 6.

(B)—Spinning and Doubling

Textile Machinery Mechanisms. W. A. Hanton. *Engineering*, 1926, **121**, 642-644 and 707-709.

In an article dealing with some mechanisms of textile machinery the writer describes spinning frame motions, mule carriage motions, the Souczek shuttle mechanism, and the four-colour automatic weft changing motions of the Northrop and Ruti looms. —B.C.I.R.A.

Twist Yarns in Rayon Weaving. "Tindairns." *Silk J.*, 1926, **2**, No. 21, p. 44.

Twist yarns are used for ornamenting fabrics either of all rayon or mixtures of rayon with wool and worsted. A very full description of a machine suitable for the purpose is given, and it is stated that experimental work has been done upon it.
—F.G.P.

Cotton Yarns: Twist. *Textielind.*, 1923, **4**, 365-370.

The question of the amount of twist required in warp and weft yarns is discussed in relation to staple length and a table is given showing twists used for cotton warps and wefts of different classes and counts. The way in which lustre or shadow effects in woven fabrics may be obtained by combining warp and weft yarns differing from one another in their direction of twist is described. —B.C.I.R.A.

High Draft Mechanism: Installation. "P.L." *Rev. Text.*, 1925, **23**, 1133.

Some general advice on the installation of high draft mechanism is given. For short staple cotton a system having a running leather band is preferred and for long cottons a system having a light roller pressure at the second line of rollers. —B.C.I.R.A.

Folded Yarns: Counts Calculations. *Text. Rec.*, 1926, **44**, No. 518, pp. 52-53.

Some examples of counts calculations for folded yarns are considered. —B.C.I.R.A.

(C)—Subsequent Processes

Quick Traverse Cheese Winder. Langenthal Machine Works, Ltd. *Text. Rec.*, 1926, **44**, No. 518, p. 93.

The machine described was designed to obviate the defects of split drum winders. It consists mainly of a drum on both extremities and along the entire circumference of which runs a groove which is a few millimetres deep. On the inner edges corners are milled the height of which corresponds to the cut-away part. On the traverse rod of the thread guide, which is operated by a heart-shaped cam, is a thread guide which catches the yarn automatically so that no threading is necessary. As the thread guide is not responsible for the order of the yarn on the cheese, the point of the cam is rounded off. This arrangement does away with the jerky motion of the thread guide and its to and fro motion is a gentle one. As the drum revolves, the thread guide travels to and fro in front of it and the yarn is laid in a loose form on the drum. It is then caught by the corners on the drum and put into the position in which the cheese receives it from the drum. The machine can easily be adapted to serve as a yarn-gassing machine. —B.C.I.R.A.

Stretch in Rayon Yarns: Winding Precautions. *Silk J.*, 1926, **2**, No. 20, p. 63.

The effect of moisture on rayon is to cause it to stretch more readily and the elongation is to a great extent permanent, therefore every effort must be made to keep the humidity constant during winding and weaving for unequally stretched rayon will cause many defects in the finished cloth, including uneven dyeing. —F.G.P.

(D)—Yarns and Cords

Novelty Yarns. *Text. Rec.*, 1926, **44**, No. 518, pp. 47-48.

Brief notes are made on the appearance and method of production of the following fancy yarns—Coloured twists, marl yarns, spirals, corkscrews and ondes, gimp yarns, loop yarns, three-colour spiral yarns, knop yarns, alternate knops, flake knops, spot knops, cloud yarns, slub or variable spun yarn, intermittent chain yarn. —B.C.I.R.A.

Patents

Spinning Frame Stop Motion. E. Giro-Prat, Barcelona, Spain. E.P.251,789.

A spring thread guide is fixed to an eccentric flexibly connected to a lever, arms on which are arranged to lift the spool from the driving drum when the thread tension is excessive. —B.C.I.R.A.

Yarn Clearing Device. Eclipse Textile Devices Inc., Elmira, N.Y., U.S.A. E.P.251,799.

In any device for performing on a travelling yarn any operation necessary to prepare it for use in weaving, knitting or sewing, the position of the operative element is automatically adjusted in accordance with the thickness of the yarn by a controlling member gently urged against the thickness of the yarn. The mechanism is described in connection with a slub-catching device for winding machines. —B.C.I.R.A.

Opening Machine Feed Device. J. J. Marx Kommandit Ges., Pfalz, Germany. E.P. 251,936.

In an arrangement for feeding large quantities of fibrous materials to openers, carding machines, &c., the material is drawn from a hopper by a double conveyer device comprising a series of toothed parallel members alternating with a series of plain supporting members. The teeth project beyond the supporting surface on the upward slope and are withdrawn gradually on the horizontal portion, so that the material has a free drop, at the delivery point, from the conveyer to the feed apron of the opener, &c. The rate of the feed is regulated by adjusting the speed of the conveyers. —B.C.I.R.A.

Cap-Frame Spindle Apparatus. L. A. Levy, Cricklewood, London. E.P.252,471.

A slotted cap for use in spinning artificial silk in cap frames is provided with a conical base, and an opposed cone beneath is arranged coaxially therewith so that a space of about an eighth of an inch is left for the passage of the filaments which contact only with the lower edge of the cap. Slots are provided in the lower cone to permit the passage of the driving belt as the bobbin is raised and lowered. —B.C.I.R.A.

Card Cylinder Reversing Gear. R. Benson, Oldham. E.P.252,503.

A reversing gear for the main cylinder of a carding engine to enable it to be driven for grinding is described. —B.C.I.R.A.

Roller Drafting Heads. S. Whitley & Co. and W. B. Walton, Halifax. E.P.252,857.

Self-weighted top rollers for ring spinning and other machines are connected together by a non-rigid coupling such as a cord, wire, chain, cable, links, &c., or are similarly connected to a weighted central boss carried in a saddle and neb arranged so that no weight is transmitted to the rollers. When the front top roller comprises loose bosses on stationary spindles, the saddle may be attached to the spindle by soldering or by setscrews. The rollers are held in place by a spring so that the saddles may be turned over to facilitate the cleaning of the rollers. —B.C.I.R.A.

Spinning Machine Cleaning Apparatus. Firth-Smith Co., Boston, U.S.A. E.P. 253,121.

A blower is traversed along a track over spinning or like machines so as to direct a stream of air on to each machine successively and to force loose fibres, lint, and dirt towards the floor, the pressure of the air being sufficient to prevent their cohesion and accumulation. An electromotor mounted on a spider and fed by means of trolleys from conductors, drives a fan in a casing, and a sheave which engages the track. The orifice of the casing is substantially the same width as the machines and in order that it may clear obstructions such as driving belts, suitable guides are provided which engage a stud or roller on the upper rim of the casing and turn it through the required angle, springs, secured to the casing and to the spider, serving to return the casing to its normal position which is determined by spring-operated ratchet rollers. —B.C.I.R.A.

Spinning Spindle: Oil-retaining Device. T. A., H. A., J., and J. & T. Boyd, Ltd., Glasgow. E.P.253,352.

In spinning, twisting, and like frames in which the spindles are wholly or partly inverted for the purpose of doffing, the space between the internal bearing tube and the socket is of such capacity as to receive all the oil from the socket when the carrier is rotated to invert the spindle, and an inverted cup is mounted on the spindle to receive any oil that may flow down the spindle. A spring catch is provided to keep the spindle in position when it is inverted. An oil cup is screwed on the end of the socket and lubricating holes are formed in the tube above the footstep. The cup may be used on spindles not provided with the described space between the spindle socket and the tube. The flyer legs engage and drive the spindle by a cross member on the spindle.

—B.C.I.R A.

Artificial Silk Mixture Yarns. J. A. Grand, Villeurbaune, Rhone. E.P.253,547.

Threads are produced by the use of artificial silk cut to suitable length and mixed prior to spinning with hemp, flax, jute, nettle, or like vegetable fibres, which have been previously freed from gum and rendered silky in appearance by mercerising.

—B.C.I.R.A.

Winding Machines: Driving Mechanism. G. Kershaw, Rochdale. E.P.253,563.

In machines for winding yarn or thread from a beam, warp, &c., on to a spindle, tube, &c., the delivery rollers are driven through a ratchet and pawl or other mechanism so that they may overrun if the rate at which yarn is being wound increases. To obviate too rapid delivery of yarn when the mechanism is started, the drive is transmitted through a spring coupling or through a friction clutch in which a sprocket drives the rollers through a disc held frictionally against the sprocket by a spring. When the tension rollers are overrunning a disc of flannel, &c., carried by a disc on the driven shaft provides frictional resistance and so acts as a brake.

—B.C.I.R.A.

Spinning Machine Knee Brake. A. Lees and Co. Ltd., and J. W. Clegg, Oldham. E.P.253,842.

A knee brake for spinning and like machines comprises a head to which arms for attaching the brake to the machine are secured, and having a wide, shallow grove in which a braking strip of leather or like material is detachably held by a bolt. The base of the groove projects towards the arms, whereby a large area of the head is in contact with the leather. The arms may be of riveted steel rod. —B.C.I.R.A.

Artificial Silk Strengthening. L. Lilienfeld, Vienna. E.P.253,853 and 253,854.

The strength of artificial textile materials such as viscose, cuprammonium, and denitrated nitro-silks is improved by treatment with a solution of caustic alkali of not more than 5% and preferably of less than 1% concentration, it being necessary that the material should be maintained in a stretched condition during at least a part of the process. Strength may similarly be improved by treatment with a solution of a cellulose thiourethane in which at least one hydrogen atom of the amino group is replaced by an alcohol radical. The material may be treated in the form of threads, skeins, cops, &c., or as woven materials consisting of artificial textile material alone or mixed with cotton, wool, silk, &c. The solutions may be applied by passing the material through, by spraying, by contact with moistened rollers, or by other methods. The alkali-treated material may be finally steamed or heated. The material treated with cellulose thiourethane solution may be passed through one or more pairs of rollers, or otherwise pressed to distribute the solution uniformly. The impregnated material is afterwards treated with a precipitating agent or is dried, preferably at a raised temperature, the method selected depending on the character of the solvent employed in making the original solution. Alternatively, a combination of these methods may be employed. The material may be stretched during the impregnation process or afterwards, for instance, during the drying at a raised temperature. To render the treated material highly flexible it may be treated with the vapours of a solvent for the thiourethane or of an agent that imparts plasticity such as the vapours of aqueous pyridine. —B.C.I.R.A.

Spinning Frame Roller Head. E. Kübler, Neunkirchen - on - Sudbahn, Lower Austria. E.P.253,901.

In drawing apparatus for spinning machines of the kind in which the middle lower roller is provided with two pressing rollers, these rollers are arranged so that the lines joining their centres to the centre of the middle lower roller make equal angles with the vertical and so that the tangents at the nips of the front rollers and of the front pressing roller coincide or practically coincide. The back pressing roller is of the same size as the middle roller of an ordinary frame and is comparatively heavy and may be additionally weighted. The arrangement ensures a delimitation of the draft between the back and middle rollers, and between the middle and front rollers. The back pressure roller is vertically above the back roller. The front pressing roller is mounted between cheeks of a sheet-iron claw adjustably secured by a screw.

—B.C.I.R.A.

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

Preparatory Processes

251,885. A. Lees & Co. and J. W. Clegg. Cap bar for slubbing, intermediate, and roving frames.

253,722. E. Barton. Silk-dressing machine.

253,827. W. Layland. Automatic raising device for feed knife of Noble comb.

253,912. Soc. Alsacienne de Constructions Mecaniques. Gill-bar device.

Spinning

252,423. A. & J. Stell and H. Welch. Bobbin support for flyer frame.

252,877, 252,878. R. L. Sutcliffe. Devices for enclosing central-core yarn with outer binding thread, &c.

253,383. T. Gibson. Automatic spindle braking device.

253,422. H. W. Knoll. Fastening for spindle bands.

253,793. J. H. Rothery. Cap spindle bearing device.

Subsequent Processes

252,596. H. Meynell. Clearer or Slub-catching device.

3—CONVERSION OF YARNS INTO FABRICS

(A)—Preparatory Processes

Warping Machine Wave Motion. *Text. Rec.*, 1926, **44**, No. 518, 91.

A patent wave motion for attachment to horizontal warping machines for warping worsted and cotton in the manufacture of fancy worsteds containing cotton stripes is described. The device overcomes difficulties due to the elastic nature of the worsted and the inelastic nature of the cotton. The striping ends are under positive control and are delivered on to the swift of the warping mill in such a manner as to ensure constant and calculated over-length which, by adjusting the contrivance, can be repeated or altered as desired.

—B.C.I.R.A.

(B)—Sizing

Sized Warp: Extension in Sizing. W. J. R. *Cotton* (U.S.A.), 1926, **90**, 682.

In experiments to determine the amount of stretch occurring in the slasher, a wheel counter was mounted on the back of the slasher to measure the incoming yarn and the number of yards delivered was determined by the cut marks. From the direct gain in length it would appear that the yarn was stretched a little over 2%, but the length of yarn unwound at the slasher was less than the length when it left the warpers and the length delivered from the front of the slasher was about the same as that delivered at the warpers so that, actually the yarn contracts at the slasher and is then stretched back to its original length.

—B.C.I.R.A.

Maize Starch Derivatives: Application. W. R. Cathcart. *Amer. Dyestuff Rep.* (Proc. Amer. Assoc. Text. Chemists and Colourists), 1923, **12**, 21-24.

An outline is given of the process of manufacture and textile uses of maize starch, modified maize starches, dextrins, gums, maize syrup, and maize sugar.

—B.C.I.R.A.

The Sizing of Rayon. *Silk J.*, 1926, **2**, No. 20, p. 43.

Rayon warp yarn having, usually, only a small twist, the filaments are easily separated and damaged by friction through the healds. Greater twist has been tried without much success. Waxing is frequently adopted and gives satisfactory results. When the yarn is being wound it may be wetted with a solution of paraffin wax or passed between two wax discs. In hand weaving of silk it was customary to spray the warp with a weak glue solution and dry it by waving a paper fan. Bobbin to bobbin sizing has replaced warp-sizing for rayon. The yarn is wound from its original bobbins over a sizing roller on to metal bobbins with a hollow perforated barrel to allow of drying. A sizing mixture is 3½ lb. flexible starch, 1½ lb. corn starch mixed with 3 gals. water, poured into 15 gals. water, boiled with stirring for 20 mins. and cooled to 90° F., which is maintained during work (3% of glycerine renders starch flexible). For hard spun yarns—11 gals. water, 5 lb. gelatine, 3 oz. glycerine, boiled for 20 mins. For hank sizing—30 lb. gelatine boiled for 20 mins. in 66 gals. water. Steep the hanks, when tepid, for 15-20 mins. and whizz. After shaking out they are hung in the stove where the hot air is admitted at the bottom. —F.G.P.

Size: Temperature and Weaving Efficiency. P. Bouju. *Rev. Text.*, 1925, **23**, 1051-1057 (from *Bull. Soc. Ind. Rouen*).

Three warps were identically prepared from the same lot of yarn and sized on the same machine with the same size but at three different temperatures. The warps were woven on adjacent looms under identical conditions and the number of breakages and the cause of each breakage was ascertained. In the first test the warps were sized at 77, 91, and 97° C., and in a second test at 79°, 98°, and 100°. A definite relation was found between sizing temperature and the number of breakages in weaving. Within the experimental limits (75-100°) the number of breakages was less as the temperature was lower. The influence of temperature was greater the finer and closer the warp and with dense warps the number of breakages increased very rapidly as the boiling point was approached, passing from 2·181 breaks per yd. at 98° to 3·000 breaks per yd. at 100°. With coarse and open warps the number of breaks did not increase much above 90° and the temperature must be about 75° to obtain any notable improvement in weaving output. In the first set of experiments sizing at 77° instead of 97° reduced the number of breakages by about one-quarter, corresponding to an increased weaving output of 2·5%. In the second set, the number of breaks at 79° was slightly more than half the number at 100°, corresponding to an increased loom output of 5%. The results are explained theoretically. —B.C.I.R.A.

Gum Tragasol: Application. R. Lebailly. *Rev. Text.*, 1924, **22**, 47-51.

An article describing the use of Gum Tragasol (Star gum) as a sizing agent. The sizing properties are discussed in detail and a description is given of the chemical properties of the gum, the method of preparing the sizing solution and its applications. It is claimed that Gum Tragasol is superior in sizing properties to other adhesives; that, being more concentrated, it is as cheap; that it allows of rapid drying; that greater strength is conferred on the threads by gum tragacanth size than by other sizes and that penetration is much more regular. Advantages are claimed for gum tragacanth, in hank sizing particularly, in the direction of obtaining regular unwinding. Results of tests carried out in the sizing machine indicate the advantages obtainable on account of the greater penetrative power of gum tragacanth as compared with other sizes. —B.C.I.R.A.

Gum Tragacanth. G. E. Van Tromp, Govier. *J. Soc. Dyers and Col.*, 1925, **41**, 370-371.

The author describes the origin, method of collection, varieties, and characteristics of gum tragacanth. Analytical results obtained with four samples of the gum are given. —L.I.R.A.

Rayon Slasher Machine. *Text. Colorist.*, 1926, **48**, 554-555.

A machine suitable for sizing artificial silk warps without stretching or chafing the yarn is described. —A.J.H.

Starch Paste: Mechanical Liquefaction. See Section 6.

Starch: Constitution. See Section 6.

(C)—Weaving

New Shuttle Material. *Amer. Silk J.*, 1926, **45**, No. 1, p. 58.

A Dutch product called "Lignostone" is made of specially treated compressed wood. It is of such hardness and durability that there is no danger of chipping or splintering and is considered to be an ideal material for shuttles. —F.G.P.

Twilled Fabrics: Weaving. J. Funke. *Leipziger Monats. Text.-Ind.*, 1925, **40**, 57.

A method is described of weaving on a jacquard twills having high weft repeat numbers, but in which the number of cards employed is limited. For example, if two weaves with weft repeats of 9 and 11 dovetailed weft-wise are woven, the design will have a weft repeat of $9 \times 11 \times 2 = 198$. In the following way the number of cards is limited to the sum of the two weft end numbers employed, viz., $9 + 11 = 20$. The two selected designs being chosen, the cards are separately cut and linked, but after each card a completely perforated one is inserted. The two card chains are laid on one another on the cylinder with the result that a pattern card is always superimposed on a fully perforated one. Since the latter will not interfere with the action of the former the desired design is obtained. By reversing the card chain or chains it is possible to produce eight different weaves with weft repeat of 198, thus replacing 1,584 cards. Point paper diagrams are given for a number of weaves obtained by card chain reversal, employing in each case 7-end and 16-end stitched twill weaves. —B.C.I.R.A.

Fast Reed Loom: Change of Speed. P. Beckers. *Leipziger Monats. Text.-Ind.*, 1925, **40**, 154-155.

Adjustments in fast reed motions, particularly in the inclination of the stop rod nib, when the speed of the loom is increased are discussed. —B.C.I.R.A.

Shuttle Checking Motion. Grossenhainer Webstuhl und Maschinenfabrik A.G. *Leipziger Monats. Text.-Ind.*, 1925, **40**, 155-156.

An improved double-acting shuttle-checking motion for change box looms is described. It has two checking straps connected by a double lever. One strap is attached to the slay through a tension lever and roller and the other strap is attached to the setting pin by a revolvable link. —B.C.I.R.A

Terry Towelling Loom. *Rev. Text.*, 1924, **22**, 53-61.

A loom designed by the Ateliers Diedrichs for weaving terry towellings is described. There is an independent heald driving mechanism, fringe-drawing is automatic without stoppage of the loom, picking with four colours is possible by the employment of drop box motions, and the loom can function without vibration at speeds comparatively much higher than those employed previously. The firm's known improvements in slay design, shuttle mechanism, card reduction, &c., are embodied in the new terry loom, and the mechanisms characteristic of the loom, which are described in detail, are the reed motion, the device for loop elimination in the coloured weft stripes and in the weft threads which are put in at intervals to reinforce the fabric, the automatic fringe-drawing mechanism and the stopping of picking and weft fork motion at the moment of fringe-drawing. —B.C.I.R.A.

False Selvage Bobbin Creel. *Rev. Text.*, 1924, **22**, 67.

The article describes a device invented 25 years ago by Prof. Bon for feeding yarn in weaving the centre selvage in a double selvage cloth. The yarn is run off bobbins on free spindles carried in two pairs on two rotating discs, the thread passing outwards through holes in the discs. The discs carry a device for rewinding the spindles should any slackening of the threads occur. —B.C.I.R.A.

Warp Streaks in Silks. J. Chittick. *Text. Amer.*, 1926, **45**, No. 2, p. 47.

When business is good, it is said, there is little complaint about these faults, but when it is bad, goods are rejected on the flimsiest pretexts and often by buyers who have no knowledge of how much freedom from streaks they may rightly expect. The higher the quality of the silk the less the risk of streakiness, but there is considerable variation in the size of threads even in good qualities. Streaks are more visible in satin weaves than in plain with the same silk because the warp only appears on the face. Raw silk warps show them more than organzine, though irregular twisting and doubling will bring them out. Imperfect reeds will cause streaks and all running looms should be carefully watched for injuries produced by a carelessly handled reed-hook or bad cleaning. Section marks in the warp must be avoided; they may be caused by bent pins on the creel or worn bobbins, or by the threads mounting in a long warp and causing irregular tension. Mixing of silk into a warp in order to use up odd lots will produce streaks unless the utmost care is exercised. Irregular dyeing will also cause them. —F.G.P.

Weaving Artificial Silk. J. J. Sussmuth. *Text. Mfr.*, 1926, **52**, 316.

