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THE PREPARATION AND FINISHING OF RAYON PIECE GOODS

By C. P. Atkinson

(Substance of a lecture delivered in Belfast on 21st March, 1945)

Desizing and Scouring

It is proposed to deal first with fabrics made from continuous filament rayon, then with crêpe fabrics and finally with fabrics made from "Fibro" and "Rayolanda." "Fibro" is the registered trade name of Courtaulds' viscose rayon staple fibre. "Rayolanda" is the registered trade name of Courtaulds' basified viscose staple fibre. It is not always realised that there are no natural impurities in rayon as received by the dyer and finisher. Therefore, all that it is necessary to remove from fabrics before dyeing are the size applied to ensure satisfactory weaving of the warps and any traces of dirt or oil accumulated during processing and weaving. Generally speaking the methods of de-sizing, scouring and bleaching normally required for cotton piece goods can be modified considerably, particularly as regards strength of detergents, time of processing and temperature of operation. Gelatine (1.5 per cent. to 4.5 per cent.) with small percentages of emulsifiable oils is usually used for sizing continuous filament warps and can best be removed by treating the pieces on the jigger. Jiggers with tension control are advocated, and it is advisable to run with tension as low as possible consistent with maintaining a level batch without any tendency to build up over the selvedges. From the point of view of ultimate handle, attention to this factor is of paramount importance.

Gelatine size is readily removed if the pieces are thoroughly wetted out on the jigger and allowed to stand for a period before washing off and scouring.

The importance of a good soft water supply, preferably supplemented by warm water for washing off is not always realised. Many of the faults which occur in dyeing and/or printing of rayons are due to faulty de-sizing and scouring, and one of the most effective insurances against these faults is to have a suitable water and a good neutral soap in all preparatory processes. If the water available has more than 1° to 2° of hardness, the use of suitable assistants (such as sodium hexametaphosphate), should be considered. The slight extra cost of the better types of soap such as the olive oil soaps is usually a good investment. They have superior emulsifying, wetting, dispersing and lubricating properties. They are an additional safeguard against faults traceable to inefficient desizing and residual lime soap. The insoluble soaps appear
inevitably when unsatisfactory water is used. Sulphonated fatty alcohols may be used with advantage in combination with soap. Since avoidance of trouble is better than its cure, the use wherever possible of a soft water, and a high grade neutral soap is advocated.

**Bleaching**

It is not necessary in general to bleach rayon to any appreciable extent, so that the process can be modified according to the construction of the fabric. For example, lining fabrics made from rayon warps and cotton wefts after singeing, de-sizing and scouring, require only mild bleaching treatment, particularly as the rayon warp is on the face of the fabric. It will be appreciated that sheeting fabrics made from 100 per cent. fibro or fibro warp and cotton weft will not require a full linen or cotton bleaching process, and that modifications can be made with advantage. When necessary, bleaching should be carried out with hypochlorite followed by chlorite, which results in a better white with reduced damage to the rayon in the fabric. (See *Dyer and Calico Printer*, 2/2/45, Vol. XCIII No. 3, and *Textile Manufacturer*, August, 1944, Vol. 70 for alternative suggestions using mixtures of chlorite and hypochlorite).

**Acetate Fabrics**

With regard to "Seraceta," which is the registered trade name of Courtaulds' cellulose acetate, I can do no better than refer you to a lecture given to the Society of Dyers and Colourists in January, 1931. I would emphasise, however, that it is essential in the handling of acetate fabrics to avoid extreme changes of temperature. Fabrics should be washed off after all hot treatments in warm water, not in cold water, because large and rapid temperature changes have a bad influence on the physical properties of the cloth.

**Crepe Fabrics**

The preparation of crêpe fabrics is discussed in a lecture given to the Society of Dyers and Colourists, October 1941—a report being published in May, 1942. Good soft water is imperative, if uneven delustring with consequent blotchiness and effects associated with insoluble soaps are to be avoided. In this connection naphthenic acid soaps are at present the subject of investigation in the U.S.A. It is claimed that their wetting power is high and their detergent power as good as standard soaps. They are good emulsifying agents for mineral oil, and therefore useful for de-sizing and scouring operations. Incidentally, the presence of electrolytes and salts in the dye-bath does not readily decompose them, and again, they have antiseptic and anti-oxidant properties, with a lower alkalinity than many ordinary soaps.

**Creping and Degumming**

Fabrics from grey stock and those which have been embossed are generally processed by the same methods, although in the latter case the evenness of the crêpe has been predetermined and continuous crêping treatments can be used with successful results. Incidentally, considerable care and experience are required for satisfactory results to be obtained in the embossing process. For details see C. P. Atkinson, *Journal of Society Dyers and Colourists* 58, No. 5, May, 1942, Table 1. In general, however, "Seraceta" warp viscose rayon crêpe weft piece goods are best handled by stringing the pieces from the selvage in book form or framing them and hanging them in scouring baths sufficiently deep to allow full immersion of the pieces. The strings must be inserted in such a way as to avoid cutting the weft in the selvages, as such defects would cause distortion. In the book form method, strings at the bottom selvage are used to prevent the pieces from ballooning in the crêping bath. The crêping vessel is filled with soft water to which is added 0.1-0.25 per cent. olive oil soap for "Seraceta" warp viscose crêpe weft piece goods. The pieces are wetted out cold and the temperature is gradually raised by means of a closed stainless steel coil under the false bottom of the vessel, during 1-2 hours. This method usually results in a really satisfactory crêpe, but it is necessary to raise the temperature to a point slightly above that used in any
subsequent process, otherwise cracking may occur during scouring or dyeing. In general, a temperature of 80° C. is used for bright, and 100° C. for dull finishes. A fuller crêpe and more pebble are obtained with a gelatine-sized crêpe weft at the higher temperature, but with low quality crêpes more attention as regards care in handling is required if creasing and cracking are to be avoided.