Practical details of weaving are discussed. —A.J.H.

Souczeck Shuttle Mechanism; Northrop and Ruti Weft-changing Motions. See "Textile Machinery Mechanisms" in Section 2B.

Twist Pattern Fabrics. See "Cotton Yarns: Twist" in Section 2B.

(D)—KNITTING

Knitting Oil-treated Rayon. W. Whittam. *Silk J.*, 1926, **2**, No. 20, p. 57.

To assist the easy passage of rayon in the knitting industry it has been found necessary to dress the yarn with an oil that will not evaporate during work to any appreciable extent. A neatsfoot oil solution is employed and the quantity left on the fibre ranges from 6·16% to 7·46%. After ten days exposure to air the loss was not more than 0·5%. —F.G.P.

Full-fashioned Gloves: Knitting. W. Davis. *Text. Rec.*, 1926, **44**, No. 518, 69.

The production of full-fashioned gloves on the hand frame or Cotton's patent frame is discussed. A full range of gauges and numerous attachments to give varied effects can be used with these frames whilst the glove made on the flat knitting machine is of the coarsest gauges only, the machine seldom exceeding seven needles per inch. —B.C.I.R.A.

"Super-auto-striper" Flat Knitting Machine: Patterning Mechanism. J. B. Lancashire. *Text. Rec.*, 1926, **44**, No. 518, 71.

A description is given of the "Super-auto-striper" patterning mechanism for flat knitting machines which has been designed to supersede the "Auto-striper." The device effects the individual control of the needles of one bed, the extra mechanism being readily fitted to existing machines of the simple type. —B.C.I.R.A.

(E)—Lacemaking and Embroidering

Imitation Embroidery. See Section 4J.

(F)—Subsequent Processes

Cloth-plaiting Machine. *Text. Mfr.*, 1926, **52**, 269-270.

The machine, which is of the usual convex-table type, is provided with an automatic compensating lag device which ensures that all folds of the fabric are plaited to the same length. —A.J.H.

History of the Prevention of Moth Damage to Textiles. A. P. Sachs. *Text. Colorist*, 1926, **48**, 526-530.

The description of the life history of moths, larvæ, and eggs commenced in the previous article, is now concluded and a summary of patented methods for protecting fabrics from damage by moths is given. The value of printer's ink as a protection against moth is doubted since ordinary newspaper (without printing) is as effective as printed newspaper. Many of the preventatives which have been used and suggested are active but are volatile, e.g., *p*-dichlorobenzene and naphthalene. Under suitable conditions four generations of moths may be successively produced in one year, that is 235,000 moths may be ultimately developed from one moth, these being capable of consuming 21·5 to 46·5 Kg. of wool. —A.J.H.

(G)—Fabrics

Jungle Modes in America. *Amer. Silk J.*, 1926, **45**, No. 1, p. 38.

Plush fabrics in imitation of leopard, tiger, and lion skins are being made in Germany and exported to the African natives for use as loin cloths, and it is suggested that American manufacturers might also manufacture these cloths profitably. —F.G.P.

Crêpe Meteors. J. Chittick. *Silk J.*, 1926, **2**, No. 20, p. 45.

This important crêpe fabric was brought out a few years ago by the great French designer, Bianchini; in appearance it has a smooth face with a good but subdued lustre and on close inspection shows a fine twill. The back is even less noticeably twilled. It has a beautiful feel, silky, pliable, and firm, with no sponginess. It is piece dyed and the weave is the simple three-harness twill, two up and one down. The warp is generally 20/22 den. raw silk of very high class. The weft should be as firm as possible with a minimum of crêping. It is usually 3- or 4-thread white raw silk of 13/15 den. with 40-50 turns per inch. A good Japan extra or best extra should be used. Half is thrown right and half left in alternate two picks. After weaving, very careful picking is necessary. Uniformity in tension during manufacture is essential. Printed meteors are very popular in America. —F.G.P.

Rayon and Worsted Dress Fabrics. *Silk J.*, 1926, **2**, No. 20, p. 49.

Details are given of a number of union fabrics which are finding a big market on the Continent and it is thought that English manufacturers are losing great opportunities for business in not putting out similar materials. Whipcords and gabardines in this mixture are said to be extremely popular. —F.G.P.

Synthetic Suits and Underwear. *Silk J.*, 1926, **2**, No. 20, p. 52.

Sniafil, the new artificial wool fibre, is of the same constituents as, but undergoes different treatment from viscose, being produced as a staple, in short lengths like wool and has no appreciable lustre. The advantage of having constant supplies of this sort of "wool" without the anxiety of keeping sheep is commented upon, and the added advantage of saving the heavy transport charges on wool is worthy of notice. It is said to be indistinguishable in handle and feel from wool and its hygienic properties to be the same, while its wearing and laundering qualities are equal to the natural fibre. Sniafil is to be made in England. —F.G.P.

Rayon Tops the Salvation of the Wool Trade. *Silk J.*, 1926, **2**, No. 21, p. 56.

Rayon is being welcomed in the wool trade, it is said, although its use by the operatives has been in the nature of a revolution. Rayon in the form of tops capable of being drawn, spun, and twisted with wool is an increasing industry. In spite of the many advantages of piece-dyed goods, it is stated that they are on the wane and that botany mixtures are coming into their own. Wool-cotton mixtures are liable to wear threadbare, but wool-rayons are not so disappointing and are of greater beauty. The simplest, plain hopsack and twill weaves are expected to offer ample scope for colour and weaves, without requiring expensive drafted or dobby designs. —F.G.P.

Fabrics of the Future. *Silk J.*, 1926, **2**, No. 21, p. 63.

It is said that rayon is now employed in 1,000 different fabrics. Novelty and low cost are to be the prime considerations. The production of textiles is stated to be below the world's requirements and artificial fibres are needed to fill the demand. Rayon gives colour and brightness, but as strength is an essential it must be mixed with natural fibres. —F.G.P.

New Artificial Silk Lining Industry. *Text. Argus*, 1926, No. 103, Sept. 1st, p. 4.

Viscose and cellulose acetate silks have become important fibres in the manufacture of lining fabrics since they allow the production of cheap, light but lustrous fabric suitable for use with ready-made garments. Artificial silks now enter largely into construction of Irene, Albert, Hilda, and Beatrice twills and the hitherto essential mohairs and alpacas have been replaced. —A.J.H.

Serviettes, Table Cloths, and Damasks: Weaving. *Textielind.*, 1924, **5**, 200-210.

Point paper diagrams are given for serviette, table cloth, and damask fabrics, &c., in which lustre effects are obtained by the use of satin weaves. For example, a 5-shaft satin weave in which a warp thread passes over four and under one weft thread, viewed on the right side of the material (or alternatively a weft thread passes over four and under one warp thread) gives a smooth, glossy surface and is a common weave for serviettes, &c. It is shown that lustre increases with shaft number but the maximum practicable number for the fabrics under consideration is 10 shafts. Increased lustre and shadow effects can be introduced by using combinations of warp and weft yarns of opposite twist. It is further shown how 15-shaft damasks and other fabrics can be built up by using various combinations of the fundamental 5-shaft patterns. —B.C.I.R.A.

Bed Spreads and Table Cloths: Weaving. *Textielind.*, 1924, **5**, 681-688 and 773-779; and 1925, **6**, 481-490 and 715-718.

Point paper diagrams and weaving directions are given for numerous highly patterned bed covers, table cloths, decorative fabrics, &c. The fabrics are divided into three classes : those with single warp and double weft systems, those with double warp and single weft systems and those with double warp and double weft systems. Many-coloured effects are introduced. —B.C.I.R.A.

Tapestry Weaving. — Gräbner. *Leipziger Monats. Text.-Ind.*, 1926, **41**, 169-171.

Point paper diagrams and weaving directions are given for a weft tapestry patterned on both sides. —B.C.I.R.A.

Cotton Duck: Specification. C. W. Schoffstall and R. T. Fisher. *Technologic Papers, Bur. Standards*, 1926, **18**, No. 264, 443-464.

The test methods used in a study of various samples of numbered duck of medium and hard textures are shown. For breaking strength, the strip and three types of grab methods were used. The 1×1×3 inch grab method was selected for the standard breaking strength method of test. The results are tabulated and the significance of the data is illustrated in various graphs. The study of the results shows how the specifications were formulated. The final specification for numbered cotton duck is given. —B.C.I.R.A.

British Styles in Men's and Women's Wear. *Text. Amer.*, 1926, **45**, No. 1, p. 13.

In worsteds, cheviots, and saxony materials rayon is being introduced for stripes in black and dark shades. It must be of the best quality, otherwise the stripe will give way before the material has worn out. A two-ply two-fold thread is preferable to a two-fold yarn. —F.G.P.

The Vogue of Novelty Curtains. *Text. Amer.*, 1926, **45**, No. 1, p. 14.

French and Swiss curtains are said to have passed out in America, being replaced by native fabrics. Really artistic ruffled curtains are made in scrims, voiles, and marquisettes, in solid colours, in two-tone effects and in six to eight colour combinations. The introduction of rayon has enhanced the beauty of these cloths and has made the more severe lace curtain still less popular. —F.G.P.

Manufacture of Madras Handkerchiefs and Lungees. D. M. Amalsad. *Text. Mfr.*, 1926, **52**, 280 (from *Indian Text. J.*).

Madras handkerchiefs, a class of goods made in India from imported yarns, are made from grey and coloured warp and weft yarns, the coloured yarns being allowed to bleed during weaving and thereby tint the grey yarns. Lungees, Kailies, and Kambayans are trade names for tartans made from coloured warp and weft yarns, and are very popular among Mohammedanmen for dhooties and headwear and among Hindu women as dress materials. Particulars of weaving and of the quality of these fabrics are given. —A.J.H.

New Use for Linen. C. R. Carter. *Text. Mfr.*, 1926, **52**, 297-298.

Artificial leather prepared by several impregnations of cotton fabric with cellulose solutions and afterwards embossed (the Ford Motor Company uses 20 million yards per annum of such fabric, 54 in. wide, for motor upholstery) may be advantageously replaced by a rubberised fabric. The fabric to be used for the rubber product must not contain more than 20 warp and 16 weft threads; the strength of such a cotton fabric is too low, but linen fabric is satisfactory in all respects. —A.J.H.

Cotton-Artificial Silk Union Fabrics. Wilsons Fabrics, Ltd. *Text. Merc.*, 1926, **74**, 532.

Three novelty fabrics are described—(1) A voile of cotton and Celanese with the Celanese thrown well to the top and the pale blue ground over-printed in a fancy stripe design in navy blue and gold, (2) a bordered marocain of cotton and artificial silk in which the embroidery is woven and the fabric is cross dyed, and (3) a cotton voile with wide artificial silk border in a light pattern of viscose and Celanese, in which cross dyeing is again employed. —B.C.I.R.A.

Twilled Fabrics. See Section 3C.

Patents

Weft Feeding: Continuous Motion. Mullor et Carriol. F.P.595,585.

This device comprises a special shuttle in the centre of which an axle bears a double balancing lever. One lever comes into contact with the loom buffer when the shuttle is at end of its course, the other bears yarn catching forks which under pressure release the shuttle for the next course. The shuttle catches the weft and conducts it in double loop into the shed and leaves it on the hook on the other side of the list. This hook brings the end of the double yarn exactly to the place where the previous loop was left. The motion is repeated for the next shed but with the yarn from the other bobbin.
—Bur. Text.

Improvements to Circular Knitting Machine. M. de Horrevitz. F.P.596,018.

These improvements, to a machine for stockings, permit the neutralisation of the levers distributing yarn at any given moment. For this purpose, at the end of these levers is transversally disposed a shaft which oscillates and on which are disposed fingers. The oscillation of this shaft is procured by other fingers disposed on a drum which is moved by a rod. The rod comes into contact with eccentrics disposed on the main shaft of the machine.
—Bur. Text.

System of Box Changing. Société Bruyere et Banzet. F.P.596,145.

The connecting rods of the oscillating lever commanding the driving rod of the box-change are hinged to noses fixed upon discs joined to toothed and freely rotating sleeves disposed in parallel. Between these sleeves, frames are disposed vertically and alternately, bearing racks which can be engaged with the discs on their ascending course. —Bur. Text.

Knitted Fabric. M. Wansker, Manchester. E.P.251,710.

A fabric consisting of artificial silk or rabbit wool and cotton is made on a flat machine in cardigan, half cardigan, or racked stitch, by plating, whereby one of the materials appears mainly on the two faces, whilst the other remains in the centre of the fabric. The plater is formed with a central passage for the plating yarn and a semi-circular guide for the backing yarn.
—B.C.I.R.A.

Knitting Machine: Streaked Patterning Mechanism. Dresdner Strickmaschinen-Fabrik Irmscher & Witte A.-G. and M. Kühne, Dresden, Germany. E.P. 251,816.

The invention of Specification 250,796 is modified in that grooved needle beds are dispensed with, the needles being guided on and under bars. The butts are situated below the needle stems and are operated on by toothed wheels on a carriage traversed by an endless chain. The carriage is provided with rollers running on bars.
—B.C.I.R.A.

Circular Knitting Machine: Plating Mechanism. T. G. Whyte and T. Smith, Shepshed, Leicestershire. E.P.251,864.

Reverse plating effects are obtained by the use of a bed of latch needles the hooks of which are set back, in conjunction with an upper bed of displaceable points capable of reversing the position of the loops on the needles. The points may be put in action in stages to diversify the patterned effects obtainable. The points are cranked and provided with butts by means of which they are moved in a tricked cylinder so as to come in between the needles. The butts are engaged for this purpose by cams which give the points the necessary vertical movements. The lower ends of the points are deflected to ensure them entering between the yarns by means of an arm fixed to the latch guard. The butts can be removed from the influence of the cams by the action of radial sliders mounted in a bed. When the slider butts travel in the cam track the sliders are idle but when the butts are transferred to a second track the inner ends of corresponding sliders press on the upper ends of the corresponding points and remove their butts from the cams. The slider butts are transferred in groups by the action of projections on a pattern wheel. —B.C.I.R.A.

Loom Driving Mechanism. E. Hollingworth, Dobcross, Yorks. E.P.251,877.

A loom which is driven by a motor through a clutch is provided with means for preventing the clutch shipper handle from being mechanically held in driving position when the motor is reversed and for preventing reversal when the handle is held in driving position. The handle is normally held in driving position in the usual notch in a slotted bracket. The motor is controlled by a switch, the handle of which is linked to a lever pivoted to the bracket and having a lug extending towards the slot in it. When the loom is working normally, reversal of the motor without first stopping is prevented by the engagement of the lug with the clutch shipper handle, and when the switch handle is in reverse position the lug covers the notch and prevents the shipper handle being placed therein.
—B.C.I.R.A.

Loom Change-box Motion. A. Barbier, Lyons, France. E.P.252,286.

In a drop-box motion for 12 boxes, four pinions arranged rectangularly are rotated on their respective shafts by toothed sectors on a central rotating plate, the rear faces of one set of sectors being in the same plane as the front faces of the second set. The pinions are clutched at times to respective coaxially mounted discs, which severally control levers each allowing of a rise of one to four boxes. The disc and lever mechanism is described. —B.C.I.R.A.

Pile Fabric Loom Creel Frame and Warp Letting-off Device. L. Lafond, St. Etienne, France. E.P.252,564.

In looms for weaving velvet fabrics face to face, the pile warps are drawn from bobbins mounted on spindles on a steeply slanting frame. Each spindle carries a spring in engagement with the adjacent bobbin. The warps pass through a comber board and through needles to a warp-clamping drawing-off device. The clamping device comprises a fixed jaw having a facing of rubber, and a lower cam-controlled jaw having a wooden sheathing provided with a facing of glass paper or emery paper and a brass or iron rod arranged above the facing to prevent injury to the warps. When the clamp is closed, a bar is moved so as to draw off warps sufficient to form the pile, the tension being maintained by the needles in front of the comber board. The breast beam is slotted and a loop of the fabric passes therethrough under a roller, whereby when the pile threads are severed by a knife the tension of the web prevents the pile threads from being pulled out. —B.C.I.R.A.

Loom Double Picking Motion. Bergmann Electricitäts-Werke A.-G., Berlin. E.P. 252,665.

A loom is provided with two picking motions, one being dependent on the speed of the loom and the other independent thereof. At low speeds, the picking is effected by a spring-operated vertical lever provided with a lateral fork to engage a roller for actuating the picking arm. The operating spring is charged by a cam on a shaft. At higher speeds a tappet on the same shaft is adapted to engage the roller, the vertical arm being held in an inoperative position by a latch and lever connected to the starting and regulating device. When the loom is started, picking is effected by the spring-operated lever, the tappet being inactive. When the loom is reversed the lever is held in the latched position. Specification 242,255 is referred to. —B.C.I.R.A.

Loom Shuttle. Lucas-Lamborn Loom Corporation, New York. E.P.252,709.

The weft passes between an eye in a transverse plate and a passage in the end of the shuttle which has its inner end on the axis of the shuttle. The weft is tensioned by a lever pivoted to a flange on the transverse plate. To thread the shuttle the weft is passed over a prong on the plate through passages to the eye; at the same time the thread is passed into a flared slot in the shuttle end which leads into the first-named passage in the end of the shuttle. The passage of the thread raises the tensioning lever to a position inclined at a small angle to the rest position. The plate is positioned in grooves in the shuttle by a stop. The shuttle ends are pyramidal. —B.C.I.R.A.

Non-woven Fabrics: Manufacture. E. O. Munktell, Stockholm. E.P.252,719 and 252,720.

(1) A fabric for towels, table cloths, &c., is produced by passing a number of layers of cellulose, cotton, or wadding or of soft and strong paper through goffering rollers and then spraying with an impregnating liquid which may comprise water, starch, borax, Japan wax, &c. The impregnated layers are then pressed, the goffering being smoothed out. The material may be passed through a pattern press to obtain an appropriate finish. For impregnation, solutions of cellulose esters, gelatine, or casein, &c., may be used with the addition of hardening agents or of softening agents.

(2) Similar fabrics are made by pressing together impregnated and unimpregnated layers of fibrous material such as crimped or uncrimped cellulose, cotton, wadding, &c. Impregnating materials are as before. The layers may be assembled in runaways, in which those layers to be impregnated are sprayed, after which the layers are brought together and compressed. The impregnated and unimpregnated layers are arranged alternately and two, three, or more layers may be used. A goffering operation may be performed. Finishing is performed by passing through smooth rollers. —B.C.I.R.A.

Jacquard Card Punching Machine. Würker Ges., Dresden, Germany. E.P.252,734.

A punching mechanism for reproducing perforated pattern strips or jacquard cards is described. —B.C.I.R.A.

Knitting Machine Tension Control Device. A. Morris, Leicester, and Klinger-Stern Hosiery Mills, Ltd., London. E.P. 252,781.

A tension control device such as a cam regulating the length of loop by operating on the stitch cam is actuated by the pattern chain at times corresponding to predetermined points in the length of the fabric knitted. The spindle of a known yarn control device consisting of a selector drum with studs acting directly on yarn fingers carries another similar drum on which studs are mounted in such a way as to be the equivalent of a snail cam. These studs pass under a lever and depress a spring plunger connected to the stitch cam. The driving mechanism of the drums is described. —B.C.I.R.A.

Loom Shuttle Swell. H. V. Carver, North Carolina. E.P.252,819.

A metal plate bolted to the shuttle binder is furnished with a sleeve to receive a bushing mounted on a bolt, which is adjustably secured in aligned slots in the horizontal limits of a channel-shaped bracket on a casting bolted to the lay. The binder, can thus rock about the pivot, an adjustable screw acting as a safety stop in case the bolt should be loosened. The binder which is of wood, has a swell covered with a facing of leather, and it has an end-facing of rubber to contact with the protector thumb. A portion of the bush is cut away and has two holes to receive the feeler fingers in case the binder is used on an automatic loom. —B.C.I.R.A.

Loom Change-box and Take-up Motions. H. Taylor and J. N. Leigh, Bolton. E.P.252,859.

In looms for weaving terry fabrics, the dobby has one or more ordinary cylinders and an additional cylinder for controlling the shuttle box motion, the take-up motion, the terry motion, and the let-off devices. The feeler levers operated by the additional cylinder are connected by Bowden wire devices to the ordinary feeler levers controlled by the ordinary cylinders, and these former levers control respective dobby levers connected by Bowden wire devices to the shuttle box motion and the take-up motion, &c. When the dobby lever controlling the take-up mechanism for producing fringe effects is operated, it operates a lever by means of a Bowden wire device, a bowl on an arm on the lever then moving away from a projection on a second pivoted lever. The second lever is then actuated in one direction by a spring and in the other by a pin fixed to the lay sword and to a vertical lever. At the same time, the bowl allows a spring-controlled pawl on the second lever to move into engagement with a ratchet wheel fixed to a pinion geared to a wheel on the shaft of the take-up beam. This is thus rotated to form a fringe. During this action the beam of the ordinary take-up motion is retained from rearward movement. —B.C.I.R.A.

Loom: Weft Stop-motion Device. T. W. Payton, Castleton, near Manchester. E.P.252,873.

The boundary frame of a weft grate or grid is bent to incomplete form from bright drawn mild steel wire to receive a separate bent bracket which is secured thereto by autogeneous soldering or welding. The bars of the grid are secured in slots or holes in the frame by welding or riveting. Horns may be provided on the bracket for securing to the frame. —B.C.I.R.A.

Circular Knitting Machine: Embroidery Mechanism. W. Spiers, Leicester. E.P.252,883.