It is not advisable to allow the cloth to remain too long in the degumming bath, particularly at 90°-100° C., as saponification of the "Seraceta" is liable to take place after 4 hours. In order to obtain a full matt finish, it is essential to maintain exactly the prescribed conditions. It is particularly important to keep the temperature as near to 100° C. as possible, by using high pressure steam in the heating coil. In the soap and phenol method, a better result is obtained by running the pieces at 100° C. for 1/2 hour rather than at 98° C. for 2 hours. Works practice has shown that for some dull finishes when soap only is used, pH 10-11 gives the dullest results, but in presence of phenol, pH 8.5-9 gives the maximum dullness. Since the pH of industrial water varies considerably, this must be taken into account, as, if a definite pH is not secured, there may be a difference in dullness under apparently identical conditions. Owing to the cooling action which occurs when pieces are treated on the winch machine, it is not possible to obtain effects as dull as those obtained when pieces are treated in book form. In some cases, however, fairly satisfactory results can be obtained by creping, de-sizing, scouring and dulling in one operation on the winch. In this connection reference should be made to a paper by the present lecturer. (C. P. Atkinson, *J. Soc. Dyers and Colourists* 1931, 47, 5). In this paper stress was laid on the concentration of the phenol and the bath temperature as well as on other important factors.

The process described usually results in a fairly satisfactory de-sizing of the "Seraceta" warps. In order to ensure the complete removal of the size, it is advisable to scour piece goods containing standard crêpe weft in a bath containing 0.15-0.25 per cent. soap and 0.1 per cent. ammonia, together with a small percentage of a reliable solvent suitable for use on fabrics with "Seraceta" warps.

If oil-sized crêpe wefts have been used it is advisable to scour the fabrics on the winch with 0.15-0.25 per cent. soap flakes (88 per cent.) and 0.1 per cent. sodium perborate at 60°-70° C. for 20 min. The perborate is added gradually to the bath during this period. A further 0.1 per cent. of perborate is added during the next 10 minutes, the temperature of the bath being raised from 75°-100° C. according to the final finish required. In no case, however, should the temperature exceed 75°-80° C. when a bright finish is specified. Before proceeding with the dyeing operation, it is advisable to check the removal of size by steeping a sample of the fabric in a turpentine solution of Sudan Red 7B for 5 minutes and washing thoroughly in cold water for 10-15 minutes. The depth of stain, if any, indicates the amount of oil size still present in the fabric. This test can be confirmed by an ultra-violet light test, although some previous experience in this case is necessary to interpret the results correctly. (White and dyed fabrics were exhibited to show the superiority of the scour in which the perborate was used, over that employing soap and ammonia. The results indicated that the more costly method was justified).

Crêpe yarns used for weft are usually tinted by means of acid dyes such as Azo Geranine 2GS, Lissamine Red 6BS, Lissamine Fast Yellow 2GS, Lissamine Violet 6RNS, Lissamine Green VS, Disulphine Blue VS and Coomassie Violet 2RS, which are removed without difficulty in the preparatory wet treatments.

An alternative method of de-sizing and dulling in one operation is to pass the fabrics through a continuous crêping machine containing potassium or sodium oleate and a little Sextol at pH between 9 and 10.
The latest American practice consists of continuous tensionless processing on a full width conveyor type machine. The goods are wetted out evenly in full width and completely immersed while being carried on the surface of a driven cylinder, finally resting on a travelling conveyor located immediately below the cylinder. The conveyor is equipped with a variable speed drive to allow accumulation of the goods as desired and the cloth is therefore free to shrink naturally, being free from tension in both directions. The fabrics then proceed to the boil-off bath, where the dual endless conveyor method allows the goods to accumulate as required and at the same time carries them buoyantly, although completely submerged through the bath. They are turned over at least six times during one single passage through the machine, thereby eliminating imperfect scouring and giving full scope for the swelling and further de-sizing so essential for rayon fabrics. The continuous circulation of the liquid is maintained by means of a centrifugal pump working in conjunction with a closed circuit heater to obtain a constant temperature in the bath, without dilution due to condensation. Provision is also made for thermostatic control and an ingenious mechanical control is incorporated in the main driving mechanism to compensate for the various weights or qualities of goods carried between the dual conveyors. This machine has been found to be very good for all fabrics requiring careful processing and full natural shrinkage.

After washing, the pieces are dyed on the winch, care being taken to avoid knotting. (For pale and medium shades, $0.1-0.25$ per cent. olive oil soap, according to the softness of the water, is added to the bath, whilst $0.1-0.25$ per cent. Monopole soap is used for heavy shades). In many cases, however, especially when dyeing heavy shades, plain soft water is satisfactory. The temperature is raised from $40^\circ$ to $80^\circ$ C. for bright finishes and to $100^\circ$ C. for dull finishes during $1\frac{1}{4}$ to $2\frac{1}{4}$ hours. In this case, direct cotton dyes are added to the bath in addition to the dyes for "Seraceta" and they are usually sufficient to give the required shade both in solid or contrasting colours. In order to obtain a suitable handle in final finishing, pale and medium shades are usually allowed to run from the dyebath without further washing, leaving a small percentage of soap in the fabric as a soft finish. With heavy shades it is generally advisable, after washing the goods, to pass them through a finishing bath containing a softening agent, e.g. Monopole soap or olive oil emulsion, or one of the many suitable proprietary products.

"Fibro" Fabrics (Rayon Staple Fibre)

Unless a full handle is required the first process to be considered is that of singeing. For prints where a sheer face is an advantage, the fabric is singed face and back or face only as required, using the gas singeing process. It is advisable, however, to adjust the plant to run with minimum tension consistent with giving an evenly singed surface.

Warp for "Fibro" fabrics should be sized with a sago tallow size. An excellent paper on the sizing of rayon staple fibre warps was published in the Shirley Institute Bulletin for July, 1936, and methods of de-sizing are also given. A further summary on the same subject is to be found in the Bulletin for November, 1936, Volume IX, Number 7, pages 299 to 305. Malt extract is required for de-sizing, normally a $0.3$ per cent. solution, at $pH$ 6 to 7.5 at $46^\circ-50^\circ$ C. Unnecessary tension must be studiously avoided and treatment on tensionless jiggers is generally preferable. (Photographs contrasting British and American practice were exhibited).

"Rayolanda" Fabrics

In the preparation of these fabrics a high degree of alkalinity is inadvisable, especially at high temperatures. It may tend to reduce the affinity of "Rayolanda" for acid dye-stuffs, although it would not affect its affinity for ordinary direct cotton dye-stuffs.
If bleaching is necessary, peroxide is recommended since with the ordinary bleaching processes, some slight reduction of the affinity of "Rayolanda" for acid colours may occur. These fabrics require close attention to tensions during processing. (Plain and printed "Rayolanda" fabrics were exhibited).