The specification relates to the application of embroidery attachments to machines of the super-posed cylinder type. The invention is described as applied to a machine with rotary needle cylinders. The rib cylinder rotates about a bearing sleeve and is supported by balls on a sliding sleeve. An inner sleeve is rotated in unison with the rib cylinder. To the lower end of the inner sleeve is attached a conical dial tricked to receive one or more patterning yarn carriers, the butts of which are operated by a stationary cam carrier on the end of a centre bar. The ends of the sliders (yarn carriers) are offset so that the yarn eyes are not in line. When a slider is projected the space between the yarn and the offset part of the slider is brought over the corresponding needle so that the needle on rising may enter to take the yarn. The rib cylinder may be raised to provide clearance for the advance of the sliders by means of a pattern-controlled lever acting on the sliding sleeve. The cam and push rod mechanism for projecting and selecting the requisite sliders is described. —B.C.I.R.A.

Loom Reed Threading Machine Disc Control Device. S. S. C. Fleischer and J. K. E. Fredholm, Copenhagen. E.P.252,926.

In a machine for threading loom reeds of the kind having an oscillatory hooked disc slidable along a shaft and adapted to progress automatically from dent to dent of the reed, stops are provided for limiting the motion of the disc in its end positions, means being also provided for holding the disc in a third position in which it is free to slide along its shaft in the direction of the reed to correct any faults. The shaft carries a projection adapted to engage a stop in one direction and a step in a spring-controlled lever in its other end position. By depressing the latter lever the projection engages a second step thereby holding the disc in a position in which it is free of the dents, so that it can be moved along the shaft. —B.C.I.R.A.

Braiding Machine: Yarn Carriers A. E. White (for American Wiremold Co.) London. E.P.252,973.

The inner yarn carriers are each provided with a guide plate carrying a pivoted deflector which meets the oncoming yarns from the outer supplies and deflects them under or over the carriers as the case may be. The movement of the deflectors is effected by removable pins mounted respectively above and below the groove of the rotary outer drum in which the carrier shoes slide. The plates are made relatively long to reduce the period during which the outer yarns are free to vibrate. This is particularly desirable when asbestos, &c., yarn is worked. —B.C.I.R.A.

Knitting Machine Cylinder Drive. W. Spiers, Leicester. E.P.252,987.

Machines of the superposed cylinder type are provided with driving means for the cylinders or cam boxes consisting of a common shaft which is driven by bevel gears from the main driving shaft. Gear wheels on the common shaft drive wheels on the cylinders. In this way it is possible to maintain the cylinders strictly in register.

The top cylinder may be supported by means of a rod suspended from a plate, a thrust disc, and a series of balls. Specification 24,290/12 is referred to. —B.C.I.R.A.

Carpet Loom: Driving Control Mechanism. E. Hollingworth, Dobcross Loom Works, Dobcross, near Oldham (Crompton and Knowles Loom Works, U.S.A.). E.P. 253,035.

In carpet loom driving mechanism as described in Specification 251,877 a device comprising an interlocking electric motor controller and clutch is provided to warn the operator, when in reverse, as to the proper time for stopping the loom. —B.C.I.R.A.

Sheet Metal Mule Carriage. R. R. A. Hurst, Bolton. E.P.253,216.

In a mule carriage built from sheet metal, channelled cross bars are secured in position by sheet metal fixing members cut and bent to provide lugs which can be secured by bolts and rivets. —B.C.I.R.A.

Light Metal Loom Picker. G. Spencer, Moulton & Co. Ltd., and R. Glascodine, Westminster. E.P.253,264.

Pickers for underpick and overpick looms are cast, pressed, or stamped from aluminium, aluminium alloy, or other metal and have a screwed-on metal holder containing a renewable striking part of rubber or the like. The cast picker has a guide-lug and a picker-stick slot and is recessed to receive the screwed holder in which is moulded the rubber striker. Holes and grooves in the recess secure the rubber which contains an axial hole. The rubber may be solid throughout with a convex face. In a modification, the picker is formed in two stamped or pressed portions riveted together and has two cylindrical bores, one lined with brass, asbestos, or the like for the guide rod, the other for the screwed shank of the holder containing a rubber disc. —B.C.I.R.A.

Circular Knitting Machine: Patterning Mechanism. E. Brooksby, Leicester. E.P.253,319.

Plain or rib machines are provided at each feeder with a rotary pattern wheel consisting of a disc with radial grooves in which slide bits having a number of steps. Mounted on the stationary cover plate is a block on which are pivoted levers selected by screws projecting through the face of a ratchet wheel. When selected, the levers are depressed so that their ends project into the track of the corresponding steps of the bits, which are thus moved radially until their butts pass outwards through a gap in an annular rib of the cover plate. The selected bits are then in position to operate on the needles or sinkers; they are returned to the inactive position by a cam acting on the sides of the butts. The bits can be moved outwards irrespective of the levers for the purpose of permitting plain horizontal stripes to be knitted. The axles of the pattern wheels are inclined and the ratchets are driven by pawls operated by cams on the needle cylinder. According to the Provisional Specification the bits may be pivoted. —B.C.I.R.A.

Loom Picking and Shuttle-checking Mechanism. J. H. and T. Hindle, Haslingden. E.P.253,354.

In side lever under-pick motions particularly for wide looms for weaving heavy fabrics, the side lever carries a bowl for engagement by a cam pivoted at one end on a spider on the gear wheel of the tappet shaft, the other end of the cam being adjustably secured to the spider by a bolt and nuts. The bowl runs in an oil bath in a bracket. One end of the lever is pivoted to brackets adjustably secured to the loom frame. The free end of the lever engages a toe on the boss of the picking stick which is mounted in a box-shaped bracket mounted on the lay-sword shaft. The bracket is slotted to receive and guide the free end of the lever. To check the picking stick and, through the picking stick, to check the shuttle and picker, spring-controlled buffers are mounted on the bracket and are engaged by the boss of the picking stick. The picking stick and lever are returned to normal position by a spring. —B.C.I.R.A.

Loom Stop Motion. J. H. and T. Hindle, Haslingden. E.P.253,355.

In looms particularly applicable to weaving heavy wide fabrics and of the kind described in Specification 249,197, a number of tongues mounted on the stop-rod on the lay swords are adapted, when the shuttle is trapped, to engage a corresponding number of frog levers pivoted to the end and intermediate transverse frames. Each frog lever has a hole through which the corresponding tongue passes normally. Each lever is connected by a pair of tension rods adjustably connected to a rod passing through an abutment on the frame and engaged by a strong compression spring, so that the shock of bringing the lay to rest is transformed into a compression of the framing. The frog levers are pivoted so that they have approximately the angular motion of the lay. When the frog levers are operated the end frog lever engages a bell crank lever which is moved to operate a toggle lever and link work mechanism to withdraw a clutch to allow a heavy fly-wheel to run loose on the driving shaft and to apply a brake to a light brake drum fast on the shaft. A light hand wheel is keyed to the shaft. A starting handle connected to the toggle mechanism and a foot lever for releasing the brake where it is desired to turn the shaft by the hand wheel are also provided. —B.C.I.R.A.

Circular Knitting Machine: Thread Guide. G. Blackburn & Sons, Ltd., and T. Widdowson, Nottingham. E.P.253,374.

Dependent thread guides are operated indirectly by a central cam acting on intermediate swinging jacks. The jacks work between radial blades secured in a ring and are provided with butts. The butts are disposed at different levels on different jacks so that by raising or lowering the central cam different sets of guides may be operated at different times. The upper ends are retained in an annular recess of the ring by a clasp spring. The construction permits of the use of an independent guide for each needle. The central cam is exchangeable for others with operating surfaces at two or more levels.
—B.C.I.R.A.

Jacquard Card Repeating Machine. A. McMurdo, L. Morrell, and J. McMurdo, Ltd., Miles Platting, Manchester. E.P. 253,381.

In a machine for repeating jacquard cards, the card to be punched and that to be repeated are moved step by step in longitudinal alignment under vertically reciprocating punches and feelers which are so inter-connected that the punches only operate when the corresponding feelers indicate a hole to be repeated.
—B.C.I.R.A.

Knitting Machine: Yarn Supply Device. F. M. Reuther, Saxony, Germany. E.P. 253,415.

Knitted fabrics are provided with designs by twisting the component yarns together in a variable manner. If they are subjected to a hard twist the design appears as points or dots; when they are twisted loosely streaked or striped effects are produced. The yarns pass down through a spindle which may be rotated in either direction at varying speeds and over transverse pins by means of which the requisite twist is imparted. The yarns then pass to a guide or direct to the needles.
—B.C.I.R.A.

Circular Knitting Machine: Transmission Gear. T. S. Grieve, Leicester. E.P. 253,465.

An adjustment of the transmission gears driving the cylinders is provided which allows the gears to be brought further into mesh for taking up back-lash due to wear so that the cylinders can be kept in register.
—B.C.I.R.A.

Circular Knitting Machine: Patterning Mechanism. A. Morris, Leicester, and Klinger-Stern Hosiery Mills, Tottenham, London. E.P.253,473.

A tucking cam control device such as a slider acting on a star wheel controlling a tucking cam is connected by means of linkwork or otherwise associated with a counteracting device such as a slider. In this way tuck work may be made part way round a tube corresponding to the positions of the sliders which are preferably diametrically opposed. The sliders are controlled by a pattern chain the studs of which move them in unison either into or out of action with the star wheel. —B.C.I.R.A.

Jacquard Card Punching Machine. A. H. Lee, Birkenhead. E.P.253,622.

In a machine for punching jacquard cards and the like, the step-by-step card traverse and the punching head are automatically actuated, the latter under manual control, while the punches are selectively locked in the head by plungers, slidingly pivoted to bell cranks operated by means of keys arranged as in a piano. The machines are directly driven from a motor or belt-driven from a line shaft; when several machines are in line, a line shaft drives each machine through a clutch. —B.C.I.R.A.

Pile Fabric Loom: Yarn Selector. W. Felton, C. Willber, F. H. Oldroyd, and Turkey Rugs, Ltd., Radcliffe, near Manchester. E.P.253,630.

In a rug-making or like machine coloured yarns are selected in accordance with the pattern by a mechanism comprising a set of levers operated singly by a pattern band to raise a corresponding plunger into the path of independently moved means, which co-operate therewith to change the yarn. In the construction shown, the selected plunger is moved by oppositely reciprocating shifter-bars to a predetermined position; this movement shifts a carriage slidable on a bar and shafts to operate yarn-changing mechanism connected thereto. The plunger operating-means are actuated either mechanically or electrically. —B.C.I.R.A.

Looms: Warp Letting-off Motion. W. G. Gass and G. H. Ashworth, Bolton. E.P. 253,661.

The weighting lever connected to the rope or cord passing round the drum on the warp beam is pivoted and is provided with a weight having rollers resting on the flanges of the channelled lever. The weight is held in the required position by a perforated pivoted member co-operating with a projection on the weight. Tension may be removed from the warps by moving the weight to the right beyond the pivot. The weight has a portion projecting downwardly between the flanges to prevent it from falling off. In a modification the lever is solid, the weight having a portion projecting downwardly at each side. The weight may be moved along the lever by a hand-operated screw and nut device, or the ends of the weight may be connected by a chain passing over guide and jockey pulleys on the lever whereby the weight may be adjusted without going behind the loom. In another modification guide channels accommodate a flat link chain connected to the weight so that it can transmit pressure without buckling, a catch or stop being provided to hold the weight in adjusted position. —B.C.I.R.A.

Circular Knitting Machine. E. Brooksby, Leicester. E.P.253,692.

A rib machine is provided with a set of transfer points mounted in the lower face of a ribbing dial and adapted to transfer loops from the rib to the frame needles. The invention is described as applied to a machine with bearded rib needles and latch cylinder needles, and with stationary cam boxes or shells. The transfer points are each bifurcated at one end and are provided with butts at the other end. The bifurcations are of unequal length, a short bowed branch fitting into a cup formed in the long branch. The points are operated by means of a cam on a pivoted arm which is normally held out of action by a ring on which bear pins held down by a second ring. Cross pins on the second ring working in slots are pressed down by the shoe of a pattern controlled lever when operation of the points is required. The projected points then pierce the rib loops, the dial needles cast off, and the loops are stretched across the bifurcations of the points while the frame needles rise and enter.
—B.C.I.R.A.

Fabric Winding Roller. J. Strang, Ltd., and W. Strang, Ramsbottom, near Manchester. E.P.253,745.

A roller for beaming or winding on of fabrics has one or more bands or strip-like surfaces of a rough, adhesive, or friction-producing nature adapted to grip the fabric and extending from end to end of the roller. In one form the roller has grooves in which are placed strips of card clothing, the points of the wires forming a continuation of the periphery of the roller. In modifications, the grooves are filled with strips of india-rubber or strips of india-rubber or stabbed sheet metal are secured to the surface of the roller. In another form a strip of metal having alternate plain and stabbed parts is wound helically round a roller in such a manner that the stabbed parts form parallel strips. In a modification, a roller having a metal surface is stabbed to produce bands separated by unstabbed portions. —B.C.I.R.A.

Parallel Knitting Machine. Elitewerke A.-G., Abteilung Diamantwerke, Siegmar, Saxony, Germany. E.P.253,856.

A jacquard roller is moved up and down by a linkwork system acted on by the cam-carriage operating lever and consisting of a slotted link connected by levers to a roller and links connecting arms to the slotted link. The movement of the cam-carriage operating lever is limited by a rod mounted on a stud on the frame. The arms are mounted on a similar stud and the slotted link is mounted on both studs. The ends of the arms carry curved members forming channels engaged by a roller on the cam-carriage operating lever as the lever moves into its extreme position. This engagement causes the linkwork mechanism to move up and down. The slotted link is connected by levers with a pawl for feeding the chain wheel. —B.C.I.R.A.

Looms: Dobby Mechanism. A. Stuber, Thann, Haut Rhin, France. E.P.253,860.

The driving lever is driven by a rod adjustably attached to a pivoted slotted guide which is turned about its axis by a roller sliding in the guide and also in a fixed but adjustable guide having a central curved part and two straight parts. The roller is operated by a rod, a slider, a second rod, and a crank on the cam shaft. The slotted guide is turned until it is aligned with a straight part of the adjustable guide, after which the roller slides in the guides without turning the pivoted guide, thus producing a dwell. A modification is also described. —B.C.I.R.A.

Looms: Pirnless Weft Inserter. A. Mullor, Sceaux, Seine, France. E.P.253,861.

In continuous weft-feeding devices as in Specification 249,471, the thread-gripping forks on the "shuttle" are combined into a double-acting centrally located fork and a fixed thread-presenting guide is used, to which the thread is led from the supply spool through a tube oscillated by a cam and lever whereby an open U-shaped part of the tube is caused periodically to fit against a felt roll to brake the thread. The thread also passes through an eye at the end of a thread-tensioning spring on the tube. When the "shuttle" is picked, the thread is carried in loop form by the fork and when it nears the selvage is engaged by the wedge-shaped rear tailpiece of a thread-gripping hook which is oscillated by cam-controlled lever mechanism. The hook and tailpiece pass between the tines of the fork and the loop of weft is transferred from the fork to the hook which is moved to various positions to drop the loop of weft at the "selvage." —B.C.I.R.A.

Looms: Beat-up Motion. Vereinigte Seidenweberein A.-G., Amrath, near Crefeld, Germany. E.P.253,893.

The beat-up movements caused by a crank drive are influenced by a spring mounting. The lay may be carried by resiliently-mounted supports such as leaf springs secured in position by angular clamps, or tension or coil springs may be mounted on the lay shaft. The spring force assists the action of the crank drive and makes it more regular. —B.C.I.R.A.

Yarn Warping Mechanism. J. Goretzki, Richenberg, Czecho-Slovakia. E.P. 253,899.

In warping cotton, &c., each thread is wound off from the inside of a cop in a triangle-shaped bobbin and then passes through a brake. The threads finally pass on to a warp beam. —B.C.I.R.A.

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

Weaving

252,984. H. J. & M. L. Thackeray. Hand-power looms.

Fabrics

251,764. A. Beaumont. Double blankets on 2/2 twill basis.

4—CHEMICAL AND OTHER PROCESSES

(A)—Boiling

Boiling-off Silk. *Text. Colorist*, 1926, **48**, No. 565, p. 54.

Silk may be degummed in water under pressure in presence of traces of alkaline matters, such as ammonia, soda, caustic soda, phosphate of soda, or borax. As an example : silk is treated for ½ hour in distilled water containing 0·25% caustic soda at a pressure of 7 lb. The lustre and feel are stated to be equal to those of silk boiled-off in a soap bath. —F.G.P.

(B)—Scouring and Degumming

Special Treatment of Silk. *Text. Colorist*, 1926, **48**, 616-617.

Brief descriptions are given of methods for preparing and dyeing souple silk, for degumming, softening, and lustring silk. —A.J.H.

Scouring Losses: The Chemica. Analysis of Cotton. R. G. Fargher and L. Higginbotham. *J. Text. Inst.*, 1926, **17**, T233-T246. —L.I.R.A.

Modern Wool Scouring Assistants. *Dyer and Cal. Printer*, 1926, **56**, 69.

Hexoran is a stable emulsion of carbon tetrachloride and is particularly suitable as an addition to scouring liquors for wool; it is volatile. Cykloran is less volatile and consists of an alcohol of high boiling point combined in varying proportions with a potassium-oleine soap. Cykloran M conc., Cykloran O, and Cykloran E contain decreasing quantities of the alcohol and increasing quantities of the oleine soap, their fat-emulsifying and dirt-removing powers decreasing and increasing respectively in the order named. Perpentol S is capable of emulsifying tar on wool and is of particular value to felt dyers. Oranit KS is suitable for assisting the penetration of wool by acids in carbonising processes. —A.J.H.

(E)—Drying and Conditioning

Bleached and Mercerised Cotton Yarns: Regain. E. Burlet. *Rev. Text.*, 1925, **23**, 1029 (from *Le Nord Textile*, 1925, No. 278).

The author has made experiments in which samples of five yarns, bleached, mercerised, and untreated were conditioned in a room under constant temperature and humidity conditions. The average regain at a temperature of 18·8° and 69% humidity was: raw cotton, 6·56; bleached, 7·14; mercerised, 9·51, the regains corresponding to the 8½% accepted regain for raw cotton being 9·25 and 12·32 respectively. The 8½% regain can still be retained for bleached cotton, therefore, whilst that for mercerised cotton is 12%. —B.C.I.R.A.

Artificial Silk: Conditioning. E. Burlet. *Rev. Text.*, 1925, **23**, 1135.

Since the regain of artificial silk may vary between 5 and 15%, it is proposed to adopt a method in which the artificial silk is conditioned in a normal atmosphere until it is in hygrometric equilibrium with the surrounding air. Experiments on cotton have shown that not many hours are required for cotton to reach this state of equilibrium; artificial silk would require a longer time. The "normal atmosphere" is determined by ascertaining the conditions of temperature and humidity under which the usually accepted regain is attained. —B.C.I.R.A.

Vacuum Yarn Conditioning Apparatus. Scheidecker Frères et Cie. *Rev. Text.*, 1925, **23**, 1143.

The yarns are submitted in a vacuum to treatment with warm atomised water, followed by cold atomised water, ensuring penetration to the centre of the yarn by the humidifying agent and condensation and fixation of the agent in the desired locality. A simple arrangement of pipes and valves enables the temperature and humidity to be accurately and easily controlled. With this apparatus the operation is complete in 2½ hours. The apparatus is illustrated but not described. —B.C.I.R.A.

Chamber Drying Machine Air Diffuser. Tomlinsons (Rochdale), Ltd. *Text. Merc.*, 1926, **74**, 480.

To prevent the air currents leaving the heating compartments from penetrating the drying room too rapidly, and to ensure evenness of distribution, a simple device comprising essentially a sloping tray divided into a series of small compartments is mounted in the bottom of the machine cells. The incoming hot air strikes the successively higher back walls of the small compartments and is deflected upwards. —B.C.I.R.A.

Drying Woollen and Cotton Materials: Theory and Practice. F. Kershaw and H. G. Black. *Text. Colorist*, 1926, **48**, 626-630.

A description of machines for drying yarns and loose, knitted, and woven materials by means of hot air. —A.J.H.

(G)—Bleaching

Braam Chlorine Absorption Apparatus. *Textielind.*, 1924, **5**, 697.

A report is given of a Dutch official test on the absorption apparatus designed by Braam. The plant is recommended for use in all bleaching processes where a low chlorine concentration is necessary to prevent damage to the fibre, and for water disinfection, &c. —B.C.I.R.A.

Conditions Governing the Bleaching of Wool with Hydrogen Peroxide. S. R. and E. R. Trotman. *J. Soc. Dyers and Col.*, 1926, **42**, 154-157.

Factors responsible for the loss in weight and damage to the epithelial scales during bleaching have been investigated and methods have been suggested by the aid of which both of these may be minimised. The cause of the greater susceptibility of chlorinated wool to damage during bleaching is to be sought, not only in the bleaching itself but also in the processes which have preceded this operation.
—B.R.A.W. & W.I.

(H)—Mercerising

Oxygen Absorption of Mercerised Cotton. See Section 6.

Contraction during Mercerisation Expressed Mathematically. See Section 6.

(I)—Dyeing

Insoluble Azo Dyes: Application. O. W. Clark and E. R. Borho. *Amer. Dyestuff Rep.*, 1926, **15**, 311-314 and 337.

A practical account of the properties of the insoluble azo colours and their application to cotton. They are produced directly on the fibre by coupling diazotised aromatic amines with naphthols. —B.C.I.R.A.

Straw Dyeing: Modern Methods. C. Williams. *Dyer and Calico Printer*, 1926, **56**, 92-93.