In the latest American practice the system of co-ordinated control known as the "Dye Master" is of interest. After the chemist or foreman dyer has decided the method of preparation required for a given shade, he traces the cycle of operations on the face of a blank disc, producing a cam for the control system to follow. The cam is then placed in the "Dye Master," and when the operator presses the start button, the entire process is carried out automatically. When the cycle is completed the cam for the particular shade involved is properly labelled and filed, and can be used in the future for reproducing the same set of conditions. Accurate control of all variables, except actual weighing of the dye-stuff is claimed, and it is stated that the object is to bring under rigid control all the factors in the dyeing operation.

Hydro-Extraction

The method of hydro-extraction used is to some extent related to the cloth construction. With ordinary woven fabrics (japs and satins) the merits of suction extraction in comparison with mangling, using a machine with comparatively soft rubber bowls, should be considered. For "Fibro" or "Rayolanda" fabrics it is essential to avoid excessive warp tension during this operation. Crépe fabrics can be plaïted out, carefully "bagged" and extracted in the ordinary centrifugal hydroextractor, which should be run at about 600 r.p.m. for 1 to 2 minutes, brakes being applied with discretion to avoid movement of the pieces. This avoids excessive creasing. They may also be passed in open width over a special suction extractor.

Drying

Crépe fabrics are best dried in a current of warm air at a comparatively low temperature, a marocain stove or festoon dryer usually giving the best results. Minimum tension, freedom to shrink and drying at a temperature below 85° C. combine to give satisfactory results. The pieces after drying are stentered to width on an open machine, preferably steaming well from an open live steam box as they reach maximum width. With some crépes, however, it is necessary to repeat this process, and bring the pieces to the required finish by running them down the stenter taking out to width slowly. The usual procedure is to combine the operations and dry the pieces on a hot air stenter of the "Overfeed" type with the minimum amount of weft and warp tension required to eliminate creases. Minimum temperatures should be used to give the softest handle.

Drying can also be effected by blanket finishing machines of the Palmer type or by Bouéthion or Weisbach drum type machines. Current practice in the U.S.A. is to use the horizontal type of cloth dryer instead of the vertical Multipass Air Lay Dryer hitherto advocated.

For ordinary woven piece goods, can drying or cylinder drying is generally to be avoided, as it results in a harsh handle, which can be only partially compensated by the use of softening agents in previous processes.

The contribution to fabric drying processes of the principle of dielectric heat generation was referred to, and references were made to a recent report of the Textile Research Institute Incorporated, New York, on the drying of textiles, which confirms in particular that:—

1. The removal of all but a few tenths per cent. of water from a fibrous material is likely to result in more or less permanent changes in its molecular structure, and, therefore, changes in physical properties.
2. Too thorough or uneven drying may impair the valuable properties of flexibility, softness and strength, and therefore, in textile drying, consideration should be given to the theories relating to the form in which moisture is distributed within the fibre structure.
An extensive range of fabrics illustrating the results of the various methods of processing discussed was shown. Particular attention was drawn to results of full scale trials on 100 per cent "Fibro" fabrics—Quality Number 1005—which were woven on two warps—one of which had been subjected to 8 per cent. stretch in sizing, and the other 4.6 per cent. stretch. The results demonstrated that if the correct process to give adequate shrinkage were applied, stability of shrinkage to subsequent washing treatments was ensured, but if the fabrics were processed under tension, appreciable shrinkage in washing was inevitable. Also, there was in the latter case a slightly greater shrinkage on washing with the fabrics woven on the warp stretched 8 per cent., when compared with the results on the warp stretched 4.6 per cent. To give an adequately shrunk finish, generally speaking, all processes should enable maximum warp and weft shrinkage to be attained, the final finish as regards shrinkage in both warp and weft being 2 per cent. to 3 per cent. less than the maximum, e.g. Quality Number 1005 with a 13 per cent. to 14 per cent. warp shrinkage in processing should be finally finished with 10 per cent. to 11 per cent. warp shrinkage. The conditions necessary for adequate warp shrinkage facilitate processing in works practice, and result in a full agreeable handle and smart, saleable appearance of the cloth. Further, they will minimise any tendency to blister in the stretched portions of garments during wear.

With 100 per cent. "Fibro" fabrics, to obtain the most satisfactory results with regard to dimensional stability (one of the main requirements before a fabric may bear the "Fast to Washing" label), it is essential:—

1. To use the methods of preparation recommended and to keep length tensions down to the minimum.
2. To adopt the same procedure as regards handling in the dyeing processes wherever possible. If it is necessary to use a pad dyeing process in order to obtain perfectly level results the unavoidable increase in tension should be compensated by releasing the same in a soaping off process in the winch after dyeing.
3. To dry under controlled conditions, and allow maximum shrinkage in both directions to occur.
4. To give an adequately shrunk final finish.

The lecturer expressed his thanks to Messrs. Courtaulds Limited, for permission to deliver the lecture.
THE CONVERSION OF BRITISH CURRENCY, MEASURES,
AND WEIGHTS TO A DECIMAL SYSTEM

By W. H. Gibson, O.B.E., D.Sc., F.R.I.C.

(Paper read at the meeting of the Section, 15th May, 1945)

In this paper only a very modest proposal is to be made. It is not suggested that a departure from present standards or discontinuance of measures that have become second nature to the users should take place, but that a conversion to a decimal system for the purposes of calculation, comparison, conversion into foreign systems, and for statistical record is possible and desirable. The handicap to the growth of industry and trade, impeding prosperity and contentment throughout the world, owing to the use of a multitude of differing systems of currency, measures, and weights based on different national standards, has been increasing for more than a century. A simple plan has occurred to the lecturer.

Traditional measures and weights have grown up naturally everywhere, and as civilisation advanced people have grouped them at pleasure into numerous systems, which have become more and more complex and diverse. Originally, men counted on their fingers, so the decimal scale of notation appears to be most readily understood and used for counting. The proportions of the human body formed the basis for measures of length. The smallest unit seems to have been the breadth of the fore-finger, the digit, roughly three-quarters of an inch. Apparently, this still exists as the Indian ungul. The width across the four digits is about three inches. It could then be observed without difficulty that the length of the foot was four times larger than four digits, so the foot became a larger unit of measurement simply related to the digit. Also, the well-marked distance between the first and second joints of the fore-finger is convenient at a unit of measurement, and it can be seen to be about one-twelfth of the length of the foot.