Methods for dyeing straw materials with Celatene dyes are described. —A.J.H.

Waste Sulphite Liquors: Reducing and Stripping Power. M. G. Kotibhashker. *J. Soc. Dyers and Col.*, 1925, **41**, 361-362.

The reducing power of sulphite liquor prepared in the laboratory from Scotch fir was investigated with a view to the possibilities of utilising waste sulphite liquor as a reducing and stripping agent in dyeworks and for bleaching rags in paper mills. Comparative Indigo vat dyeings using hydrosulphite and waste liquor as reducing agents are described. The results in each case were similar and dyeing was even. Indigo-stripping tests with the liquor are described. —B.C.I.R.A.

Franklin Dyeing Plant. J. D. Murray. *Amer. Dyestuff Rep.*, 1926, **15**, 316-317.

The yarn is wound on compressible spiral or helical springs and dyed in a closed kier under a hydraulic pressure of 10 to 25 lb., according to the temperature of the dye liquor and the tight or loose condition of the packages. The yarn packages are compressed on hollow, perforated spindles on the dye kier. When dyeing is complete the surplus water is removed by means of a hydro-extractor or ordinary laundry wringer and the yarn is put in trays and placed in a drier. —B.C.I.R.A.

Mineral Khaki Colours: Application. S. L. Hayes. *Amer. Dyestuff Rep.*, 1926, **15**, 321-325.

A general account of the production of khaki colours on cotton fabrics by the fixation of salts of iron and chromium.
—B.C.I.R.A.

Colours of a By-gone Age for Spring. M. H. Rorke. *Amer. Silk J.*, 1926, **45**, No. 1, p. 39.

The new spring colour card of the Textile Colour Card Association of America contains a number of shades reminiscent of the French Court of the Eighteenth Century—La Vallière is a silvery mauve, Marie Antoinette a grey-rose, Polignac a shade of bois-de-rose, Maintenon is a brown-pink, and Chevreuse a pink-brown. Clear green blues are Monaco and Mediterranean, Cathedral Blue is said to reproduce the blended jades and amethysts of the windows at Chartres. Phantom Red is a brilliant scarlet with a hint of yellow. Crystal Grey is soft and has a pinkish cast; Metallic Grey suggests burnished platinum, Rosetta Grey is a rich dark colour. Lovebird is a rich green. —F.G.P.

Dyeing Vat Colours on Rayon. F. F. Warshaw. *Amer. Silk J.*, 1926, **45**, No. 1, p. 61.

Cotton tie bands on the skein should be used as they do not slip; the hanks are placed on carefully selected bamboo rods, which are free from splinters. Very great care must be taken in selecting dyes suitable for the purpose, always remembering the subsequent treatment of the dyed yarn and its ultimate use. When mixed dyes are employed it is essential that they are of such nature as will give the best results under similar circumstances. The trade can probably be educated to accept shades that will give better results in working than those selected. The yarn is wetted out in a bath of water containing a small quantity of hydrosulphite, caustic soda, glue, and monopol oil at 110° F. The reduced dye is put in portions in a bath suitably heated and the yarn immersed and given the required number of turns to exhaust the dye before adding more. When all the colour is on, the yarn is placed in the oxidation bath of bichromate and acetic acid or allowed to oxidise naturally. After washing and soaping, the yarn is whizzed and dried. Unevenly dyed skeins are sorted out, and if there is a harsh feel when dry the batch must be softened.
—F.G.P.

Ice Colour Vat Cooling Device. C. Winternitz. *Bull. Soc. Ind. Mulhouse* (Pli cacheté 1848 of 20/VII./1908), 1926, **92**, 163-164.

The ordinary wooden feed roller is replaced by a hollow iron or copper roller provided at one end with a screw cap through which an ice and salt or other freezing mixture is introduced. By this means the printing process can be worked for some hours at a room temperature of 30-35° C. The device may be applied also to dyeing with ice colours. —B.C.I.R.A.

Cotton-Artificial Silk Union Fabrics: Dyeing. H. Blackshaw. *Dyer and Cal. Printer*, 1926, **55**, 205 and 225.

A general account of methods of dyeing cotton-artificial silk piece goods. —B.C.I.R.A.

Woollen Piece Dyeing; Cause of Faults in——. J. S. Heuthwaite. *Dyer and Cal. Printer*, 1926, **56**, 66-67.

A description of common faults, their cause and correction, in dyed woollen piece goods. Variation of shade among pieces in the same batch is usually due to the presence of different qualities of wool used in their manufacture or variations in the process of preparation. For example, milling particularly affects the affinity of wool for mordants and dyestuffs according as it is carried out slowly or quickly. Unequal decatising frequently causes one end of the dyed piece to be darker than the other; the inner layers of the piece adjacent to the decatising roller gain an increased affinity for mordants and dyes. Dark and light "lists" are usually due to unequal distribution of liquors used in preparatory processes, e.g., acids in carbonising, and alkalis in scouring. Heat and milling creases are readily distinguished from each other, since the former are associated with felted fibres. Mildewed patches appear light or bare (in carded goods) after dyeing. —A.J.H.

Problems of Hosiery Dyeing. R. C. Spurgeon. *Dyer and Cal. Printer*, 1926, **56**, 94-95 (from *Canadian Text. J.*).

Paddle dyeing machines are most satisfactory. Penetration of seams, heels, and toes of all-silk stockings is ensured by degumming and dyeing simultaneously instead of successively; a mixture of sulphonated castor oil and sodium silicate is preferred for degumming since the resulting textile materials has a high lustre and soft handle. Hosiery containing artificial silk, natural silk, and cotton together is preferably degummed before dyeing. When dyeing sulphur colours on cotton mixed with real silk, the silk is degummed after dyeing the cotton since the gum protects the silk from deterioration by the alkaline dyebath. Excessive shrinkage is the most serious fault which occurs in dyeing hosiery containing wool; it may be avoided by reducing the duration of dyeing and the quantity of alkali used in scouring. —A.J.H.

Formic Acid in Textile Processes. H. O. Richardson. *Dyer and Cal. Printer*, 1926, **56**, 104-105.

The manufacture and uses of formic acid for assisting the mordanting of wool, the stripping of dyed fabrics and the dyeing of leather are discussed. —A.J.H.

Dyeing of Artificial Silk. E. Greenhalgh. *Dyer and Cal. Printer*, 1926, **56**, 106-107.

The concluding article of the series. Level dyeings on cotton and viscose silk brocade fabrics are obtained by dyeing below 60° C. until about 75% of the depth of shade is obtained, and then completing the dyeing while raising the temperature of the dye liquor to 80°-85° C., but without the addition of a further quantity of dye. Such brocade fabrics should not be singed over a hot-plate. —A.J.H.

Dyeing with Lichens. A. R. Horwood. *Dyer and Cal. Printer*, 1926, **56**, 110-111.

The application to textile materials of dye extracts obtained from lichens mainly obtainable in Scotland, e.g., archil, cudbear, and crottle, is described. —A.J.H.

Dyeing of Vat Colours. J. S. Heuthwaite. *Dyer and Cal. Printer*, 1926, **56**, 132-133.

The first of a series of articles dealing with methods for dyeing with indigoid, anthraquinone, and sulphide vat dyes. —A.J.H.

Azo Colours, Insoluble; The Composition of Some Products used for the Production of——. F. M. Rowe. *J. Soc. Dyers and Col.*, 1925, **41**, 354-356.

The author has investigated a number of compounds used for the production of insoluble azo colours, e.g., Naphthol AS-BR, Naphtholate AS, Brenthol H soluble 50% paste, various bases, fast salts, and Permanent Red 2G (AGFA) = Monolite Red 2G (BDC). —L.I.R.A.

Artificial Silk: Dyeing. J. Huebner. *J. Soc. Dyers and Col.*, 1925, **41**, 387-401.

A review of the literature of the last 11 years, including patents, on the dyeing and printing of artificial sil . —B.C.I.R.A.

Silk-Cotton Hose: Dyeing. H. D. Mudford. *J. Soc. Dyers and Col.*, 1926, **42**, 44-46.

A report of a lecture on the methods of dyeing natural silk hose with cotton tops and feet. —B.C.I.R.A.

Azo Dyes: Application. D. H. Peacock. *J. Soc. Dyers and Col.*, 1926, **42**, 53.

Azo dyes may be attached to cotton through the agency of a nitrobenzyl ether of cellulose and the subsequent reduction of the nitro group and diazotisation. Cotton is boiled with a 1-2% solution of nitro-leucotrope (nitro - phenylbenzyldimethyl-ammonium chloride) washed and reduced with hydrosulphite solution at 60-70° and then, after washing diazotised; coupling with β-naphthol gives a rose shade. The feature of these dyeings is their fastness to washing. —B.C.I.R.A.

Mordant Dyes: Historical. G. T. Morgan. *J. Soc. Dyers and Col.*, 1926, **42**, 54-58.

In a lecture on recent researches on mordant dyes the production of mordant dyes and lakes is reviewed from the time of Pliny to the present day. —B.C.I.R.A.

Starches: The Behaviour of Different, towards Dyestuffs and Iodine. J. Huebner and K. Venkataraman. *J. Soc. Dyers and Col.*, 1926, **42**, 110-121.

Numerous experiments are described. It was found that the starches may be arranged in the following order with regard to the power of adsorbing basic dyestuffs—Rice, maize, potato, tapioca, wheat, sago. Some acid and direct dyes were absorbed by the starches in fair quantity but others to a small extent or not at all. Maize, wheat, and tapioca starches were found to absorb larger amounts of a direct dyestuff (Diamine Sky Blue) than did potato starch. The adsorption of Methylene Blue, Methyl Violet, and Magenta from aqueous solutions was found to follow the simple absorption law, the weight of dyestuff absorbed by a given weight of the starch being proportional to C^{1}/n where C is the concentration of the dyestuff. —L.I.R.A.

Dyeing Wool with Indigo. F. Peterhauser. *J. Soc. Dyers and Col.*, 1926, **42**, 152-154, *and J. Soc. Chem. and Ind.*, 1926, B535.

Indigosol O (*cf.* Voucher and Bader, *J. Soc. Chem. Ind.*, B, 1925, 864) is superior to indigo since it is easily soluble in water and may be applied to wool by methods used for acid dyes; it does not oxidise in the dyebath and allows the accurate matching of desired shades. Its subsequent development by oxidation is not satisfactory when hydrogen peroxide, a persulphate, or atmospheric oxygen is used. Indigosol OR and O4B are similar soluble derivatives of monobromo- and tetrabromo-indigo respectively.
B.R.A.W. & W.I.

Celanese; Fast-to-light Dyeing on——. G. H. Ellis. *J. Soc. Dyers and Col.*, 1926, **42**, 184-186.

The lecturer referred to the excellent fastness properties of the S.R.A. Celanese dyes and gave a list of these dyes selected for greatest fastness to light. He then pointed out the desirability of being able to make use of these colours in conjunction with light resistant cotton dyes for Celanese-cotton mixtures. If anthraquinone vat dyes are used, there is danger that the properties of the Celanese will be impaired by the alkalis used in the preparation of the vat. This difficulty has been largely surmounted by using the alkali salts of phenols (e.g. sodium phenate) in place of caustic soda. Not all anthraquinone vat colours are applicable by this process, but a considerable number are quite suitable and leave Celanese practically white. Further information is given in Dyeing Leaflets Nos. 5 and 6 (British Celanese, Ltd.). —L.I.R.A.

Indigosol OR and Indigosol Yellow HCG. *Chemicals*, 1926, **25**, No. 17, p. 32.

These are two new water soluble and stable vat dyes manufactured by Durand and Huguenin, S.A., Basle, Switzerland. Indigosol OR is a further addition to the indigosol group and is intended for the production of navy blues. Like the other members of this group, it is soluble in water and is quite stable. Its chief application is in calico printing, and, like Indigosol O and O4B, it is suitable for both print-on and resist styles. In fastness it corresponds to that of Indigo MLB/R. This new brand may be developed either by the steaming process or by the nitrite process, both processes giving, particularly on unmercerised goods, brighter blues than those obtained with Indigosol O. Indigosol Yellow HCG is also a further addition to the Indigosol range of dyestuffs. Like the other Indigosol brands, it is stable, soluble in water and is suitable for producing old gold shades. In combination with Indigosol O and O4B, it is possible to obtain valuable greens of very good fastness to washing. Indigosol Yellow HCG is chiefly intended for textile printing, both for direct printing and particularly for resist styles. In view of its stability when printed and its easy fixability, the new product is of interest for machine printing as well as for block and yarn printing. This brand is best developed by the steaming process. White resists with Hydrosulphite NF conc. or Rongalite C on Indigosol Yellow HCG are not quite satisfactory, but on the other hand very fine colour resists may be obtained with the aid of the nitrosamines of insoluble azo colours, or with various vat colours. Moreover, Indigosol Yellow HCG may be used as a resist under Aniline Black according to a process, patent which has been applied for by Durand and Huguenin, A.G. —L.I.R.A.

Dyer's Tannins: Properties and Application. H. O. Richardson. *Ind. Chem.*, 1926, **2**, 195-196.

The paper contains notes on the origin, extraction, and properties of the commoner tannins used in dyeing. —B.C.I.R.A.

Azo Dyes, Naphthol AS Dyes, and Ionamines: Application. F. M. Rowe. *Ind. Chem.*, 1926, **2**, 208-212.

A review of progress in the production of insoluble azo dyes on the fibre, including a note descriptive of how the requirements for dyeing cellulose acetate are met by the ionamines. —B.C.I.R.A.

Cotton and Artificial Silk Union Fabrics: Dyeing. G. Rudolph. *Kunstseide*, 1926, **8**, 147.

Directions are given for obtaining a single uniform colour tone in a union fabric of cotton and viscose or cuprammonium artificial silk. Substantive dyes, of which suitable examples are given, are used in the process. For light shades 2-3% of Marseilles soap, 0·5% soda ash, and 5% Glauber salts according to the shade required are added to the dyebath. Dyeing is performed at 30° and later at 40°. For deeper shades the percentage of Glauber salts is increased up to 15% and the temperature of the bath is first 40° and later raised to 70°. Artificial silk and also cotton as a rule dye deeper at higher temperatures. Should the artificial silk show a greater affinity for the dyestuff than the cotton, the steam must be increased to lower the temperature. Mercerised cotton gives better results than unmercerised. The amount of Glauber salts must be regulated carefully. More equal shades are obtained by the use of a good wetting agent; Nekala (1-1½ g. per litre) is recommended. —B.C.I.R.A.

Roughness of Dyed Silk Hosiery. *Silk J.*, 1926, **2**, No. 20, p. 61.

Dyeing of silk hosiery employs the most harsh treatment in the entire silk dyeing industry. Poor silk speedily develops lousiness in rotary machines and even the best silk will break down. A heavy thread silk stocking will break more quickly than a light one and every effort should be made to get the process finished as quickly as possible, although the shade be sacrificed to some extent. Monel metal machines have proved good for hosiery dyeing. —F.G.P.

Present Day Plants for Dyeing Rayon Goods. R. Sansome. *Silk J.*, 1926, **2**, No. 21, p. 50.

A dyeing machine is described in which the hanks are all turned together and when dyed may be lifted in one lot while another similar lot is lowered in the vat. The advantages of the machine are that the yarn is gently moved automatically with very little power, the entering and lifting are conducted very easily, the turning of the hanks ensures even dyeing, the operations of wetting, dyeing, and rinsing are performed in the one vat, the treatment is regularised by adjustment of the mechanism, and the dyer can take swatches at any moment by stopping the machine and lifting the whole batch. —F.G.P.

Artificial Silk: Dyeing. B. Schwärzel. *Leipziger Monats. Text.-Ind.*, 1926, **41**, 194-195.

A short general article, with pattern sheet. —B.C.I.R.A.

Dyeing Acetyl Silk Yellow and Similar Shades. *Text. Colorist*, 1926, **48**, No. 566, p. 109.

Tartrazine may be produced on the fibres of cellulose acetate and silk by making a cold mixture of dioxytartrate of soda dissolved in just sufficient hydrochloric acid and phenyl hydrazine in just enough acetic acid and working the fibre for 10 mins. before raising the bath to 122° F. maintained for 20 mins. By substituting para-nitro-phenyl-hydrazine an orange shade is obtained. Terra-cotta shades are formed in a single bath of nitrosamine and 1-2-4-toluylene diamine in presence of acetic acid. No mention is made of the fastness of these colours. —F.G.P.

Dyeing Piassava. *Text. Colorist*, 1926, **48**, No. 566, p. 110.

Piassava is a fibre derived from certain kinds of palms. Blacks and browns may be obtained from basic dyes in weakly acid baths with or without alum, dyeing 10 mins. cold and 20 mins. at 160°-175° F. Improved fastness at some sacrifice of shade is got by dyeing at the boil. Acid dyes with a small addition of oxalic acid give good shades. Dianil colours used with Glauber's salt and soda ash are said to be satisfactory. —F.G.P.

Distributing and Non-distributing Acid Dyes for Silk. *Text. Colorist*, 1926, **48**, No. 566, p. 111.

These names are applied to colours that dye slowly and evenly and those which rush on to the fibre unevenly. Boiled-off liquor may be omitted when the first sort are used on degummed silk, but is essential with the others. Distributing dyes can be used in compound shades, the others must be used singly. As there are many dyes lying between these extremes care is needed in dyeing. —F.G.P.

Omission of Boiled-off Liquor in the Silk Dyebath. *Text. Colorist*, 1926, **48**, No. 566, p. 112.

It is stated that the functions of boiled-off liquor are to preserve the sericin in partly degummed silk and to assist level dyeing. As much silk is wholly degummed the first use is only partial and as Marseilles soap is often used for the second function the answer is in the affirmative. The fact that it is a very cheap commodity that would be otherwise thrown away is not alluded to. —F.G.P.

Water and Soap in the Dyeing of Silk. *Text. Colorist*, 1926, **48**, No. 565, p. 37.

For the throwster and dyer the ideal soap is a hard white curd made from olive oil and caustic soda; olive oil foots of high grade may be used and the soap must be neutral. Formerly, the name Marseilles soap indicated this but of late years that name may mean anything, and much foots of very inferior grade is used. Adulterations with oils such as cotton seed, rape seed, pea nut, corn, poppy, and sesame are frequent and unsatisfactory, and barytes and soap-stone are sometimes added as fillers. A suitable analysis is given—Fatty acids, 60-65%; sodium oxide, 6·5-7·5%; water, 27-33%; insoluble, not over 0·5%. Pure olive oil soap will readily dissolve silk gum, is easily dissolved in luke-warm water, and leaves no disagreeable odour. All water used for silk should be soft. Calcium and magnesium salts form soaps which stick to the fibres and prevent evenness in weighting and dyeing.

—F.G.P.

Basic Dyes on Silk. *Text. Colorist*, 1926, **48**, No. 565, p. 38.

Where fastness to light is not a vital matter, basic dyes are valuable from their richness of colour and easy reception by silk. Moderate temperature and neutral baths are usually sufficient; unbroken boil-off liquor may be used if the silk is only soupled. In a few cases slight acidity is required—Methylene Blue, Rhodamine Scarlet, Rhoduline Orange, and Auramine. With tin-weighted silk, too, acid is needed, giving richer and fuller shades than on unweighted. The dye should be added in parts, allowing each portion to be absorbed before putting in the next. A temperature of 150° F. is usual but Fuchsine requires 176° F. With schappe silk, however, the bath should be gradually raised to nearly boiling. —F.G.P.

Investigation of Certain Pyrazolone Dyes for Wool, Silk, and Cellulose Acetate Silk. E. C. Jennings. *Text. Colorist*, 1926, **48**, 523-526.

The yellow, brownish-orange, and yellowish-orange shades obtained by immersing wool, silk, and cellulose acetate silk in warm solutions containing sodium dioxytartrate and of one phenylhydrazine, *a*-naphthylhydrazine, bromo-phenylhydrazine, and dinitrophenylhydrazine respectively have similar fastness to light on all fibres, the fastness of washing being about equal on wool and silk but inferior to that on cellulose acetate. Dyes produced from bromophenylhydrazine and *a*-naphthylhydrazine are insoluble, but those obtained from phenylhydrazine and dinitrophenylhydrazine are sufficiently soluble to dye wool, silk, and cellulose acetate silk from a hot solution. All the pyrazolone dyes referred to above and containing amino but no sulphonic acid groups are capable of direct application to cellulose acetate silk. —A.J.H.

After-treatment of Cotton Material dyed with Sulphur Colours. *Text. Colorist*, 1926, **48**, 542-543.

Methods for topping sulphur colours with Aniline Black, for after-treating with metallic salts, e.g., copper sulphate and bichromates, and with hydrogen peroxide are described. Bronzy shades may be corrected by treatment with a warm dilute solution of sodium sulphide. Sulphur colours may be effectively topped with basic dyes. —A.J.H.

Direct Cotton Dyes on Wool. *Text. Colorist*, 1926, **48**, 544-545.

Many direct cotton dyes—a list of such is given—may be used for the production of fast shades on wool. Dyeing is effected in a neutral bath and after-treatment with metallic salts, e.g., chromium fluoride or a bichromate frequently increases the fastness of shade. Diamine Fast Red F yields shade on wool equal in fastness to milling as those obtained with alizarin. —A.J.H.

Dyeing of Natural Silk Fabrics. R. Sansone. *Text. Colorist*, 1926, **48**, 595-598.

A description of suitable machinery.

—A.J.H.

Dyeing Immunised Cotton with Acid Dyes. A. P. Sachs. *Text. Colorist*, 1926, **48**, 601-603.