It may be assumed that it was found convenient to measure longer distances by the pace or double-pace, and we know that the Roman mile of 1,000 double paces spread through the Roman world. The time taken to march from one place to another was important, so distances were often expressed in terms of time. The old Austrian measure, the Stunde, one hour's travel, was about 3¼ miles. This suggests the idea of compounding measures of different kinds, such as velocity in miles per hour, or length per unit weight so important in textiles, or price per unit length or weight. In Britain the simple relationship that 2 paces were equal to 5 feet or 60 inches, became generally accepted. The English mile was probably 2,000 paces originally, but this simple decimal relation was lost when the statute mile was taken as a simple multiple of the furlong, 8 furlongs or 5,280 feet or 2,112 paces of 30 inches.

The measurement of land was probably determined by the area found workable and large enough to maintain existence. A very old English measure of area was the hide, a cultivated area found to be large enough to support a family or household. The grouping of such areas led to the formation of the hundred, an old administrative division of an English county, an area originally supporting 100 families, made up of 100 hides. The measurement of land has played a great part in forming the English social, political and economic life, and the term "hundred" still lingers in the "Chiltern hundreds."
Industrial development and the growth of towns broke up a system which related the population to the land required to support them in a direct and practical fashion, and possibly many of our present day problems of location of population and industry, and town and country planning, have arisen through our forefathers' failures to cope with this situation.

The original partition of land among families seems to have been usually on a decimal basis. The tithing was a civil division of ten householders bound as sureties for each other's behaviour. The hide was divided up decimally again into 100 acres. The acre was commonly an oblong strip of land, the length being the length of the furrow. In this way the furlong or furrow-long became 660 feet. The chain of 66 feet, one-tenth of the furlong, was taken as the width of the strip of land. It follows that the acre is an area of any shape containing 43,560 sq. ft. The floor space of factories and other buildings on land is still reckoned in square feet.

Since wheat is the staple food crop in temperate climes, the quantity of wheat produced annually on the hide of land was a matter of vital importance to the family. Probably measurement by capacity came first, and large and small boxes formed measures. Similar measures of capacity came into use for liquids. These measures may have been cubes in some cases, for instance, our present bushel of 2219.3 cubic inches is very near to 2,197 or a cube of 13 inches side. The difference in weight of different substances of the same capacity measure probably led to measurement by weight as preferable, and perhaps some customary measure of wheat was taken to give a unit of weight. If the fact that there are 7,000 grains in the pound has any significance, it may be that weights were standardised against counted grains of wheat. In any particular locality the customary weights and measures were quite naturally employed for all sorts of purposes, so people chose multiples or sub-multiples to suit their purposes. Craftsmen and merchants brought many such into use. As it is simple to divide anything into two equal parts, and to continue this process, sub-divisions of 2, 4, 8 and 16 are common. For some purposes it was found convenient to have units divisible by three, and in the textile industry the yard of 3 feet became the basic unit of length.

With the coming of the industrial revolution and the expansion of foreign trade such a multiplicity of systems became confusing, and in Britain since 1826 uniformity of weights and measures has been compulsory.

The tables of weights and measures, taught in schools, began to take a fixed shape, thus:

<table>
<thead>
<tr>
<th>Measures of Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 inches = 1 foot.</td>
</tr>
<tr>
<td>3 feet = 1 yard.</td>
</tr>
<tr>
<td>6 feet = 1 fathom.</td>
</tr>
<tr>
<td>100 fathoms = 1 cable.</td>
</tr>
<tr>
<td>10 cables = 1 nautical mile.</td>
</tr>
<tr>
<td>51 yards = 1 rod, pole, or perch.</td>
</tr>
<tr>
<td>22 yards = 1 chain = 100 links.</td>
</tr>
<tr>
<td>10 chains = 1 furlong.</td>
</tr>
<tr>
<td>8 furlongs = 1 mile.</td>
</tr>
<tr>
<td>= 6,000 feet. = 5,280 feet.</td>
</tr>
</tbody>
</table>

It can be seen that sailors and surveyors chose a large unit, unfortunately not the same one, and divided it into thousandths. The smaller units, inches, feet and yards, were not related on a decimal system. The smallest naval unit, the fathom, was a round number in feet, but the sub-division of the furlong results in the awkward relationship of 1 link = 7.92 inches. The relation between the yard and the rod is also awkward, particularly in square measure. It appears that too many customary measures were retained unaltered to make the table really convenient for trade.

The Weights and Measures Act of 1878 superseded all previous laws and enacted the legal measures for Great Britain, basing them on the standard yard and the standard pound, held by the Standards Department of the Board of Trade. The yard and the pound are independent of each other, but the
capacity standard, wet or dry, is not, for it is based upon the pound. The gallon is defined as the volume of ten standard pounds of distilled water weighed in air against brass weights, both water and air at the temperature of 62° Fahrenheit, with the barometer at 30 inches. None of the tables is divided decimally and together with our non-decimal currency, the need for confusing, complicated and time-wasting conversions still exists in industry and trade. Similarly in other countries many unrelated systems of weights and measures came into existence, but in many cases they originated from the natural measures of the foot and pace, which are themselves related decimally. It is worth remarking that the old Russian Fuss is the same as the British foot and the Russian Arschin is 28 inches, not far removed from the British pace of 30 inches. The Indian Guz and the Spanish or Spanish-American Vara are 33 inches. Egypt and Turkey have the Dira Baladi and Arschin of 29·8 inches, and some half-dozen other countries have a customary measure around 30 inches. This leads to the conclusion that if we had chosen 30 inches instead of 36 inches for our standard length and decimalised our length table, it would not have been difficult for other countries to adopt the same system.

In 1801 the French government broke completely with tradition, and introduced the metric system, allied with a decimal currency. By choosing a new standard having no simple numerical relation to existing standards, other countries were faced with complex calculations, or if not heavily committed they could adopt the metric system, and use this entirely consistent decimal system. Its only merit was that it was consistently decimal. Great Britain and America were already great manufacturing and trading nations and they were not able to make this change, although America did have a decimal currency. In the course of time other countries followed the example of France and adopted the metric system, and the trading nations of the world tended to form themselves into two large groups. The English-speaking countries and others closely associated with them by political or economic ties used the British or American measures, another group used the metric system.

The British Government made the metric system permissive in 1897, but it has only come into limited use in certain industries. A dual system of measures and weights in industry and trade has some of the disadvantages of two languages, much duplication is necessary of sizes and prices, if both are really used, and the time-saving advantages of a decimal system are not gained. It is doubtful if any people take readily to a foreign system not clearly related to their native one. Thus in Egypt the English and the metric measures are legal, but the people use the Dira Baladi of 29·8 inches and the Kantar, divided into 100 Rotls, for weight.

There now seems no possibility that Britain or America would abandon their present standards and instal the metric system. An immense volume of production during the war has been measured in this way, and a larger labour force than ever before is accustomed to it. In engineering, decimals of the inch are used and these must be retained unless gauges are altered. No encouragement has been given to the plea for a decimal currency either. On 24th October, 1944, the Chancellor of the Exchequer, in reply to Sir Frank Sanderson, said that a decimal currency was not being considered, he doubted whether it would be of material assistance in the export field and thought that there were weighty objections to it.

It is evident that no sweeping changes would be entertained, but the proposal now made, while it secures the advantages of a decimal system for all purposes of calculation and conversion into other systems, such as the metric, and into other currencies, which are decimal, retains the present legal standards of currency (the pound sterling), length (the yard), weight (the pound), and capacity (the gallon). The unit used for purposes of calculation has been taken in a simple proportional relationship to the legal standard, where this is
necessary to obtain a decimal table. All the present coins are retained in use at their present values in relation to the pound sterling, but one new coin, a paper note of 25/- in value is needed as a coin of account. It is necessary that any such change as this should appeal not only to leaders in politics and industry, but should be welcomed by the man in the street as retaining his old established custom and tradition, and at the same time relieving him of the drudgery of calculation in inconsistent, illogical, and non-decimal systems. With the general use of the slide rule, much calculation could be saved, and it would be possible, for example, for Members of Parliament to check the figures in the Chancellor of the Exchequer’s Budget speech on their slide rules, as they were spoken in the House. In short, the endeavour is to give the ordinary man the best of both worlds.

The currency proposal is shown in Table II. The new coin of account value 300 pence has been called the Centrid and is made up of 100 Trid. This is usual in decimal currencies, e.g. the dollar of 100 cents. The value of the Trid is 3d., and the name has been coined by translating threepence into Latin and contracting denarius into d. The name Centrid follows as 100 Trid. The Trid exists as the present threepenny piece, and it is hoped that the name Trid would be welcomed by ‘bus conductors, as unmistakable in sound when taking fares. The new currency of account would be easily understood by Americans, and if the normal rate of exchange were taken as 4 dollars to the £1, conversion is simple using a factor for the actual rate.

The table of measures of length is very similar to the money table. Three inches is taken as the basic unit of length, and has been named the Trin from 3 inches. 10 Trins or 30 inches is the pace and is also a customary measure in other countries. In Central and South America an old Spanish measure, the Brazo, is still used. The word means arm, and the length is about 27 inches. The length of the arm is about equal to the pace, so it is suggested that 10 Trins might be called 1 Arm. The Arm could be legally defined, if necessary, as five-sixths of the standard yard. The conversion of our present measures of length into this decimal system is simple. Thus, 1 inch is 0.33 trin, 1 foot = 4 trin, 1 yard is 12 trin or 1.2 arm, 1 rod, pole, or perch is 66 trin, 1 chain is 264 trin, 1 link 2.64 trin, 1 furlong 264 arm, and 1 mile 2,112 arm, this figure is easier in calculation than either 1,760 yards or 5,280 feet, most people can multiply by 2.

The measure of length is of basic importance in the textile trade and is used not only by itself, but in a number of compound measures. At the present time the system of yarn count is a burning question, and under the auspices of the Unification of Testing Methods Committee of the Textile Institute, conference has been held to discuss the possibility of adopting a universal yarn count system. The textile industry would benefit much more from the adoption of a universal yarn count if this reform were part of a general scheme for decimalising measures and weights.

Accepting the situation that the metric system is ruled out at the present time, it is suggested that the adoption of the Arm-Trin table of lengths would enable us to retain the present cotton count as the universal system. The present unit of cotton count is 840 yards per pound, converting into arms per pound we get 1,008 arms per pound. This is sufficiently near to 1,000 arms per pound for practical purposes, and a closer adjustment could be made in course of time. The name of the unit might be Tapp, thus replacing Typp. (Thousand yards per pound). This change would not upset any operative or yarn salesman, and they would not have to stop to think about it. As regards weight, the standard pound has been retained. Unlike the metric gramme there is no relation between length and weight. Actually 1 trin cube of water weighs 0.975 lb., which is surprisingly near 1 pound. The Cental of 100 lb. should be used, or the Egyptian name of Kantar could be taken for 100 lb.
The short ton is already widely used, but it seems a pity that there is no name for half a short ton. For capacity, the gallon of 10 lb. is generally used and a new measure might be used of one-tenth of a gallon for which the name Pot is suggested.

<table>
<thead>
<tr>
<th>Table I. British Measures of Length Decimalised</th>
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</thead>
<tbody>
<tr>
<td><strong>Decimal Scale</strong></td>
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<tr>
<td>Value in Arms</td>
</tr>
<tr>
<td>2.430</td>
</tr>
<tr>
<td>2.400</td>
</tr>
<tr>
<td>2.112</td>
</tr>
<tr>
<td>264</td>
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<tr>
<td>240</td>
</tr>
<tr>
<td>26.4</td>
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<tr>
<td>6.6</td>
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<tr>
<td>2.4</td>
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<tr>
<td>1.2</td>
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<td>1</td>
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</tbody>
</table>

1 Arm →

| 1 | 0 |
| 0.4 | 1 Foot |
| 0.264 | 1 Link |
| 0.100 | 1 Inch |
| 0.033 | 1 Ungul |

Cotton Count 1,008 app. 840 yards per pound

<table>
<thead>
<tr>
<th>Table II. British Currency Decimalised</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada and U.S.A. (Taking 4 dols. to £1)</td>
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5 dols. = 1 CENTRD

| | £1 | |
| | 10/- | |

1 dol. = 20 Trid.

| | 2/6 | |
| | 2/- | |
| | 1/- | |
| | 6d. | |
| | 3d. | |

10 Cents =

| | 1d. | |
| | 1/2d. | |
| | 1/4d. | |

For present Rulings in Account Books—£ s. d. → C. t. d.
YORKSHIRE SECTION

STANDARD TESTING OF YARNS AND FABRICS

By A. W. BAYES

(Paper delivered to the Yorkshire Section, 15th March, 1945)

"Routine testing" would be an alternative title if it were not desired to emphasize the importance of standard methods, but both should indicate that the immediate concern is not with research techniques. In research work ideas, instruments, methods and machines develop together as the investigation progresses, but besides research there are other wide fields of endeavour in industry, namely, technical development and quality control, which, though similarly based on measurement, have a different aim. The research worker aims at controlled experiments, with the fewest variables, and no guessing. In practical production, and this is particularly true of textiles, the stuff is produced by workpeople and machines in great quantity, and adequate quality, but with several important factors wholly or partly uncontrolled. In such circumstances it is essential to standardise the methods and conditions of measurement, that is to say, the testing machines and their use, the test room atmosphere, and the method of expressing the results.