Cotton immunised by means of *p*-toluene sulpho-chloride and subsequently treated under suitable conditions with ammonia, gains an affinity for acid dyestuffs. The dyeings obtained are reasonably fast to soaping, particularly with after-chrome, alizarin, and pyrazolone dyes. Methylamine, dimethylamine, ethylamine, benzylamine, and other aromatic amines may be used instead of ammonia, but the resulting cotton has a less satisfactory affinity for acid dyes. The basic characteristics of the treated cotton are due to the presence of combined amine groups. —A.J.H.

Temperature in Dyeing; Importance of——. *Text. Mfr.*, 1926, **52**, 242-243.

Individual dyes have their individual temperatures at which they have their greatest affinity for the fibre. Thus when two or more dyes are mixed it is unlikely that they are both working to the best advantage, and so, for any definite temperature the proportions of the two dyes must be adjusted to obtain a given shade. Again the rate of dyeing of the two colours may be different, one of the dyes going on to the fibre more rapidly than its companion. This may be overcome by raising the temperature so that the remaining dye is taken up from the dyebath. This, however, makes it difficult to dye uniformly successive baths of material. Many dyes do not require a boiling dyebath, satisfactory results may be obtained in the range of 190°-205° F. Excessive temperatures used with basic dyes tend to deteriorate the colouring matter and the temperature for these dyes should be held within a narrow range, say, 140°-160° F. When used for topping the temperature may be somewhat higher, but should not rise above 175° F. When dyeing with a padding machine a reduction of temperature will probably occur. With a combination of dyes this alteration in temperature will tend to break up the combination of conditions that has been producing the desired shade. As the temperature falls off the several affinities of the various dyes are not likely to change in the same degree, the result being an alteration in the shade. —L.I.R.A.

Hosiery Dyeing Machine. *Text. Mfr.*, 1926, **52**, 303-304.

A machine for dyeing artificial silk hosiery is described, circulation of the dye liquor being obtained by means of live steam and compressed air. Friction and strain on the hosiery is thus avoided. —A.J.H.

Submerged Beam Dyeing Machine. Baldwin and Heap, Ltd. *Text. Merc.*, 1926, **74**, 503.

The actual dyeing apparatus is a tank in which there is fixed a perforated beam stem. The dye is pumped into the bath through the beam stem in such a way that it travels the whole length of the beam before it forces its way through the perforations and into the yarn. During the operations of washing, steaming, dyeing, and drying (by compressed air) the beam is rotated automatically. A test carried out on the machine by 30 cotton weaving firms in the United States showed the dyeing to be even all through the beam (carrying 300 lb. of yarn). —B.C.I.R.A.

Autoxidation of Sulphur Black Dyeings. *Text. Rec.*, 1926, **44**, No. 522, p. 66.

The most recent researches (by K. Brass) on the after-tendering of sulphur black dyed cotton materials indicate that tendering is avoided or reduced by afterchroming and by replacing soaping by a prolonged washing with hot water. Prolonged washing with water not only removes oxidisable sulphur from the dyed fabric, but it also deepens the shade. —A.J.H.

Dye Penetration into Cell Membranes. See Section 1C.

Dyeing Souple Silk. See "Special Treatments of Silk" in Section 4B.

Application of Vat Dyes. See "Cotton Cloth Printing" in Section 4J.

Dyestuffs Fastness Tests. See Section 6.

Dyestuffs: Light Sensitivity. See Section 6.

Dyehouse Economics. See Section 9.

(J)—Printing

Red and White Discharges on Dark Indigo Bottom. J. Pokorny. *J. Soc. Dyers and Col.*, 1926, **42**, 157-158.

The author enumerates six technical methods which have been proposed for the production of red and white discharges on a dark indigo bottom and describes in detail the following new method—Print 20 parts lead chromate powder, 40 parts starch-tragacanth thickening, 28 parts diazotised *p*-nitroaniline, 12 parts water. Discharge with hot hydrochloric acid and ferrous sulphate. The quantity of lead chromate must be varied according to pattern. The smaller the pattern, the more lead chromate is required. The usual naphthol preparation, i.e., β-naphthol or β-naphthol R (9 parts β-naphthol with one part F acid) and ricinoleic acid, can be used. The printing paste requires, as do all the six methods mentioned, a rather deep engraving, for instance, 22-24 lines, where for ordinary printing 27-28 lines are used. The paste is printed out of a copper trough with a brush and it is necessary to cool well, both in the pot and in the trough. If this is done, five to six thousand yards of goods can be printed without changing the paste. The best red is obtained on goods freshly padded with naphthol and discharged on the same day as printed. Hydrochloric acid 27° Tw. is used at 37° C. for discharging, with the addition of 30 g. iron sulphate per litre. —L.I.R.A.

Imitation Embroidery Fabric: Printing. J. Frossard, C. Rebert, and B. Lothareff. *Bull. Soc. Ind. Mulhouse* (Pli cacheté 2281 of 20/X./1913), 1926, **92**, 167-170.

To obtain relief effects in imitation of embroidery, the fabric is printed with a solution of cellulose acetate in acetic acid (or other cellulose derivative may be employed) and the solution precipitated with water. For precipitation, the fabric introduced between the cylinder and the engraved roller comes in contact with a second roiler provided with a thick covering of wool which can be impregnated with water. Pigments resistant to acetic acid may be incorporated in the printing solution. In a criticism the process is stated to be an amplification only of a previous process of Ratignier. —B.C.I.R.A.

Coloured Tannin-antimony Reserves: Printing. A. Scheurer. *Bull. Soc. Ind. Mulhouse* (Pli cacheté 1999 of 11/V./1910), 1926, **92**, 165-166.

The white fabric is coated with tannin and then printed with a paste containing antimony salt, antimony oxide, and a basic dye, for example, Methylene Blue. For dyeing the ground the fabric is again coated with a paste containing tannin and a second basic dye. The fabric is steamed, passed into tartar emetic, washed and soaped. The basic colour present in the antimony salt reserve is fixed on the tannin deposited on the white fabric and reserves the super-printing of the ground. —B.C.I.R.A.

Printing Cotton by the Indigo-glucose Method. *Text. Colorist*, 1926, **48**, 617-620.

A discussion of methods; several recipes are given. —A.J.H.

Methods of Producing Direct Printed Effects on Silk and on Rayon Silk Fabrics. R. Sansone. *Text. Colorist*, 1926, **48**, No. 566, p. 99.

Ageing of small lots of printed fabrics may be carried out in a steam cot fitted with lines on which the rack may be run in and out. Printing with Helindone vat colours yields very fast effects, some of which are quite bright. A suggested mixture is—250 pts. water, 230 dextrine, 80 glycerine, 60 Turkey-red oil, 60 soda ash, 150-300 dyestuff, 30 hydrosulphite, 25 olive oil. —F.G.P.

Katanol: Application. R. Fischer. *Leipziger Monats. Text.-Ind.*, 1926, **41**, 195-198.

A general summary of the uses of Katanol in printing. Katanol O is generally used for this purpose. Katanol W is a special product for half-wool dyeing and is only used in exceptional instances in printing, e.g., in half-silk printing. —B.C.I.R.A.

Developments in Calico Printing. R. Sansone. *Dyer and Cal. Printer*, 1926, **56**, 86-88.

Methods and machines for printing ice colours are described. Several recipes are given for orange, claret, brown, blue, and black shades. —A.J.H.

Native Indian Fabrics in Muttra (India): Printing. H. B. Shroff. *Indian Text. J.*, 1926, **36**, 229.

The printing industry of Muttra is primarily a cottage industry. The work consists mainly in the production of saries in imitation of the Sanganer style and of scarves, kerchiefs, and dhooties. Printing is seasonal and has to be stopped in the rainy season for lack of ageing, drying, washing, and clearing facilities. The designs in use are, on the whole, old ones, and there is very little improvement; there is a slight increase in the use of geometrical figures. The blocks are made from well-seasoned shisham wood free from knots. The design from a transparent paper is directly tapped by means of a sharp instrument in the form of a broken outline, and the block is cut by sharp taps, drills, and chisels. The blocks of Muttra have two distinctive features. The portions cut in relief are straight instead of tapering and the engraving is much deeper. —B.C.I.R.A.

Coloured Reserves: Printing. Koechlin Frères. *Bull. Soc. Ind. Mulhouse* (Pli cacheté, 1060 of 19/XI./1898), 1926, **92**, 161-163.

A foundation colour is printed on the fabric with a paste containing dyestuff but no mordant; the fabric is dried and superprinted with a design, generally a ground, with a convenient mordant. The colour of the foundation will only be fixed at the points superprinted with mordant. The operations may be reserved. To obtain foundations of one or several colours with white or multicoloured designs, the foundation is printed as before, but using appropriate colours for each roller, and superprinted with a convenient mordant. When the superprinted design is to be of several colours, i.e., a ground with coloured motifs, dyes which do not fix or which reserve the underlying colours are chosen for the motif colourings. With foundation colours obtained with alizarins, tannin colours may be chosen for the motifs. —B.C.I.R.A

Cotton Cloth: Printing. W. Cotton. *Amer. Dyestuff Rep.*, 1926, **15**, 325-334.

The following new developments in calico printing are discussed—The introduction in Europe of the so-called "Indanthrene houses" which produce and sell fabrics printed with Indanthrene dyes only, the use of vat dyes as colour discharges on vat colours and as colour discharges or resists under Aniline Black, the Indigosols and their uses, the use of the Rapid Fast colours, the naphthols and the use of Katanol in the production of discharge styles. Brief reference is made to the printing of artificial silk fabrics and in the discussion a method of dyeing with vat colours under pressure is described in which the liquor is pumped through the yarn and through piece goods under pressure of nitrogen drawn from a bomb. —B.C.I.R.A.

(K)—FINISHING

Calendering Linen Fabrics. G. Rice. *Text. Amer.*, 1926, **46**, No. 1, pp. 23-24.

The author describes the operation of calendering, which is stated to be accomplished by passing the cloth between the hard surfaces of smooth rollers resulting in an equal flattening of all the threads in the cloth and producing a soft, silky lustre. Attention is drawn to the special surface of each roller employed and also to the importance of the pressure being properly regulated. A high degree of pressure is needed between a paper and any kind of metal surface roller if brilliancy of finish is wanted, and a light pressure will do if a dull finish is required. The effect of the temperature of a metal roller on the gloss of the fabric is referred to. The embossing of linen fabrics is also dealt with and the principle of the embossing machine outlined. —L.I.R.A.

A Simple Calender Guard. *Dyer and Cal. Printer*, 1926, **56**, 109.

A simple adjustable wooden guard suitable for placing before the "nip" of calendering machines so that the hands of operatives cannot be drawn between the bowls is described. —A.J.H.

Pin-plate Tentering Machines: Control. H. D. Martin. *Text. Rec.*, 1926, **44**, No. 518, p. 59 (from *Text. Colorist*).

The importance of tentering in finishing cotton fabrics requires that the process shall be as efficient as possible. Pin-plate tenters have many objections as compared with modern clamp-plate tenters, including retarded production, pin holes in the cloth selvages, more damaged cloth, higher cost

of repairs, less easy handling, more short lengths and more soiled cloth. Improvements which can be made in the pin-plate equipment when it is impossible to replace this by clamp-plate machines are discussed.
—B.C.I.R.A.

Cloth Raising. *Text. Mfr.*, 1926, **52**, 274-275.

The effect of quality of material, structure, twist, and ply of yarns, firmness of fabric and weave on raising is discussed.
—A.J.H.

(L.)—Waterproofing

Methods of Waterproofing Textiles. *Text. Argus*, 1926, No. 101, 18th Aug., p. 7.

Mechanical, chemical, and electrolytic methods for rendering fabrics showerproof and waterproof are described. Fabrics waterproofed by the electrolytic formation of a basic aluminium oleate when the fibres may be dry cleaned (with benzene) without loss of its water-resistant properties, since the basic oleate differs from the normal aluminium oleate in being insoluble in benzene. —A.J.H.

Patents

Degreasing Wool. Societe Commaniale. F.P.584,383 (from *Melliand's Textilberichte*, 1926, **7**, 720).

The degreasing of raw wool may be brought about by extraction in a closed vessel with trichlorethylen. This may be done at low, as well as at high temperatures. After extraction, the solution is removed from the apparatus by evacuating or centrifuging and the wool is then quickly dried by means of a flow of hot air in vacuum. It then still contains all the other valuable constituents, especially the potassium salts, but mineral impurities are also present, which must be got rid of by suitable means.
—B.R.A.W. & W.I.

Yarn Conditioning and Cooling Apparatus. F. Kershaw. U.S.P.1,587,384 (from *Amer. Dyestuff Rep.*, 1926, **15**, 552).

The apparatus comprises a casing having conveyer chains at each side and transverse sticks mounted on the chains from which the hanks of yarn are suspended. A transverse retarding bar is located in the path of the lower ends of the hanks so as to retard all the hanks suspended from a single stick, and means are provided for projecting sprays of fluid on to the sides of the yarn on each side of the opening formed by the retarded hanks.
—B.C.I.R.A.

Urea Application. Raduner & Co. A.-G., Horn, Switzerland. E.P.251,993.

Fibrous materials are finished by means of solutions containing urea. In an example, a dressing liquid for finishing cotton fabrics consists of starch solution to which urea is added. Urea may be added to the final bath before drying dyed vegetable or animal fibres. —B.C.I.R.A.

Silk: De-mineralising. British Silk Research Association, W. S. Denham and W. Brash, London. E.P.252,064.

The mineral content of silk is reduced and the retention of a deleterious proportion of acid avoided, without the consequent washing in pure, softened, or alkaline water to remove such excess acid, by treating the silk with an amount of acid not considerably in excess of that required to bring it to the iso-electric condition. The strengths of the solutions used should not be substantially greater than that represented by the *p*H value 3·8. In an example, 25 grams of degummed mulberry silk are immersed for 24 hours in 2,000 c.c. of distilled water containing 0·00063% of free nitric acid, wrung out, soaked again for one hour, wrung out again, washed with distilled water, and dried and conditioned. The dry ash was reduced from 0·55% to 0·04%. —B.C.I.R.A.

Tentering Machine. J. M. Clerc-Renaud, Villeurbaune, Rhône, France. E.P. 252,323.

In a fabric finishing machine wherein the tentering chains pass round two series of drums so that the fabric moves in a zig-zag path, the drums in each series are of such diameters or are so spaced that the angle between the warp and weft threads at successive undulations gradually decreases from the entry end to the exit end of the machine. One series of drums are adjustable to and from and to a small angle relatively to the other series. The feed rolls, winding-on drum, &c., are driven through variable speed gearing by means of ropes and expanding pulleys.
—B.C.I.R.A.

Alkaline Phenol Solution. L. de Wolf, Lebbeke, Belgium. E.P.252,360

In a process for treating vegetable textile fibres, applicable also to yarns and fabrics, the defibering, scouring, and bleaching is effected more rapidly and lanification, mercerisation, and gelatinisation facilitated by the addition of a phenol to an excess of alkali. Monovalent or polyvalent phenols and their homologues may be used. Where bleaching is to be effected, oxidising agents acting in an acid, alkaline, or neutral medium may be used. Alkaline hypochlorites and permanganates are mentioned. As an example, jute is soaked in an oxidising bath, rinsed, wrung carefully, and subjected for 5-15 minutes to a solution containing 1 vol. of 38° Be. caustic soda and 1 vol. of 33% phenol, then wrung, rinsed, and dried. —B.C.I.R.A.

Azo and Vat Dye Mixtures. I.G. Farbenindustrie A.-G., Frankfort-on-Main. E.P. 252,384.

Cotton is dyed with mixtures of vat dyes and insoluble azo dyes by impregnating with a mixture of an azo coupling component and a vat dyestuff dissolved in the usual way, and then simultaneously oxidising the vat dyestuff and developing the azo dyestuff by applying a diazo solution. Almost any vat dyes may be used and the azo coupling components are specified. In examples (1) a green shade is obtained on cotton by impregnating with diacetoacetyl-*o*-tolidine and leuco 4 : 4^1-dioxyindanthrone and developing with an acetic acid solution of diazotised *o*-chloraniline or 2 : 5-dichloraniline; (2) a brown shade is obtained by impregnating with 2 : 3 - oxynaphthoylaminohydroquinonedimethyl ether and leuco trichlorindanthrone and developing with diazotised 2 : 5-dichloraniline; (3) a bluish-red on cotton or artificial silk by impregnating with 2 : 3-oxynaphthoic-*m*-nitranilide and leuco succinyldiaminoanthrarufin and developing with diazotised 4-nitro-2-anisidine: in each case the material is first introduced into a solution of the coupling component, the reduced vat dyestuff added, and the material centrifuged and developed in the diazo solution. —B.C.I.R.A.

Wetting and Dispersing Agents. I.G. Farbenindustrie A.-G., Frankfort-on-Main. E.P.252,392.

Liquids are emulsified and solid and liquid materials wetted or dispersed with the aid of an aromatic sulphonic acid which contains at least one alkyl group and at least one halogen atom, nitro, hydroxyl, or amino group; benzyl-anilinesulphonic acid and acids having tanning properties are excluded. The acids may be used as substitutes for soaps, for emulsifying organic liquids in water, and for dispersing dyes, &c. In examples, a solution of the sodium salt of the product obtained by sulphonating alphachlornaphthalene and condensing with isopropyl alcohol is used for the wetting of wool and for the production of lather; a readily wettable and finely dispersed dye preparation is obtained by mixing with a dyestuff such as Indanthrene Blue RS, a solution of the sodium salt of diethyl-metanilic acid or of diamyl-alphanaphthylamine sulphonic acid; a cleansing and washing agent is prepared by mixing with methyl-cyclohexanone the sodium salt of di-butylaniline-sulphonic acid. —B.C.I.R.A.

Hank Dyeing Apparatus. P. Caldwell, Newton Heath, Manchester. E.P. 252,507.

In apparatus for dyeing hanks comprising a frame having top and bottom rollers, the frame is totally immersed in the liquor and is suspended from crank arms oscillated by pitmen. The upper rollers are geared together and are oscillated by mechanism comprising a double pawl mounted between arms pivoted on the shaft of a ratchet wheel and connected by a link to a lever from which depends a weighted cord. —B.C.I.R.A.

Hydronaphthalene Scouring Agents. L. L. Lloyd, A. Womersley, C. Wilkinson, and A. Scott, Bradford. E.P.252,811.

A scouring process for textiles comprises treatment with either (1) the condensation products of the hydrogenated naphthalenes with fatty acids, or (2) the sulphonic acids of the hydrogenated naphthalenes or the alkaline salts of these acids, or (3) the condensation products of these sulphonic acids or salts with the fatty acids. The fatty acids specified are oleic, and those from castor, arachis, olive, or cotton seed oils. —B.C.I.R.A.

Detergents; Preparation of——. I.G. Farbenindustrie A.-G., Frankfort-on-Main. E.P.253,105.

Saponaceous or Turkey-red oil and like compositions suitable for use in hard or salt water or with acid dyebaths and for washing and fulling fabrics and in carbonising baths comprise a hydro-aromatic or aromatic sulphonic acid or salt of high wetting power. An organic solvent, sulphite cellulose liquor or both may be added. The compositions may be prepared by mixing the acid or its salt or a concentrated solution of it with fused soap, or kneading or mixing the soap and dry salt together, or by adding the acid during the saponification process. Twenty parts by weight of acid or salt to 80 parts of soap is suitable. Borax, alkali silicates, glycerol, benzine, alcohols, cyclohexanol, ethylene glycol, mono ethyl ether or other solvent may also be added. Sulphonic acids specified are those obtained by condensing hydro-aromatic or aromatic sulphonic acids with aliphatic, hydro-aromatic, or aromatic-aliphatic alcohols; condensation products of formaldehyde with naphthalene sulphonic acids; or sulphonic acids containing halogen, nitro, amino, or hydroxyl groups. —B.C.I.R.A.

Spot-dyed Knitting Yarns; Production of——. H. E. van Ness, Elmira, New York. E.P.253,461.

Cops of partially dyed yarn for knitting mixtures are dyed in band-like portions extending all or part way round it, the dyed portions reaching from the outer surface to the surface where it is in contact with the core. Spotted yarns so produced may be sufficiently regular in character to give an indication of the appearance of the knitted product obtained therefrom. The dye may be applied by the method described in Specification 205,057, or by dropping or wiping the dye on the predetermined part of the yarn mass during its formation in the winding machine. —B.C.I.R.A.

Dyeing Machine. J. Schlumpf, Winterthur, Switzerland. E.P.253,500.

In apparatus for circulating liquids through materials by means of a rotary pump the vats for the materials and the pump are made relatively movable so that one pump

may be employed for a number of vats. In one form, a vat of wood is mounted on rollers so that it may be brought up to a rotary pump having branches and a reversing valve actuated by gearing. The vat has a medium wall in which is an opening and one side of the vat is constituted by a stationary wall through which the branches lead, connected to the vat by clamping rods, a tight joint being made by rubber bands. In a modification, the pump is mounted on a carriage together with an electric motor and a reservoir for liquid and is moved up to a stationary vat.
—B.C.I.R.A.

Dyeing Machine. J. Schlumpf, Oberwinterthur, Switzerland. E.P.253,657.

In apparatus for dyeing, &c., rods of tapering section for supporting hanks or skeins are mounted in racks each comprising a lower member formed with two grooves, one carrying a resilient packing, on which the rods rest, and the other a notched strip of leather, canvas, indiarubber, &c., by which the rods are spaced apart, and an upper member of similar construction and adapted to be pressed down on to the rods to keep them in place. A glass rod on the upper member prevents the skeins from chafing against the racks. In a modification, the strip is replaced by teeth formed on one of the members, one side of the teeth having less inclination than the other to allow the rod to be inserted in an inclined position and then to be turned upright for clamping.
—B.C.I.R.A.