Control of yarn count is the first need in the mill, and the figure of prime importance is the average count. Usually attention is focused on the individual wrapping; leas are wrapped and weighed and the weights are averaged. Accordingly various special balances have been designed for rapid weighing, as for example, the Knowles and quadrant balances, giving readings of count directly, and the "chainomatic" types (1). With such apparatus the variation between leas within one doffing of bobbins is obvious, but it is not always realised that this variation is as much a characteristic of yarn as the average count is. This fact must be faced bravely because it is a feature of textile production and cannot be disposed of by any tricks or dodges. In single cotton yarns the standard deviation of count is about 4 per cent., and the standard error of a mean count can be calculated from this for any number of leas. The draft wheel changes commonly made are of the order of one tooth in forty, though finer changes are possible. It can be argued, therefore, that the standard error of the mean should not be greater than 1\% per cent. if one is to be reasonably sure of wheel changing, but this is not really good enough, because it is necessary to know whether the correct count would be given more nearly by the present wheel or by another differing by one tooth. For this the standard error of the mean should be about \(\frac{1}{4}\) per cent. This requires the averaging of 40 leas. It means either a lot of work for somebody and a lot of waste yarn or a new method of test. Between bobbin differences are an important source of variation and there is a high correlation between weights of consecutive lengths of yarn, so a much shorter length might be taken and all forty ends could be run off together. A machine to do this is not available, but until it is, too much emphasis will be put on the variability of yarns and much time will be wasted in unnecessary changing of pinions. Single lea variability could then become a matter for special investigation with a balance more rapid and more convenient than the quadrant or chainomatic types, but one which could be less sensitive.

Correct count is not enough without adequate strength. The question of strength is always cropping up; as a check on performance, as a test of material quality, or of tendering, or merely, one is sometimes tempted to believe, to make a specification look complete. The commonest machines employ the
pendulum balance and a constant rate of traverse mechanism on the pulling jaw. This is very simple; in some circumstances it is dangerously simple. The rate of loading varies throughout the test and with the extensibility of the material. Cotton is broken more quickly than wool, so the marked superiority of cotton is enhanced still further! There are errors too. The indicating pointer may be flicked forward at the break, or the pawls may slip, and in some circumstances, spectacular inertia errors occur. The wavy line at the beginning of a single thread test chart is well known, but in some cloth strength tests the line has barely time to get wavy before the specimen breaks. This is when errors of 20-30 per cent. arise (2). The immediate practical solution is drastically to reduce the rate of traverse. It can be argued that it is the conditions of loading just before the break that determine the breaking load, so if the rate of traverse were adjusted to give, in these last moments, the same rate of loading as is used in the constant rate of loading test, similar strengths would be obtained. This, however, makes the test much slower than the usual constant rate of load test in which the specimen is broken in one minute. The best practical compromise seems to be to reduce the rate of traverse to 4½ inches per minute, and to use only the upper four-fifths or so of the scale. Constant rate of loading machines have their problems too. There is, for instance, the choice of method of loading, by lead shot, spring or pendulum. However, it seems likely that when the testing is done sufficiently slowly, it is possible to get equivalent results on machines of various types and capacities. There remain the questions of size of strip, and manipulation of the jaws. The virtual standardisation of the 1,000 lb. capacity Goodbrand machine for Army and Navy stores testing before the war led to a variety of strip widths in order to provide reasonable values for strength, but this has reduced the usefulness of the results and has led to the use of inconveniently wide strips. The tests should serve two purposes; checking that the batch is up to specification, and providing a background of experience for improvement in the old cloth and for estimating new cloths. If this background of experience is to be useful the test figures must be simplified. Unfortunately strength is not directly proportional to the strip width, so it is not just a matter of reducing the figures to a strength index such as pounds per inch width, breaking length per thread, etc. One specification calls for 6½ in. wide strips of cotton poplin. These are particularly difficult to handle, and errors of as much as 20 per cent. may result from inaccurate adjustment and packing of the jaws. Obviously this is an unsuitable size of strip for this type of cloth. Strips 2 inches wide are much easier to handle and more consistent breaking loads are obtained, but a smaller capacity machine has then to be used.

Standard conditions of temperature and humidity are essential for satisfactory working. The weights of all textiles increase in a damp atmosphere, but the strengths behave variably; some, such as of cotton and linen, increase, others such as of viscose and wool, decrease; so competitors tend to choose a humidity to suit their own product.

Cotton circles are satisfied with 70° F., 65 per cent. R.H., but the B.I.S.F.A. rules for rayon specify 20° C. and 60 per cent. R.H. It seems best to standardise at a level of humidity which is exceeded by natural conditions on only a few days in the year, and which can, therefore, be provided by adding water to the atmosphere at normal indoor temperature. The coolest and driest conditions meeting these requirements, in North East Cheshire at any rate, seem to be about 70° F. and 65 per cent. R.H. Conditioning boxes have been suggested from time to time to dispense with the need for conditioned test rooms (3), but the rate of change of regain of single threads and strips of cloth is too rapid for such boxes to be satisfactory. The test room itself must, therefore, be conditioned. Now the dew point corresponding to 70° F., 65 per cent. R.H., is 57½°, so whenever the temperature of the window glass, or of ceiling joists, falls below 57½°, dew will form, and in winter, pools will collect on the
Various methods of humidifying the air are available. The weight of water to be added is quite small, particularly if the air is recirculated. An automatic control to a fan with a supply of moist air seems to work well enough; alternatively the control can be fitted to the water supplying a spray. In either case it is well to warm the water and to provide for dirt; dirt in the fresh air, and dirt in the drinking water. Both supplies may be clean enough for human beings, but they will not do for humidifying apparatus.

The records should be standardised too. The standard nomenclature of our Terms and Definitions Committee should be used, of course, and the British Standard descriptions of direction of twist and of ply yarn structure, and use made of test record sheets and cards. Provision should be made for collecting data on variability while the tests are accumulating. The mean range is the simplest measure of variability to use and it is to be recommended for routine use. Strictly the standard deviation, calculated from the root mean square, is a more accurate measure and a further apparent disadvantage of the mean range is that it increases as the size of the group is increased, but routine testing supplies so many test results that the loss of accuracy in using the mean range is of no consequence, and the second objection may be met by standardising the size of group on 4, or 5 tests, or by applying the appropriate factor to give an estimate of the standard deviation. It is a simple step from this to control charts, which show at a glance how the tests are going. Confidence limits, drawn on each side of the standard value, are helpful as a permanent indication of the variability of the plotted averages, but the next step of using the lines as a sign for action is another matter. In repetition engineering, it seems, when the control chart shows that the diameter of the 100,000th bullet is too large the mechanic knows why, and knows how to adjust the tool to put it right. But in textiles, the control chart points seem to wander up and down of their own volition. Nobody knows why, and there is only an even chance that the tests will go right again after the customary adjustment has been made. Even in these circumstances control charts are informative and well worth making.

Many users of fabrics, hospital authorities, rubber manufacturers, leather cloth manufacturers, etc., have their own specifications and standard methods of test. Some follow War Office specifications, others the Air Ministry, others again use the A.S.T.M. methods, and some even fix methods of their own. No doubt firms and authorities should be free to do what tests they like, and how they like, within their own confines, but when they also issue specifications, the manufacturer's position becomes very difficult. The need is for a full set of British standard test methods which any one manufacturer or purchaser can use with confidence. I spoke on these lines to a meeting in this city seven years ago, when the Textile Institute Standardisation scheme was beginning. Our progress since then has not been spectacular, but useful work has been done. In the more leisurely days of peace it seemed desirable to fix standards only after objective testing had shown which figures would be ideal for the purpose. Starting with the apparently simple matter of cloth strength testing machines we were led to examine variations in machine design, the theory of pendulum acceleration, the effect of rate of loading, variation in manipulation of specimens, lubrication of slides, methods of calibration, and so on. Ten papers have been published so far, and no doubt more will follow, but still no standard has been set. Meanwhile, however, the Institute was asked to prepare an emergency set of standard methods of test for narrow fabrics. The work had to be done quickly so a new method was tried. Sub-committees took small sections of the work and agreed on standard methods from their own experience. One or two tests were novel and some testing was done to confirm the committee's decision on these, but for the most part existing experience
Yorkshire Section

and knowledge proved adequate for the preparation of provisional standard methods of test. This success encourages us to proceed by this method in future, providing opportunities for revision, but also encouraging the preparation of papers of the earlier type in order to confirm that the standards are sound or to provide data for their revision.

The work is continuing. For success it needs the interest and assistance of all members of the Institute who are engaged in testing. Your comments, your criticisms, and your service on the working sub-committees will be very welcome.

DISCUSSION

Professor King: Mr. Bayes has shown that standardisation in testing is an urgent need. There are many types of machine and many ways of doing the same thing and there should be standardisation. Mr. Bayes’s plea of seven years ago for standardised methods of testing now seems to be bearing fruit. He has pointed out some of the difficulties involved. Committees have spent much time on the subject but finally is still a long way off.

When making strength tests on cloth differences in the results arise according to deflection of the pendulum. Would Mr. Bayes enlarge upon this.

Mr. Bayes: Inertia errors tend to be greatest at low loads and high speeds. The magnitude of the errors can be demonstrated on vertical type machines by a simple technique using weights suspended from the top hook or clamp in place of the test specimen. Many engineers are using cotton materials today but their testing machines were bought for testing wire or sheet metal. When they use such machines on light cotton cloth the pendulum jerks once and the specimen breaks, and they call the result the cloth strength, but their figures do not agree with mine at all. There is no doubt that a test done reasonably slowly, not using the first 20% of the capacity of the machine, will give an accuracy adequate for everyday purposes.

Dr. Martindale asked what Mr. Bayes advocated with regard to testing yarns for quality control. In the cotton industry routine testing of yarns for the counts involves the weighing of the counts individually. This practice is quite uncommon in the worsted industry. Do these individual weighings mean that all information relating to variability of counts is completely lost? In routine testing in cotton mills the standard deviation of the weights was 4 per cent. and this is almost a standard figure in cotton spinning. It is certainly not true in worsted spinning, in which, since it depends on top variability, the deviation is quite different. Reeling 40 short lengths and taking the average count, might serve for cotton but it would not do in worsted spinning since different types of material give different standards of variability.

Dr. Martindale sought Mr. Bayes’ opinion on the possibility of using types other than the pendulum or spring type such as the Houndsfield Tensometer. It is a very versatile type of machine (capacity 60 lb. to 2½ tons) and would be useful to a firm having many cloths of different strengths to test.

Mr. Bayes: In Lancashire individual leas are weighed and averaged. There are two things to measure, average and variability, and obviously for the day to day production of the right count the average is the important thing. A wheel may be changed to produce the right average, but it is necessary to measure the variability as well. Cotton varies in count from lea to lea, as in the case of worsted. The variation amounts to 3 to 5 per cent. in ordinary preparation spinning and up to 12 per cent. in condenser spinning. The idea of taking 40 ends is to weigh them altogether. Though all information on cop to cop variation is lost it gives very rapidly and easily an accurate average for the machine. The usual difficulty is that so few ends are averaged that it is never clear whether the draft wheel should be changed or not! Mr. Bayes agreed with Dr. Martindale on the importance of weighing individual leas. The variability of one-inch lengths of card sliver in condenser spinning and the corresponding variability in the yarn, agreed reasonably well. It is a very useful technique.

For cloth testing, the Houndsfield Tensometer is not very convenient. It was developed for the testing of resins and metals in small samples. It may be further developed for general textile purposes, but at present it has various disadvantages and it is difficult to apply an autographic recording device. Anything new in methods of testing should have consideration bearing in mind the fact that textile materials have an enormous range of strength. Nearly every testing laboratory needs a very wide range of capacities and versatile machines are desirable. The Denison machine has four capacities in the one machine. The Cambridge Textile Extensometer for testing filaments and yarns has a wide variety of capacities and speeds.