Cloth Raising Machine. R. Haddan, London. E.P.253,752.

In a napping machine, the carding pins on one-half of each roller point in the direction of travel of the cloth over the napping-drum and the pins on the other half in the other direction, the rollers being driven by the action of two webs of cloth to be napped without other gearing. The halves of the rollers may be of different diameters and ball bearings may be provided for the rollers. —B.C.I.R.A.

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

Dyeing

252,240. C. M. Barnard and British Alizarine Co. Compounds for dyeing cellulose esters.

253,662. C. S. Bedford. Chrome-mordanting process for wool.

253,865. I. G. Farbenindustrie A.-G. Silk dyeing with azo dyes.

Washing

251,669. E. C. Duhamel & Cie. Generale des Industries Textiles. Apparatus for washing wool and other textile materials.

5—LAUNDERING AND DRY CLEANING

Textile Soaps: Comparative Emulsifying Powers. D. M. Simm. *J. Soc. Dyers and Col.*, 1926, **42**, 212.

Experiments have been made with Donnan's drop number apparatus with the object of determining the comparative emulsifying powers of different textile soaps. The results obtained indicated that but little reliance can be placed upon the test, the apparatus used, the age of the solution, and the oil with which the emulsifying power is measured influencing the results. The experiments showed, however, that the drop number increases with the concentration of the soap solution to a maximum of about 0·5% to 0·8%.
—L.I.R.A

PATENTS

Ink-removing Composition. M. A. Lange. U.S.P.1,584,871 (from *Chem. Abs.*, 1926, **20**, 2233).

The composition comprises 1 part phenol, 2 parts alcohol, and 2 parts benzene.
—B.L.R.A.

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

Laundering

252,976. S. G. Jowitt. Washing machine: oscillating receptacle.

6—ANALYSIS, TESTING, GRADING, AND DEFECTS

Wood: Constitution. B. Holmberg and S. Runius. *Chem. Zentr.*, 1926, **i.**, 136-137 (from *Svensk. Kem. Tidskr.*, 1925, **37**, 189-197).

On the assumption that in wood lignin and cellulose are chemically combined, the combination may be of the ester type with lignin as acid and cellulose as alcohol component or of the acetal type with lignin as the carbonyl and cellulose as the alcohol component or the reverse. If the ester type exists, ethoxylignin should result when wood is acted on either by an alcoholate or by alcohol and acid and should be saponifiable to lignin. If the combination is of the acetal type, and since acetals are stable towards alkali, alcoholate should not act on wood, but acid and alcohol should effect acetal formation with the production of ethoxylignins, stable to alkali, if lignin is the carbonyl component or form lignin if this is the alcohol component. Experimental work on the above basis is described in detail. Sodium alcoholate was without action on wood. By treating wood with alcohol and hydrochloric acid a product

designated "alcoholysis lignin" was obtained containing 19·38% alkoxyl (calculated as OCH_3). This product was unsaponifiable with alkali. The conclusion is drawn that the combination of lignin and cellulose in wood is of the acetal type with lignin as the carbonyl component.
—B.C.I.R.A.

α-Cellulose: Estimation. H. Bubek. *Papier-Fabr.* (Fest-u. Ausland-Heft), 1926, 66-71.

A new method of determining α-cellulose is described based on the fact that, of a cellulose mercerised with 17·5% by weight of caustic soda solution, a maximum goes into solution on diluting the mercerising liquid to 8-9% by volume. The following definition of α-cellulose is accordingly proposed—α-cellulose is that constituent of a cellulose which, after ½-hour mercerisation with 17·5 weight per cent. of pure caustic soda solution at a temperature maintained at 18° C., is insoluble in 8-9 volume per cent. of caustic soda solution at room temperature. The method of analysis is described and the results are in agreement with the definition. The maintenance of a definite mercerising temperature is essential; over a temperature range of 12-27° the value for α-cellulose increases with increasing temperature. Short time differences in the period of mercerisation do not greatly affect the results. By a 1½-hour mercerisation as compared with a ½-hour mercerisation, the maximum lowering of the α-cellulose value over a series of celluloses was only 0·36%.
—B.C.I.R.A.

α-Cellulose: Estimation. H. E. Wahlberg. *Amer. Dyestuff Rep.*, 1926, **15**, 398 (from *Svensk Pappers-Tidning*, 1926, 1st Jan.).

In a criticism of Schwalbe's results the author describes determinations of the α-cellulose content in artificial silk cellulose which he has made by the Waentig and the Jentgen methods. More consistent results are obtained by the latter method.
—B.C.I.R.A.

Cellulose: Estimation. N. Bengtsson. *Chem. Zentr.*, 1926, **i.**, 3355 (from *Mitt.* No. 279 *der landwirtschaftl. Zentralversuchsanst.* (*Schweden*), *Bacteriolog. Abhandlung*, No. 37, 1925, 1-13).

A method is described for estimating cellulose from straw sawdust, fertiliser, moss, lignite, &c., in soils. After treating with sodium bisulphite and hydrochloric acid under pressure the residue is dried and the cellulose dissolved with Schweitzer's reagent. The cellulose is reprecipitated with 80% alcohol. Details of the method are given. —B.C.I.R.A.

Cellulose and Starch: Adsorption from Alkali Solution. S. Liepatoff. *Kolloid-Z.*, 1926, **39**, 9-14.

The rate of adsorption of alkalis from alcoholic solution by starch and cellulose is slow and is considerably higher in dilute than in concentrated solutions. The rate of adsorption is the rate at which concentration is equalised in the boundary between the two phases. This equalisation is effected by diffusion. The rate of adsorption is directly proportional to the diffusion constant and the total surface area of the adsorbed substance, and inversely proportional to the thickness of the diffusion film. The rate of adsorption increases with increasing temperature.
—B.C.I.R.A.

Cellulose Acetates: Cryoscopic Properties. Kurt Hess and G. Schultze. *Annalen*, 1926, **448**, 99-120.

The abnormal cryoscopic behaviour of crystalline cellulose acetate is explained. If prepared crystalline cellulose diacetate dissolved in glacial acetic acid is placed in a freezing point apparatus in the usual way, the molecular weight reading decreases with time to a value below that of the simple cellulose diacetate molecule (molecular weight, 255). If the cellulose diacetate is dissolved at a temperature of 60° and the solution then frozen, the molecular weight increases on standing to a maximum and then decreases, again to a value below 255. By experiments on gas absorption by glacial acetic acid and acetic acid-cellulose acetate solutions, the cause of the anomalous behaviour of the cellulose diacetate was traced; and cryoscopic determinations made *in vacuo* gave minimum molecular weight values approximating closely to 255. A similar confirmation of the assumption that a C_6-group is the structural element of polysaccharides is afforded by cryoscopic molecular weight determinations of cellulose triacetate and lichenin acetate which also give limit minimum values of 255. —B.C.I.R.A.

Wood Cellulose: Whiteness Test. H. Wenzl. *Papier-Fabr.* (Verein Zellstoff Ingenieure Section), 1926, **24**, 409-410.

In connection with the author's method of determining the "white content" of bleached wood celluloses by means of the Ostwald half shadow photometer he now lays down conditions as regards physical condition and strength to be fulfilled by the specimens under test. Since even the most highly bleached samples of wood cellulose show colouration, colour filters which eliminate red or yellow tinges must be used. Appropriate filters are shown.
—B.C.I.R.A.

Mercerised Cellulose: Oxygen Absorption. W. Weltzien and G. zum Tobel. *Papier-Fabr.* (Verein Zellstoff Ingenieure Section), 1926, **24**, 413-414.

Mercerised cotton cellulose takes up oxygen in large quantities at room temperature and in greater amount as the temperature is raised. The oxygen absorption curve given for bleached cotton wadding placed in a vessel filled with oxygen and maintained

at a temperature of 60° for 41 days, shows a continuous increase in oxygen absorption. The experiment was stopped before any end point was reached; the amount of oxygen taken up during the experiment exceeded 1 mol. O_2 per $C_6H_{10}O_5$ group.
—B.C.I.R.A.

Starch Solution: Preparation. C. L. Alsberg, E. P. Griffing, and J. Field. *J. Amer. Chem. Soc.*, 1926, **48**, 1299-1300.

Dry starch is ground in an ordinary pebble mill until most of the granules are seen, under the microscope, to be cracked or frayed. The length of the grinding varies with the size of the mill, its charge and speed, and the variety of starch. About 2% of ground starch is sifted slowly into distilled water which is being agitated by an electrical stirring device and stirring is continued for about 1 hour. The liquid is centrifuged at about 2,000 r.p.m. for ½-1 hour and the supernatant solution is decanted and stored in an ordinary bottle with enough toluene to cover the surface. Wheat starch gives a clear solution. Potato starch gives an opalescent solution but the opalescence can be removed by filtering through diatomaceous earth using a Büchner funnel. The solutions keep for many months and are superior to starch paste or Lintner's soluble starch for use as an indicator. —B.C.I.R.A.

Starch Paste: Mechanical Liquefaction. Petit and Richard. *J. Inst. Brewing*, 1926, **32**, 281 (from *Brass. et Malt.*, 1926, **16**, 33-35).

Following on an earlier statement that soluble starch could be prepared from 2% starch paste by mechanical shaking after the addition of traces of mineral salts, it has been found possible to achieve this result by mechanical means alone. Six successive sprayings through a nebuliser under a pressure of 2 lb., or driving three times through tubes fitted internally with baffle-plates yields a soluble starch passing through filter paper and with a specific rotatory power of +210°, the viscosity having decreased to $\frac{1}{25}$ its original value. If this solution is preserved by the addition of toluene or by sterilisation at 100° C., the slight initial cloudiness increases and a deposit, consisting of starch and cellulose fibres, separates in about six months. In cases where the solution is perfectly clear at the start, it remains unaltered during this period. Whereas during diastatic hydrolysis of starch paste very little deposit is formed, similar treatment of a paste liquefied as above results in the separation of a heavy precipitate. Details are given of an examination of this precipitate, indicating that it is an intimate mixture of starch and cellulose. Further investigations show that starch flour that has been treated with petroleum ether gives a paste of very low viscosity. —B.C.I.R.A.

Starch: Constitution. J. C. Irvine and J. Macdonald. *J. Chem. Soc.*, 1926, 1502-1518.

Exhaustive methylation of starch indicated three distinct stages yielding three products of constant composition and properties. These are designated (I.) dimethyl starch, with 32% methoxyl, (II.) methylated starch, 36·3% methoxyl, and (III.) trimethyl starch, 43·7% methoxyl. On hydrolysis with methyl alcohol and hydrogen chloride, II. and III. yielded 2 : 3 : 6-tri-methyl methylglucoside of melting point 57·5°. No trace could be found of the 2 : 3 : 4 product (derived from maltose). The results are in agreement with those arrived at in recent studies of enzyme action. The alternative possible disaccharides based on the 2 : 3 : 6 trimethyl glucose unit are discussed.
—B.C.I.R.A.

Gelatin: Swelling and Osmotic Pressure. J. H. Northrop and M. Kunitz. *J. Gen. Physiol.*, 1926, **8**, 317-337.

The swelling and the osmotic pressure of gelatin at *p*H 4·7 have been measured in the presence of a number of salts. The effect of the salts on the swelling is closely paralleled by the effect on the osmotic pressure, and the bulk modulus of the gelatin particles calculated from these figures is constant up to an increase in volume of 800%. As soon as swelling is increased by any salt beyond this point, the bulk modulus decreases. This is interpreted as showing that the elastic limit has been exceeded. Gelatin swollen in acid returns to its original volume after removal of the acid, while gelatin swollen in salt solution does not do so. This is to be expected if the elastic limit (above) is exceeded. The modulus of elasticity of gelatin swollen in salt solutions varies in the same way as the bulk modulus calculated from the osmotic pressure and the swelling. The increase in osmotic pressure caused by the salt is reversible on removal of the salt. The observed osmotic pressure is much greater than the osmotic pressure calculated from the Donnan equilibrium except in the case of aluminium chloride where the calculated and observed pressures agree closely. The increase in swelling in salt solutions is due to an increase in osmotic pressure. This increase is probably due to a change in the osmotic pressure of the gelatin itself rather than to a difference in ion concentration. —B.C.I.R.A.

Stressed Gelatin: X-ray Fibre Structure. (1) J. R. Katz. (2) O. Gerngross and J. R. Katz. *Kolloid. Z.*, 1926, **39**, 180-183.

(1) Following the work in which an analogy between the X-ray diagrams of stressed gelatin and fibrous collagen is demonstrated, the authors looked for evidence of fibrillar structure in gelatin which had been more highly stressed. Such stressed

gelatin after drying *in vacuo* over sulphuric acid showed, often without mechanical treatment, fissures in the direction of stress. When a strip of such gelatin after long drying was struck sharply with a hammer it broke into splinters which were fibrous and recalled asbestos fibres. It is pointed out that although a necessary condition of fibre structure is the ability to split along the length axis the converse is not necessarily proof of fibrillar structure.

(2) The method used by the authors in making glycerin-gelatin gels capable of sustaining very high stresses is described. With improved technique in stressing, the similarity between the X-ray diagrams of stressed gelatin and sinew collagen is further emphasised. —B.C.I.R.A.

Stressed Gelatin: X-ray Diagrams. J. R. Katz and O. Gerngross. *Chem. Abs.*, 1926, **20**, 528 (from *Natur-wiss.*, 1925, **13**, 900-903).

In the X-ray diffraction spectrum obtained from dry gelatin films, prepared with and without mechanical stress, the diffuse ring and the wide, sharp ring occurring in the unstressed material (periods of identity 4 and 2·7 Å.u. respectively) changed their appearance in stressed gelatin (100% elongation). The sharp ring dissolved into two crescent-shaped parts in the direction of the stress, two broad interference spots appeared (10 Å.u.) on both lateral sides of the central blackening, two diffuse elliptical spots at 5·5 Å.u., and no peripheral spots. This spectral diagram is in every detail analogous to that of fibrous collagen. From a theoretical standpoint this is of great importance, in that for the first time a fibre X-ray diagram has been artificially produced. Theoretical discussion is as yet withheld. —B.C.I.R.A.

Adhesives and Adhesive Action. *Engineering*, 1926, **121**, 700-701 and 737-738.

An illustrated review of the Second Report of the Adhesives Research Committee. Work on the extraction of gelatin from new sources and on its purification and standardisation is described. Details are given of the methods employed in a general investigation into adhesive action. Various types of tension and shear tests of films of adhesive between wood and between metal surfaces are described. For some films between metal surfaces the following conclusions are drawn—Thin films are stronger than thick and smooth surfaces give better joints than rough. From more general experiments is shown the benefit of applying an adhesive in two or even three stages, allowing each subsidiary film to dry before the next is applied. It is suggested that any fluid which wets a non-porous surface and then by cooling or other processes becomes a tenacious mass may be regarded as an adhesive for that surface. The various methods employed to test the tensile and shear strengths of films of glues and gelatins are described. It was found that the fracture of a glued wood joint was usually due to the breakdown of the wood, the tensile strength of the adhesive itself being greater than that of wood. —L.I.R.A.

Pectin; A Comparison of Various Methods of Obtaining Ash-free——. A. M. Emmett. *Biochem. J.*, 1926, **20**, 564-568.

The inorganic matter present in pectin may be reduced to 0·5% by electrodialysis. This method is more efficient than dialysis against distilled water or N/50 hydrochloric acid. The apparatus is described in detail. The residual 0·5% of inorganic matter is not removable by further dialysis. —L.I.R.A.

Pectin: Preparation. M. A. Griggs and R. Johnston. *J. Ind. Eng. Chem.*, 1926, **18**, 623-625.

The preparation of pure pectin from lemon albedo is described in detail. After extraction with acid the electrolytes are removed by dialysis, the pectin is precipitated by dropwise addition of alcohol, the gelatinous precipitate is flocculated by electrolysis and is filtered by suction through silk cloth. The product contains 11% moisture, 0·18% ash, has a specific rotation of +230 at 23° C., and is of high jellying power. The colloidal properties of the aqueous pectin solutions are described and a table of viscosities is given. The structure of the pectin gel is under investigation. —B.C.I.R.A.

Incrustations of Flax. F. Ehrlich and F. Schubert. *J. Chem. Soc.*, A., 1926, p. 547 (from *Biochem. Z.*, 1926, **169**, 13-66).

Extraction of the fibre with water at 120°-135°/2 atm. removes the pectin in a water-soluble form (hydropectin) in a yield of 16% of the dried flax. Hydropectin is a mixture of 53 parts of hexopentosan (extracted by 70% alcohol) and 45 parts of calcium magnesium pectate. The hexopentosan on hydrolysis gives a syrup containing 55% of pentoses, 17% of *d*-galactose and 20% lævulose. Further, the presence of *l*-xylose was inferred from the rotatory power of the hydrolytic products, whence the hexopentosan is supposed to be galactan - lævulosan - xylan - diaraban. Calcium magnesium pectate and free pectic acid have been examined; the former contains 3·6% of methoxyl and the latter smaller percentages of methoxyl and acetyl groups than in the corresponding product from turnips. Galacturonic acid equivalent to 56% of the pectic acid was isolated on acid hydrolysis, and *l*-arabinose, *l*-xylose, and *d*-galactose were also identified in quantities suggesting the formula $C_{46}H_{68}O_{40}$, or diacetyl-arabino-xylo-galacto-dimethoxyltetragalacturonic acid. —L.I.R.A.

α-Lignin: Constitution. E. Hägglund. *Biochem. Z.*, 1925, **158**, 350-356.

Further experimental evidence in the form of analyses of the β-naphthylamine compound of α-lignosulphonic acid, &c., is brought forward in proof of the chemical identity of α-lignin. —B.C.I.R.A.

Lignin: Constitution. K. Freudenberg and H. Hess. *Annalen*, 1926, **448**, 121-133.

The authors formulate some reactions which serve to characterise the hydroxyl groups of primary, secondary, tertiary alcohols and phenols, and apply them to differentiating between the different hydroxyl groups of the lignin molecule. Assuming 820 as the molecular weight of lignin, they find that five hydroxyl groups react with *p*-toluene-sulphonyl chloride. Of these, less than one (0·9) is aromatic in character, the remaining 4·1 hydroxyls are aliphatic or hydroaromatic. Of these non-phenolic hydroxyls 0·6 was primary. Of 16 gram atoms of oxygen contained in 820 grams lignin, four are found in the methoxyl groups, more than four belong to aliphatic, mainly secondary or possibly to hydroaromatic hydroxyls. Approximately one is phenolic, and a half may be carbonyl oxygen. Carboxyl groups were not detected. There is no tertiary hydroxyl present. —B.C.I.R.A.

Stocking Yarns: Mechanical Properties. P. Krais. *Leipziger Monats. Text.-Ind.*, 1925, **40**, 259-260.

A table of measurements of tensile and bursting strengths and extensibilities and other mechanical properties of artificial silk and mercerised cotton yarns used for making stockings is given. In a table comparing the relative strengths with those of loaded and unloaded silk yarns it is shown that the wearing qualities of artificial silk and mercerised cotton are higher than those of loaded silk yarns, but considerably below those of unloaded silk yarns. —B.C.I.R.A.

Textile Fabric: Tribo-electric Properties. P. E. Shaw and C. S. Jex. *Proc. Roy. Soc.*, 1926, A111, 339-355.

In observations of the charges arising by rubbing together two like solids (glass/glass) which have been rubbed or heated differently, and of the mutual friction of two like solids (glass/glass) which have been similarly rubbed or otherwise treated in a systematic way, the following definite effects have been found—(1) A glass surface starting in a standard state of purity adsorbs condensible material if left in the air and its coefficient of friction (μ) *slowly* descends in several days from a value 1·2 to about 0·7. (2) Ordinary textiles rubbed on the standard glass bring about the lowering of μ *quickly*. For a value of $\mu = 0{\cdot}18$ the charge on the glass due to rubbing becomes positive, having been negative for higher values of μ. (3) Textile materials, rendered clean by prolonged extraction in a Soxhlet slowly reduce μ for the glass to about 0·6 as the limit. The charge on the glass remains negative. (4) When glass has medium values of μ the sign of the charge due to rubbing can be made + or — according as rubbing is gentle or violent, and when yarns and fabrics are used, according as rubbing is along or across the fibre. (5) Two standard glass surfaces acquire no charges when rubbed together, but if one has been rubbed by a textile more than the other it is positive to the other. —B.C.I.R.A.

Fenchel Paper "Water-extensibility" Tester. K. Fenchel. *Papier-Fabr.* (Fest.-u. Ausland-Heft), 1926, 98-103.

An instrument constructed by the Schopper firm for testing the extensibility of paper in the wet state is described in which the extension of a wet strip of paper is measured under the constant conditions following—(1) An immersion of the strip for one minute in distilled water at room temperature and the extension reading taken after an interval of three minutes; (2) the load to be half the weight per square metre of the paper under test and to be applied before immersing the strip; (3) the test strip to be taken from the middle of the paper width. The so obtained extension value is termed the "water extensibility." The "moisture extensibility" will be dealt with in a later communication. —B.C.I.R.A.

Writing Paper: Tensile Testing. S. Kohler and G. Hall. *Chem. Abs.*, 1926, **20**, 987-988 (from *World's Paper Trade Review*, 1926, **84**, 1610-1614; *Paper Makers' Monthly J.*, 1926, **63**, 419-421; and *Paper Mill*, 1925, **49**, No. 50, 14, 16).

Tests made at the Swedish Government Testing Institute show that—(1) The tensile strength is increased and the elongation decreased on increasing the speed at which the Schopper tester is run; (2) no difference in folding resistance is observed on running the machine at 80 and 110 double folds a minute, and an increase of about 5% on running it at 140 double folds a minute; (3) better agreement is obtained in the determination of tensile strength than in determining folding resistance; (4) under the action of light the folding resistance of paper made from bleached sulphite pulp decreased much more rapidly than that of unbleached or bleached cotton or linen rag paper; (5) increase in the copper number of the fibre material probably reduces the durability of the paper; (6) rosin sizing causes a decrease in the folding resistance. The effects of different sizing and loading on durability are given. —B.C.I.R.A.

Mullen Tester: Application. K. Fenchel. *Papier-fabrikant* (Verein Zellstoff Ingenieure Section), 1926, **24**, 294-295.

The bursting test affords the best method of judging the strength properties of paper, but the results must be expressed in a form which is independent of the weight per sq. metre of the paper. The author proposes for the comparison of different papers tested on the same machine a factor which he calls the relative bursting pressure which is the observed bursting pressure reduced to a weight per sq. metre of 100 grams. A table is reproduced showing, for the apparatus used by the author, the relation between relative and absolute bursting pressures for papers having weights per sq. metre between 50 and 160 grams. —B.C.I.R.A.

Paraguay Cotton: Spinning Test. T. Bühler. *Leipziger Monats. Text.-Ind.*, 1926, **41**, 161-163.

Climatic conditions in Paraguay are almost as favourable for cotton cultivation as those in a large part of the cotton belt of the United States. The results of a spinning test on Paraguay "Primera" cotton are given. According to the staple diagrams 52% of this cotton is between 25 and 30 mm. staple, and 30% between 20 and 25 mm. The cotton was spun to the same counts as American strict middling of 28-30 mm. staple. —B.C.I.R.A.

Chinese Cotton: Spinning Tests. *Textiel-ind.*, 1925, **6**, 67-71.

Spinning tests on acclimatised "Trice" and "Acala" cottons and the improved native type known as "Million Dollar" are reported. The Trice cotton was clean and free from sand, leaf, seed, and water; the blow room loss was 6·8% as against 8·5% for Middling American. The breaking load of 20's warp was about 70-75 lb., between those of G.M. and F.M. American. The Acala gave even better results, a 2/42 yarn was stronger than G.M. American, showing that the cotton is suitable for fine counts. Compared with ordinary mixing the Acala appears to possess greater strength for less weight; the fine convolutions which characterise this variety facilitate spinning which accordingly requires less working time. The yarn is very supple and lustrous. Contrary to the opinion generally held of Chinese cotton, it is possible to spin successfully from the "Million Dollar" variety 36 and 42's yarns, and 32's yarn can be spun profitably commercially. The appearance is undoubtedly better than that of American yarns and the whiteness, evenness, and lustre of the fabric are striking. Statistics for the years 1923 and 1924 are given in the article in respect of the number of spindles in Chinese mills, Chinese production, imports, exports and consumption of raw cotton, hours of wages and conditions of work in the Chinese mills. In 1924 only 17% of the cotton sent to the Cotton Testing House was passed as standard (as compared with 31 and 40% in the two preceding years). The measures taken in the various provinces to repress illicit practices (mainly weighting cotton with water) are described, and consist in free seed distribution and establishment of test houses. —B.C.I.R.A.

Tests for the Fastness of Dyestuffs on Wool; A Proposed System of——. H. R. Hirst. *J. Soc. Dyers and Col.*, 1925, **41**, 347-354.

Gives in detail methods which have been adopted for testing the fastness of dyestuffs on wool. The standards recommended by the German Commission on Fastness of Dyes (1914) have been used with certain modifications. A bibliography is appended. —L.I.R.A.

Absorbent Cotton: Testing. M. Francois and F. Richard. *Chem. Abs.*, 1926, **20**, 1303 (from *J. pharm. chim.*, 1925, **2**, 273-280).

A review of several standard methods indicates the need for an assay method for absorbent cotton. A well-defined immersion test should be given in the Pharmacopœia Codex, allowing a maximum of 10 secs. for the time of complete wetting. The fat content, to be determined by extraction with ethyl alcohol, should not exceed 0·20 gram per 100 grams of cotton, and tests for ash and neutrality should be given. —B.C.I.R.A.

Absorbent Cotton: Testing. Alfredo and Pagniello. *Chem. Abstr.*, 1925, **19**, 3349 (from *Giorn. farm. chim.*, 1925, **74**, 153-158).

The Italian army medical service test for absorbent power gives lower results than the usual immersion test but claims to be exact. The absorbent power is reduced in strongly twined fibres and is sometimes completely destroyed by sterilisation. —B.C.I.R.A.

Elasticity. A. Schob. *Chem. Abstr.*, 1926, **20**, 684 (from *Gummi-Ztg.*, 1925, **40**, 624-625).

It is proposed to define elasticity as the ratio: work recovered/work expended, when a material is subjected to deformation. For complete elasticity the ratio is 1 and for complete plasticity it is 0. Neither limit is, however, reached by any material. This definition does not involve the extent of the deformation, the latter depending merely on the specific resistance against deformation. Deformation thus presupposes elasticity but is not a measure of it. On this basis rubber is a relatively inelastic material, compared, for example, with steel. Elasticity as thus defined can be measured directly by the relative height or rebound of a falling body. —B.C.I.R.A.

Colorimetry. C. Schæfer. *Physikal. Z.*, 1926, **27**, 347-353.

The author tested Ostwald's view that the addition of black to a pigment alters its shade (other authorities have assumed that only darkening occurs). By measuring the relative brightness of a yellow (and green) pigment alone and mixed with 25%, 50%, and 75% of black pigment, decreases in relative brightness of approximately 25%, 50%, and 75% were obtained.

These differences could be compensated by suitable illumination. The conclusion is drawn that admixture of black effects only a darkening. By a theoretical treatment of light remission powers of pigments—Ostwald's black and white correspond to maxima and minima on the remission curves—the author shows that it is impossible to characterise a definite colour tone by its content of black and white alone, and that a further factor, namely, the width of the remission region must be taken into consideration. —B.C.I.R.A.

White Paper: Colour Measurement; and the Pfund Colorimeter. R. E. Lofton. *Technologic Papers, Bur. Standards*, 1923, **17**, 667-676.

The colour characteristics of 21 commercial white papers have been measured using the Pfund colorimeter in which the principle of multiple reflections is employed. Light from a 100 watt incandescent lamp falls on the larger of two discs of the paper to be investigated and is reflected between the two discs and finally up through a circular aperture in the smaller disc to an optical cube by which it is reflected horizontally into an eyepiece. Simultaneously a beam of light from the source is reflected by a roughly ground glass disc along a tube, through the optical cube and into the eyepiece. The field of view through the eyepiece is divided horizontally and the lower half is lighted by diffuse reflection from the samples. A lever arm and pointer are connected with the horizontal axis of the mirror, and by means of the lever arm the ground glass mirror can be rotated about its horizontal axis so as to direct any proportion of its total reflection along the tube to the eyepiece. The pointer moves along an arbitrary scale which has been graduated in terms of light intensities. The examination of the paper is made by matching the two halves of the field as they appear when viewed through each of three coloured glasses placed at a given point in the eyepiece tube. A graph furnished with the colorimeter may be used to convert the scale readings found to coefficients of diffuse reflection. None of the papers tested was found to be truly white. —B.C.I.R.A.

Eastman Colorimeter: Application. W. Brecht. *Papier-Fabr.* (Fest-u. Ausland Heft), 1926, 72-86.

The results of researches concerned with the numerical determination of fastness to light of papers, indicate that the Eastman colorimeter can be adapted to this purpose in a satisfactory way. Three papers of optically different colour-appearance were tested for their colour composition before and after being subjected to the action of standard artificial radiation from an electric light source. The change in the separate component constituents was expressed as a percentage and represent a criterion indirectly proportional to the fastness to light. It was found necessary to take into account errors specific to the observer and the paper colour tested. The researches communicated form the beginning of a systematic investigation which aims at explaining the effect of different fibre substances and different sizes, dyestuffs and loading materials on the fastness to light of papers. —B.C.I.R.A.

"Guild" Trichromatic Colorimeter. J. Guild. *J. Sci. Instr.*, 1926, **3**, 273.

In this instrument, which is designed for standardisation work as well as for ordinary test purposes, the primaries are obtained by dyed gelatin filters giving saturated red, green, and blue colours respectively. The filters are mounted in three annular windows while a periscopic prism, revolving rapidly about the centre of one of its apertures, combines the three colours by persistence of vision. The outer end of this prism passes immediately behind each filter and so transmits the light from each to the centre of the optical system and the field of view. Sectorial shutters in front of the annular windows control the relative amounts of the three primaries in the mixture. Provision is made for measuring saturated colours by a dilution method. The results can readily be transferred from the arbitrary primaries of the instrument to any fundamental set of primaries, or can be expressed in terms of hue and saturation if desired. —B.C.I.R.A.

Heterochromatic Photometry. C. Schaefer. *Physikal. Z.*, 1925, **26**, 58-64 and 908-913.

The author has made photometric measurements, step by step, round a complete colour cycle, such as the Ostwald colour atlas, using (*a*) a direct comparison, and (*b*) a flicker photometer, in order to determine whether the commutative law is valid for these two methods of heterochromatic photometry. He finds that if too few steps are taken the individual comparisons become inexact owing to the large colour differences involved; if on the other hand the steps are small, the accumulated error at the end of the cycle is large. With 12 steps he finds that both systems are valid to about 3 or 4% and this must be regarded as within the experimental error. By further work reported subsequently the validity of heterochromatic photometry was confirmed. —B.C.I.R.A.

Dyestuffs: Light Sensitivity. G. Kögel and A. Steigmann. *Kolloid-Z.*, 1926, **39**, 52-56.

It is possible to detect latent light impressions in Methylene Blue in the presence of gelatin (or cellulose) as dye substrate. An exposure to light of 1-2 seconds is sufficient to make a silver-free Methylene Blue-gelatin paper developable. Methylene Blue yields, on the shortest exposure, with strictly yellow, red, blue, or green filters, a reduction product which reduces silver nitrate and even silver chloride to "nuclear" silver. If therefore the exposed panchromatic Methylene Blue-gelatin paper has poured over it a silver nitrate solution (1 : 100), there results in the exposed parts of the Methylene Blue gelatin (with any filter but least with green), silver nuclei on which image-forming silver precipitates on subsequent physical development with alkali-free metol-sulphite (and silver nitrate which is already present in the film). The panchromatism of the Methylene Blue, specially its red- and green-sensitivity is so extraordinarily well marked that the paper is suitable for meteorological and physiological light measurements. Quinonediazide - gelatin papers can be prepared and developed in the same way, and other dyes which have been found to act similarly are dicyanine, orthochrome-T, eosin, erythrosin, rhodamine B, thioflavine-T, flavinduline and phenosafranine. —B.C.I.R.A.

Emulsification. A. J. Stamm and E. O. Kraemer. *J. Phys. Chem.*, 1926, **30**, 992-1000.

A survey of recent studies of emulsions shows that much of the original evidence for the "oriented wedge" theory of emulsions has not been confirmed and that the consequences predicted by the theory have not materialised. It is suggested that insufficient attention has been paid to the mechanism of emulsion formation. The formation of an emulsion by shaking, mixing, &c., may be safely considered as consisting of two stages—(1) A pulverisation of both phases into lamellæ and drops, and (2) a coagulation or reunion of the drops of one or both phases. The degree of dispersion and the phase relations of an emulsion are the net results of these two opposing processes. The function of an "emulsifying agent" is to protect, more or less, the drops of *one* phase already formed in the pulverising stage from coagulating, whilst allowing the drops of the other phase to coagulate to give the dispersion medium. The protecting or stabilising action probably depends on the formation of a film at the interface. Although the character of such a stabilising film is incompletely understood, it seems unlikely that the molecules in the film can determine the film properties by virtue of their geometrical size and shape, as suggested in the oriented wedge theory. Examples are given to demonstrate the complexity of the mechanism of emulsion formation.

—B.C.I.R.A.

Fats and Oils: Iodine Values. B. M. Margosches and K. Fuchs. *Ber.*, 1926, **59**, 375-376.

The difference between the per-iodine number and the iodine number is suggested as a convenient constant for fats. Iodine numbers, per-iodine numbers, and "difference iodine numbers" are tabulated for a number of oils, including cotton seed oil. —B.C.I.R.A.

Mineral Oils: Autoxidation of, and Determination of the Tar Value. J. Marcusson and W. Bauerschafer. *J. Soc. Chem. Ind.*, B., 1926, p. 427 (from *Chem Ztg.*, 1926, **50**, 263-264).

The acids produced in the sludge test of mineral oils have been examined. Those from a normal, unrefined transformer oil (d^{20} 0·891, open flash pt. 154°, acid value nil, tar value 0·88, ash 0·015%, viscosity at 20° 3·09) had a greater density than 1 and the copper salts were completely soluble in benzine. Treatment with benzine caused a separation into 60% of soluble oily acids and 40% of insoluble, asphaltic acids. The soluble acids had acid value 66, saponif. value 130, acetyl value 58, iodine value 16, mean molecular weight (Rast) 285. No reaction was given in the formolite test. The insoluble acids had acid value 67, saponif. value 269, acetyl value 127, iodine value 18. It is concluded that the soluble acids consist of hydroxynapthenic acids formed from saturated naphthenes and that the insoluble acids are produced from unsaturated hydrocarbons by union of two molecules and the addition of oxygen. Of the acids from a refined white oil (d^{20} 0·842, open flash pt. 181°, free acid nil, sulphur 0·015%, tar value 14·5, viscosity at 20° (3·98), 90% were soluble in benzine and this fraction had d 1·014, acid value 121, saponif. value 240, acetyl value 44, iodine value 16, mean molecular weight 357, and gave a negative formolite reaction. The copper salts were soluble in benzine and the peroxide content was very slight, the amount of active oxygen present being 0·06%. A modified sludge test is described, wherein, by the use of sodium hydroxide as catalyst, a saving in time and oxygen is effected. Fifty g. of the oil are mixed with 10 g. of pumice saturated with sodium hydroxide (prepared by addition of the pumice to 0·7 g. of sodium hydroxide in 10 c.c. of water and drying at 105°) in a 200 c.c. conical flask and heated at 120° for 24 hours. The mixture is cooled, 50 c.c. of 50% alcoholic sodium hydroxide (containing 7·5% NaOH) are added, and the liquid is heated under a reflux condenser for 25 minutes. The soap solution is separated, acidified, and extracted with benzene. From the extract, after removal of mineral acid by washing, the tarry matter is obtained by evaporation. This method with refined transformer oils, gives results differing by only a few hundredths of 1% from those obtained by the standard German method. —L.I.R.A.

Distinguishing Indigo from Indanthrene Blue. C. F. Green. *Text. Colorist*, 1926, **48**, 615.

Dyed fabric is spotted with a solution containing 10 g. of stannous chloride, 50 c.c. of hydrochloric acid and 50 c.c. of water; either dye is discharged, but that of Indanthrene Blue returns whereas Indigo does not. —A.J.H.

7—BUILDING AND POWER

(C)—Power

Springs: Design. (1) T. McLean Jasper. (2) W. G. Brombacher. *Mech. Eng.*, 1926, **48**, 487-494.

(1) The paper deals with the design of steel springs to be used for shock-absorbing and for recuperating machinery. Experimental results of tensile strength and other tests on a 1·02% carbon steel quenched at various temperatures are given.

(2) The paper gives the results obtained in a study of the design and properties of phosphor-bronze helical springs for precision instruments. The spring testing apparatus is described.

(3) A report of the discussion on the above two papers. —B.C.I.R.A.

Purifying Steam. *J. Soc. Dyers and Col.*, 1926, **42**, p. 162.

A new development in connection with boiler plant, the automatic drying and purification of the steam inside the boiler itself, is of particular interest to dyers and bleachers. There are normally present in the steam, particles of iron rust from boilers, pipes and tanks, as well as mineral dust, chiefly scale, which is deposited in the boiler, even with a water of 5° hardness, together with 2-5% of free moisture particles in the form of a mist carried over mechanically. Absolutely clean steam is very important in dyeing operations, and a new separator and dryer known as the "Atlas" made by the Power Auxiliaries Co. Ltd., of Manchester, claims to remove all the solid impurities and reduce the moisture content to less than 0·5%. The apparatus consists of a longitudinal light cast-iron box, inside the boiler, attached to the bottom of the steam outlet pipe. The steam enters through the sides of the box, which is built up of a large number of narrow gutter baffles with a narrow slit space between, arranged in rows close together, one behind the other, the slits in each row being staggered relatively to the next row. In this way the steam is split up into hundreds of narrow streams (the total area of which, however, is greater than the boiler outlet pipe) which are forced to take a rapid zig-zag course, during which all the water particles and the impurities are left behind. These run down to the bottom of the boxes, and are discharged by a pipe through the front of the boiler. —L.I.R.A.

Zeolite Water Softening. F. B. Beech. *J. Chem. Soc.*, 1926, B., p. 468 (from *Eng. and Cont. Water Works, Issue*, 1925, **64**, p. 1051-4).

Experiences with a zeolite water-softening plant for treating boiler feed water are outlined. The saving in fuel consumption and boiler maintenance effected during the first ten months of working was sufficient to pay the cost of the softening plant. The base-exchange compound used is glauconite (greensand), a hydrous silicate of iron, aluminium, and potassium, and after 20 months' use the only important change detectable in the material was an increase in the manganese content from 0 to 0·28%. Approximately ⅓ lb. of sodium chloride is required for regeneration per 1,000 grains of hardness removed. The plant will remove manganese and *Crenothrix*, rendering the water suitable for laundry purposes, &c. There is little difference in the cost of softening by this method and by the lime soda process. —L.I.R.A.

(F)—Lighting

Lighting of Silk Mills. W. J. Jones. *Silk J.*, 1926, **2**, No. 21, p. 62.

Photographs are given showing old-fashioned and scientific lighting of the same weaving shed. The figures given prove that 15% greater production may be obtained at a trifling increase of cost for lighting. Old style of drop pendants supply patches of intense light amid comparative darkness, while the new system of grouped lamps produce an effect resembling daylight in character and uniformity, at the same time saving wiring, giving greater power efficiency and involving less breakage of lamps. Details of lighting arrangements should be carefully adjusted to the requirements of the room. —F.G.P.

Lamplough Daylight Unit. F. E. Lamplough. *J. Soc. Dyers and Col.*, 1926, **42**, 110.

The unit contains six 200 or three 500 watt lamps and gives a good and even illumination. Reference is made to the "shot" effect due to the "yellow spot" of the retina, which causes pairs of fabrics which match when examined near the eyes to appear totally out of match when seen at a little distance. —B.C.I.R.A.

Electric Lamp Photoelectric Control Apparatus. J. Kunz and V. E. Shelford. *J. Optical Soc. America*, 1926, **12**, 693-696.

Equipment for controlling artificial lights so that they are turned on when sunlight is obscured and off when it is available comprises a Kunz photoelectric cell, a galvanometer relay, a pneumatic valve and a pneumatic electric switch. Diagrams are given showing the arrangement of the apparatus which renders possible the automatic control of factory lights, &c. —B.C.I.R.A.

Lighting. F. Benford. *Gen. Elec. Rev.*, 1925, **28**, 707-713.

Some notes on light and vision, including a discussion of some types of glare and other causes of eye fatigue and a brief treatment of the merits of direct, indirect, and semi-direct lighting. —B.C.I.R.A.

(G)—HEATING

Heating and Ventilating Installations: Modern, in the Textile Industry. G. Schmidt. *Leipziger Monats. Text. Ind.*, 1926, **41**, 267-269.

Temperatures are given for points at various heights above the floor of a shed and the system of ventilating by using the greater buoyancy of the warmer air is shown to waste a considerable amount of heat. It is pointed out that long hot air conduits made of metal also give large heat losses. A system is described in which machines designed to heat and circulate the air are installed in the places in which hot air is needed. The supply of heat is provided by steam or hot water pipes and each heating unit can be turned off when not required. The system is claimed to be very economical and is easily installed. It can be used also to cool the air in warm weather, thereby reducing the supply of moisture necessary to give suitable working conditions. —L.I.R.A.

(H)—HUMIDIFICATION

"Vortex" Humidifier. J. W. Graham. *Text. Rec.*, 1926, **44**, No. 518, 80-83.

A lecture on humidification in the cotton cloth factory, dealing with the effect of artificial humidification on the cotton, on the operatives and on the standing charges of the mill, and with special reference to the Vortex system of humidification. This consists of a series of cylinders connected together and to a pump by suitable feed and return pipings. The pump draws water from a tank which is, in turn, supplied from the drinking water service. In the upper part of each cylinder is a jet with a nozzle of $\frac{1}{16}$ in. diameter from which is pumped $1\frac{1}{4}$ gallons of water per minute. On leaving the orifice the stream of water impinges on the flat head of a toughened nickel pin which breaks it up into the shape of a constantly onrushing hollow cone of water. As this speedily fills the body of the machine it establishes a partial vacuum sufficiently powerful to induce a current of 1,000 cu. ft. of air per minute to enter the machine. During its passage through the water spray the air is humidified, heated, or cooled by the use of hot or cold water, and thoroughly cleansed of dust and dirt particles. —B.C.I.R.A.

Hygrometers. *Text. Merc.*, 1926, **74**, 479.

A general account of methods of measuring humidity in the textile industry. —B.C.I.R.A.

Recording Hygrometer. L. Behr. *J. Optical Soc. America*, 1926, **12**, 623-653.

From the formula for relative humidity in terms of wet and dry bulb temperatures, it is shown that for constant humidity the relation between the temperatures is very nearly a linear one, and that the value of the humidity is defined by the ratio (wet bulb temperature —A) / (dry bulb temperature —B) where B is a constant and A is a function of the relative humidity but changes only slightly with it. By using a nickel resistance thermometer in a network which is essentially a split circuit potentiometer, it is possible to secure a potential difference across the ends of a slide wire which is directly proportional to the denominator of the ratio. In a similar circuit a potential difference is obtained which is proportional to the numerator. The latter potential difference is automatically balanced against a portion of the former by recorder mechanism and the position of balance indicates the ratio, so that the instrument reads directly in relative humidity. The recorder mechanism is capable of automatically balancing any network of impedances where the balance point is attained by the motion of one or more sliders along slide wires and where the balance point is determined by the absence of current in the recorder galvanometer. Two forms of wet bulb are described which are capable of continuous operation. In one, the customary wick is replaced by a spray and in the other a long wick is provided so that a clean portion can be substituted for the soiled part merely by turning a roller to wind the wick from one holder to another. —B.C.I.R.A.

(I)—VENTILATION

Ventilation in Weaving Sheds. *Text. Mf.*, 1926, **52**, 218.

An account is given of experiments carried out by the Industrial Fatigue Research Board to observe the effect of fan ventilation in a weaving shed and also to determine at what values of temperature and relative humidity the output reaches a maximum. The output when the fans were running, was found to increase by 1·6% in the morning spell and 2·9% in the afternoon spell. The beneficial effect of the fans was most marked when the temperature and relative humidity were high. The value of the relative humidity at which the number of warp breakages was a minimum was found to be 87·5%, while the value for maximum output was between 75 and 80%, thus showing that high relative humidity reduces the efficiency of the weaver. The temperature for maximum output was between 72·5° and 75° F. The investigation shows that very high temperature and humidities are undesirable and that the output is increased by efficient ventilation. —L.I.R.A.

Ventilation Installations; Textile——. See Section 7G.

8—DESIGN

The Mutochrome and its Application to the Coloration of Design in Industry. A. B. Klein. *J. Soc. Dyers and Col.*, 1926, **42**, 121-124.

The purpose of the Mutochrome is to enable any given design or pattern to be studied in an infinite variety of colour combinations with the minimum expenditure of time and effort. Briefly stated, the method adopted is to produce on different portions of the same photographic plate a series of transparencies each of which corresponds to one element of the design. These images are then projected on to a screen through separate lenses in such a way as to "mesh" accurately. Any individual element can then be coloured in any desired manner by the insertion of a colour filter in front of the corresponding lens, the adjustment of an iris diaphragm controlling the brightness or "depth" of the colour. The Mutochrome is used both for making the transparencies and for projection—a procedure which not only simplifies the preliminary operations, but also gives a perfect solution of the problem of registration. Having once obtained the transparencies for the elements of any design, an infinite number of colour combinations and gradations can be tried with the utmost speed. If the screen is covered by material of the texture which is actually to be used, the precise appearance of the coloured fabric will be seen. —L.I.R.A.

9—COMMERCE, ECONOMICS, LABOUR, &c.

Silk Hosiery in the Magazines. *Silk J.*, 1926, **2**, No. 21, p. 66.

It is said that American women (numbering about 40½ millions) use annually nearly 625 million pairs of stockings, 40% of which are silk, at a cost of 345 million dollars. Both hosiery and underwear makers are using increasing quantities of rayon. —F.G.P.

Silk in Czecho-Slovakia. *Silk J.*, 1926, **2**, No. 20, p. 72.

Ribbons are produced as a domestic industry, other goods in the mills. There are about 12,500 looms weaving silks, plushes, velvets, satins, and unions. The umbrella and tie silks have a world-wide fame and costly art fabrics for clerical vestments and upholstery are made. —F.G.P.

Cotton: Production Statistics. J. A. Todd. *Emp. Cotton Grow. Rev.*, 1926, **3**, 280-284.

The 1925 crop of American cotton amounted to 57% of the world production of all staples, and to 80% of the world production of medium staples. The acreage, crop, and yield per acre figures by varieties for each year since 1915-16 are given. In 1925-26 the Indian staples ⅞ in. and over averaged 93 lb. per acre, whilst poorer staples yielded only 82 lb. Empire crops for seven years and estimates for the 1925-26 year are given. —B.C.I.R.A.

Cotton Production in Colombia. *Internat. Cotton Bull.*, 1926, **4**, 325-327.

Excellent cotton but very mixed in type is grown in the Atlantico Department. Staple length varies from ⅞ in. to 1¼ in., and all of it is very strong. Nothing but perennial is grown, and the most primitive methods of picking are adopted. The branches in most cases are cut off and allowed to remain on the sandy soil for a week before the cotton is picked. Yields are about 250 lb. per acre. Classing is not performed, and adulteration of cotton in the bale is common. —B.C.I.R.A.

Cotton Cultivation in U.S.A. (Texas). *Internat. Cotton Bull.*, 1926, **4**, 358.

High yields were achieved on small acreages of unirrigated land in connection with a competition organised by the Texas press. The winning crop yielded 16 bales on five acres of old land that had been restored to fertility by intelligent fertilisation and cultivation. The cotton was classed as strict middling 1$\frac{1}{16}$ in. and was sold at 23 cents a lb. Seventeen farmers in Smith County averaged from two to three bales to the acre; and the costs of production for all the 200 entrants who farmed five acres intensively averaged only 9 cents a lb as compared with 22 cents for the whole of the State. —B.C.I.R.A.

Cotton Acreage in U.S.A. *Internat. Cotton Bull.*, 1926, **4**, 359, 361.

A table gives the value of October contracts in both January and March from 1914 to 1926, together with the acreages planted each year. This table is useful in view of the contention of many members of the cotton trade that the price of cotton is not a factor of importance in determining the acreages. They consider that the farmers have no alternative "money crop" and are therefore compelled to concentrate on cotton irrespective of the remuneration offered. The leaders of the American Cotton Association admit the failure of their attempts to restrict the 1926 acreage, preparations for planting having exceeded the acreage for the 1925 crop. The response to the appeal in Texas was particularly small. —B.C.I.R.A.

Cotton in U.S.A. (Oklahoma): Co-operative Marketing. *Internat. Cotton Bull.*, 1926, **4**, 363-365.

The costs of handling cotton by the Oklahoma Cotton Growers' Association during the last four years are analysed. A comparison of street prices with those paid to members shows a gain of 7·15 dollars a bale in 1921-22, 19·58 dollars in 1922-23, a loss of 5·99 dollars in 1923-24 and a gain of 6·51 dollars in 1924-25. From evidence in the trade it is now apparent that the association has influenced the entire industry and street buyers are now operating on a smaller margin than before the organisation was established. —B.C.I.R.A.

Cotton Production in U.S.A. (S. California). *Internat. Cotton Bull.*, 1926, **4**, 365-369 (from the *Mercantile Trust Review of the Pacific*, October, 1925).

The progress of cotton growing in S. California since 1920 is described at length, and a table gives the area under cotton and the yields per acre for the past five years in the San Joaquin Valley, Imperial Valley, and Riverside countries and in the Mexican Imperial Valley. San Joaquin with an average yield of nearly a bale to the acre and an increase from 37,250 acres in 1924 to 91,100 in 1925 shows the greatest progress. —B.C.I.R.A.

Cotton: World Production. *Internat. Cotton Bull.*, 1926, **4**, 376.

The Bureau of Agricultural Economics of the United States Department of Agriculture estimates the world's cotton crop for the 1925-26 season at 27,800,000 bales of 478 lb. net excluding linters, which compares with 24,800,000 bales last season. The U.S.A., Egypt, Sudan, Russia, and Turkey showed increases, the Indian crop remained the same, and slight decreases are reported from Mexico, China, and Peru. Figures for both seasons are given country by country. —B.C.I.R.A.

Cotton Production in Argentina. *Internat. Cotton Bull.*, 1926, **4**, 376.

The crop in 1924-25 suffered from drought and pests and the yields were reduced to 400 lb. seed cotton per acre. An increase in the area under cotton from 104,513 hectares to 110,335 hectares for the 1925-26 crop is however reported. Of the latter area 89% lies in the Chaco Territory. —B.C.I.R.A.

Cotton Production in the Belgian Congo. *Internat. Cotton Bull.*, 1926, **4**, 378.

Cotton to the amount of 6,000 to 7,000 tons will be grown in the north-east of the Belgian Congo—the Uelle district—this year; and cotton raising companies in the whole colony expect to grow between 20,000 and 40,000 tons annually by 1930. Twenty-two ginning stations are in course of erection and orders have been placed for the plant for 13 more. These are in addition to the 21 ginning stations already operating. —B.C.I.R.A.

Cotton Production in Portuguese East Africa. *Internat. Cotton Bull.*, 1926, **4**, 382.

Rapid increase in the numbers of farmers engaged in cotton growing is reported from Southern Mozambique. This area produced 713 bales from 4,470 acres in 1923-24 and a sevenfold increase in acreage was made in 1924-25. The crop for the past season, however, has been a failure owing to floods, heavy rains, and pests. Official estimates place the production at 5,000 bales for all Mozambique as compared with 10,000 bales in 1923-24. —B.C.I.R.A.

Cotton Production in Nyasaland. *Internat. Cotton Bull.*, 1926, **4**, 382.

The 1925 crop is estimated at 2,800 tons of lint, nearly three times the 1924 crop. The Port Herald district produced 1,700 tons. Owing to the appearance of pink bollworm in North Nyasa and to the restrictions placed on cotton movement from that area, cotton growing by the European planters of North Nyasa is almost prohibited, and the question of compensation has been raised. —B.C.I.R.A.

Cotton Production in Peru. *Internat. Cotton Bull.*, 1926, **4**, 392.

The 1926 crop is estimated at 185,000 bales of 500 lb., made up of the following varieties—Tanguis 157,000 bales; Suave 11,000; Mitafifi 11,000; Rough 3,000; Semi-rough 1,000; Pima, Sakel, and others 2,000 bales. A later estimate gives 194,000 bales as the total crop. —B.C.I.R.A.

Cotton Production in Russia. *Internat. Cotton Bull.*, 1926, **4**, 393.

Cotton plantings this year will amount to 1,954,000 acres, an increase of 20%. In Central Asia—the Uzbek Soviet Republic—the plantings are estimated at 1,395,000 acres, in Transcaucasia, 363,150 acres and in the Turkoman Soviet Republic 195,350 acres. —B.C.I.R.A.

Cotton Production in Salvador. *Internat. Cotton Bull.*, 1926, **4**, 393.

The crop for last season will be approximately 3,000 bales, a drop of 8,000 bales in comparison with the previous crop; and it appears certain that the crop will not figure as of any importance during 1926. Failure is ascribed to boll weevil and to other pests. —B.C.I.R.A.

Cotton Cultivation in Egypt and the Sudan. E. J. Russell. *Internat Cotton Bull.*, 1926, **4**, 394-401 (from *Geographical Teacher*).

A general account of the present condition of cotton growing along the Nile Valley. —B.C.I.R.A.

Cotton Production in Syria. *Internat. Cotton Bull.*, 1926, **4**, 401.

The 1925 yield aggregated 6,770 bales of which 90% was grown about Aleppo and is of the Baladi type. In Latakia district about 200,000 lb. were grown; about one-third was of Sakellaridis seed, and some considerable development of this variety is expected. —B.C.I.R.A.

Cotton Cultivation in the Dutch East Indies. *Textielind.*, 1924, **5**, 605-607.

The cotton of Flores (Dutch E. Indies) commands a price on European markets equal to that of good American varieties. Caravonica is the variety planted. The main cotton area consists of the eastern side of the island of Flores, the island groups of Solor and Alor, Sawoe, Rote, the province Koepang, Amarasi, and specially the fertile plains of South Beroe. The cotton crop is an intermediate crop between the djapoeng, the main foodstuff of the natives, and the rice of the dry ground. The great difficulty in the way of extending cotton growing lies in disposing of the crop. This is complicated by the fact that the crop is not vital but merely a source of profit to the population, and accordingly the Government is trying to prevent exploitation of native growers. The history of the formation and fall of a central Amsterdam purchasing company is described and the present selling arrangement through an agreement with the directors of the old company and under Government control of prices is outlined. —B.C.I.R.A.

Cotton Cultivation in the Belgian Congo. *Textielind.*, 1925, **6**, 105-106.

An account of Belgian efforts to establish cotton growing in the Congo. American Upland types, especially "Triumph," are being acclimatised with success. The belt lies between 2° N. and 10° S. of the equator, and the best districts are Maniema, Kasai, Sankuru, and Lomani in the South, and Upper and Lower Uelé in the North. The normal yield per hectare is about 200 kilos. of ginned cotton. The Congo crop in 1921 was about 1,583 tons, in 1922, 2,593, and in 1923, 4,900 tons of raw cotton. Seed supplies and prices, conditions of sale, importation of seed and ginning operations are strictly controlled by a decree applying to all the above districts, the aim being to maintain a high quality in Congo cotton. —B.C.I.R.A.

Cotton Cultivation in India. W. H. Himbury. *Text. Merc.*, 1926, **74**, 476-478.

A report on a recent visit of inspection in India. Considerable progress has been made. A large new ginnery has been established. The work of the agricultural colleges is commended but they are understaffed. The two most important developments taking place are the Sukkur barrage and the extension of irrigation in the Punjab and Sutlej valley scheme. The Sukkur scheme should be complete by 1929 or 1930 when a million acres should be available for cotton growing. —B.C.I.R.A.

Cotton Cultivation in the Sudan. W. H. Himbury. *Text. Merc.*, 1926, **74**, 500-501.

The development of rain-grown cotton—Sakel—and to some extent American varieties—in the lower Sudan is reported on very favourably. Limiting factors are lack of cheap and efficient transport and an inadequate number of ginneries. The four new Government ginneries at Makwar are equipped with a total of 320 roller gins. Two further ginneries with saw-ginning plant will be erected shortly in the Mongalla district. —B.C.I.R.A.

Sisal Industry; Notes on the——. J. M. Wingate. *Bull. Imper. Inst.*, 1926, **24**, 49-50 (from *J. Gold Coast Agric. and Comm. Soc.*, 1925, **4**, 140).

Reference is made to the sisal hemp plantation which has been established near Accra by the Gold Coast Government. During the eight months August 1924 to March 1925, 128 tons of fibre and eight tons of tow were produced. It is estimated that the cost of bringing one acre into bearing and harvesting the leaves would amount to about £6 3s. 6d. One acre of sisal plants should yield 41 tons of leaf during its life and it is probable that the Government would be able to pay 10s. per ton for it. A profit of £14 6s. 6d. would thus be made for about 2½ months' work. The opinion is expressed that the most convenient area for a farmer to work would be nine acres, divided into three equal blocks, one of which should be planted in the first year, one in the second, and one in the third. In the fourth year the first block should be replanted and so on in regular rotation. —L.I.R.A.

Artificial Silk: Application. P. Krais. *Leipziger Monats. Text.-Ind.*, 1926, **41**, 186-187.

Some production and consumption statistics are given, and the uses of artificial silk are briefly discussed. —B.C.I.R.A.

The Stability of Rayon. *Silk J.*, 1926, **2**, No. 21, p. 49.

Rayon is the one fibre not subject to the vagaries of nature, being under human control, consequently there will be no great fluctuations in supply and price, and any demand will surely be met. Therefore if either of the other three great textile fibres fail, as did silk at the time of the Japanese earthquake, rayon can be used partially, at any rate, to bridge the gap. The world's output is so large and its uses so distributed that any basic change is impossible, and the supply is constantly increasing, while qualities improve. Its use is firmly established in the public mind, and only its true virtues should be attributed to it. —F.G.P.

World's Rayon Output Analysed. *Amer. Silk J.*, 1926, **45**, No. 1, p. 57.

Last year's output was 25% more than 1924, and a conservative estimate puts the 1926 production at 33% more than 1925. America leads, but the outputs from Italy, England, and Germany are sufficiently near to make the race interesting. In America the Viscose Company, a subsidiary of Courtaulds, Ltd., produces as much as all the others, the production for 1926 being estimated at 40 million pounds; the estimated total is 80 millions. American rayon imports are considerable: 1,712,184 lb. for 1924, and 5,000,000 lb. for 1925. Japanese production has risen from 527,oco lb. in 1922 to 1,500,000 in 1925. Tables are given showing for 1925, America with

54,700,000 lb., Italy 30,000,000, England 28,000,000, Germany 27,100,000, France 14,400,000, Belgium 11,100,000, and the world's total 185,484,000 lb.; the estimate for 1926 being 245,000,000 lb. The uses of rayon are tabulated—21% is mixed with cotton, 18% with silk, 20% is used in hosiery and 15% in underwear. —F.G.P.

Dyehouse Economics. T. D. Buttercase. *J. Soc. Dyers and Col.*, 1926, **42**, 145-151.

The lecturer dealt with the avoidance of waste in dyehouses under the following headings—Wages, materials (dyewares, chemicals, fillings, &c.), coal and power, repairs and maintenance, miscellaneous (including damages and allowances and all standing charges, rates, insurance, &c.). The importance of having the right type of man for each particular operation and of attention to the welfare of the workers was insisted on. The relations between employers and workers and the subject of wages agreements were discussed. Considerable emphasis was laid on the importance of tracing the causes leading to the production of faulty material. In conclusion the importance of a reliable system of costing was pointed out. The lecture was followed by a discussion. —L.I.R.A.

Female Labour in Japanese Cotton Mills. *Text. Colorist*, 1926, **48**, 557 (from *India Text. J.*).

A report on the conditions in ten cotton mills employing about 84,000 females or about 60% of the total number of such employees in Japan. The report deals with age, average duration of employment, education, working hours, holidays, wages, the dormitory system, medical aid, and recreation. The employees are able to save about 70% of their income. —A.J.H.

Protection in "Color Fast" Labels. *Amer. Silk J.*, 1926, **45**, No. 1, p. 37.

In America goods are labelled "Color Fast" and "Guaranteed" but it is stated that these terms mean nothing, although wholesalers and retailers frequently exaggerate their importance. It is suggested that an association be formed to issue to members paste-on labels saying what is guaranteed and what "Fast" means, as colours fast to light may nor be fast to perspiration and laundering. Such marks attached by the dyer and finisher would have real value in ensuring the public confidence. —F.G.P.

10—MISCELLANEOUS

Hydrogenated Solvents: Properties and Application. E. H. Killheffer. *Amer. Dyestuff Rep.*, 1926, **15**, 345-350.

A general account of the preparation, properties, and industrial uses of the following solvents—"Tetralin" (tetrahydronaphthalene), "Decalin" (decahydronaphthalene), "Hexalin" (cyclohexanol), cyclohexanone, "Hexalin acetate," and "Methylhexalin." —B.C.I.R.A.

Sulphonated Oils: Properties. J. B. Crowe. *Amer. Dyestuff Rep.*, 1926, **15**, 379-382.

A general article dealing with sulphonated oils, including their manufacture, uses, analysis, and requisite properties for use in the textile industry. —B.C.I.R.A.

Zinc Chloride: Toxicity. *Chem. Abs.*, 1925, **19**, 3578 (from *Proc. Am. Wood-Preservers' Assoc.*, 1925, 18-22).

Tests have been made of the resistance of 18 species of wood-destroying fungi to zinc chloride. The order of resistance of the fungi is very different from that for sodium fluoride. Sodium fluoride is slightly more toxic than zinc chloride to two-thirds of the fungi tested. —B.C.I.R A.

Mercury Lamp. E. O. Hulburt. *J. Optical Soc. America*, 1926, **12**, 519-520.

A simple laboratory mercury lamp is described which can be blown from pyrex or quartz tubing and in which wax seals can be employed. The form and dimensions of the tube are given. The electrodes are of iron. When exhausting, the lamp is tilted continuously to allow as much gas as possible to be drawn off. It is sealed by a stop cock. The lamp has a life of about 20 hours, but can be renewed by re-exhausting. With a current of 2 ampères its light intensity is equal to that of the small Cooper Hewitt quartz lamp. —B.C.I.R.A.

Microscope in the Textile Laboratory; Some Notes on the Use of the——. L. G. Lawrie. *J. Soc. Dyers and Col.*, 1926, **42**, 73-76.

The author briefly reviews the manifold uses to which the microscope may be put in the textile laboratory. Simple methods of cutting thin sections of textile fibres for microscopic examination are described. —L.I.R.A.

Caustic Soda Recovery Plant. A. Schrohe. *Papier-fabrikant* (Verein Zellstoff Ingenieure Section), 1926, **24**, 297-299.

A synopsis of processes described for the recovery of waste caustic soda in the manufacture of viscose and in the mercerisation of cotton. —B.C.I.R.A.

Recovery of By-products from Wool Scour Effluents. *Text. Rec.*, 1926, **44**, No. 521, 55-57.

A description of methods for recovering fatty materials. —A.J.H.

Patents

Sodium Hydroxide Recovery. L. N. Taylor, London. E.P.252,304.

Alkali may be recovered from waste liquors, obtained in the treatment of cellulose material with caustic soda, by precipitating with magnesium bicarbonate. The filtered liquor is boiled and the carbon dioxide evolved is recovered. The resulting solution of sodium carbonate may be causticised in the known manner. —B.C.I.R.A.

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