Mr. Briggs: Presumably the yarn going out of the mill is reeled in a conditioned atmosphere and presumably under standard conditions of relative humidity and temperature. With regard to tension in reeling and speed of reeling, how do these affect the counts?
Mr. Bayes: Production wrapping is not done in a conditioned room in Lancashire. Variations in cloth weights up to 3½ per cent. arise from changes in ordinary weather conditions. Tension and speed are not very important in cotton testing, although they may be in wool. Variability of the material is so great that the effects due to tensions and speeds are swamped.

Dr. Martindale: In an experiment in reeling 1/24s worsted yarns the limits of tension were 0-3 oz. which produced a variation in counts of 3 per cent. No tester would use these extreme values, but a worsted spinner might conceivably say that was due to two different methods of holding the yarn while reeling.

Mr. E. J. Poole asked Mr. Bayes if it were necessary to pay attention to the levelness of cotton yarn. In wool levelness is a paramount factor. Could Mr. Bayes say how it should be measured. He thought the mean deviation per-cent. was sufficiently accurate for practical purposes and it eliminated the squaring necessary for calculating standard deviation.

Mr. Bayes considered that it was a very simple matter to find the standard deviation. With a steady flow of results where no very great accuracy is required the mean range in groups of 4 or 5 could be used. The relationship between mean range and standard deviation has been worked out and for simplicity of explanation in the mill and for general usefulness it is the most suitable method. Levelness is not easy to test. Normally black wrapping boards are used. It is quite a simple matter to keep a few bobbins in stock typical of the production for purposes of comparison. It is quite satisfactory for a quick test. As a quantitative test a small shadowgraph arrangement is used whereby the diameter of the yarns is thrown on a screen. Many measurements are necessary.

Mr. F. Kendall condemned spray methods of obtaining standard atmospheric conditions.

Mr. Bayes agreed. He advocated vigorous circulation of air.

Mr. F. Kendall referred to tests on five strips made by each of five test houses. All the results showed that the cloth met the specification as regards warp strength, but in the case of the weft strength one test house got all five results above the specification strength and the other four lots were all below strength.

Mr. Bayes pointed out the great difficulty attending the tests for possible differences between test houses. Such tests would need very careful planning and execution. Condemnation of a laboratory was a serious matter unless the test figures showed unmistakably on critical analysis that gross errors were being made.

Mr. Halliday: Mr. Bayes has proved the necessity of standard means of testing. We have had experience of different results from different laboratories. This should not be the case. If methods are the same and the work is done honestly the results should coincide. In the mill, particularly in small firms, they cannot all be equipped with air conditioned laboratories with absolutely standard conditions and the best possible use has to be made of conditions as they exist, that is all that really can be done. In some cases tests are not carried out with anything like the care they should have.

REFERENCES

1 Bayes, J. Text. Inst., 1940, 31, p84.
3 Bayes, J. Text. Inst., 1935, 26, t120.
Reviews


The work is divided into fifteen chapters, commencing with a brief historical review followed by a survey of the main raw materials on which the industry depends. Chapter III deals with the theoretical aspects of polymerization leading up to Chapter IV with a survey of the chemistry of the main plastic materials. This in turn leads to a review of the manufacture of plastic materials and elastomers, treated in separate chapters. The physical properties of thermoplastic and thermosetting materials are next dealt with in two chapters which constitute the second natural division of the work. Chapters IX, X and XI again form what might be a further separate section dealing with the applications of plastics in lacquers and finishes, synthetic textiles, and adhesives including plywood and impregnated wood. Dies and moulds are treated in Chapter XII and general plant in Chapter XIII under the somewhat ambiguous title of "The Manufacture of Plastic Articles." The two final chapters deal respectively with the chemical and physical testing of plastics and the analysis of raw materials.

Having regard to the magnitude and ramifications of the plastics industry as we understand it today, one must at the outset express apprehension both at the ambitious title and the layout of the work. Experience has shown that to treat either the scientific or the technological aspects of plastics, provides more than adequate subject matter for a single work. On the scientific side one feels that the author has in a measure attained his aim, but as regards the technological aspect, one is as certain that he has, to quote from his preface, "rendered confusion even more confounded."

Throughout the book much valuable space is lost by unnecessary repetition, verbose and loose statement, and lack of logical sequence. For example plasticizers are treated on page 61, further defined on page 197 and with greater detail on page 198, and again with details on page 155, all of which could more advantageously have been collected at one point. The production of cellulose acetate described separately on pages 95 and 220, might give the impression that the processes and the materials were essentially different for plastics and rayon. Whilst one can appreciate the desire of the author to bring all possible detail together at crucial points, this policy has lead to a waste of valuable space. In like manner verbose and loose statement has robbed the author of many valuable pages; as for example the paragraph on coal on page 79, and the opening sentence of chapter IX which states that "A branch of plastics which has thrived considerably is that dealing with synthetic resins," etc., which actually leads up to the treatment of cellulose lacquers.

On the "scientific" side the author has given a good cross-section of current literature, although in some instances the necessity for brevity has robbed the references of much of their potential value. Many more references to current literature could have been given with advantage. The lack of acknowledgment for material used, e.g. the tables on pages 80 and 81, is surprising for a work of this calibre.

Inconsistencies are many: one might accept "Nylon and "nylon" on the same page, but "nitrocellulose" and "nitro-cellulose" on page 197 are surprising, in view of the statement on page 64, which refers to a "derivative of cellulose the nitrate; often erroneously referred to as nitro-cellulose." Again we have "superpolyam ide" on page 93, "super polyamide" on page 221.

These are of course small points which merely annoy the reader. Much more serious are the doubtful or blatantly inaccurate statements made throughout the work, mainly on the technological side. One reads with surprise on page 198 that "it is only comparatively recently that cellulose acetate has become available in commercial quantities at reasonable prices and with uniform properties." On the manufacture of cellulose acetate given on page 95 we can envisage the dire results which would follow if the process is worked as described.
Similarly undesirable results might follow attempts to produce celluloid sheets as described, and one hesitates to think what might happen if any but the most experienced attempted to chip and saw cellulose nitrate to "give a powder which may be moulded into a variety of forms." Such inaccuracies as these are inexcusable and cannot lightly be passed over.

Whilst the author cannot find space for some legitimate branches of plastics technology (thus film production has passing reference only on page 198), synthetic fibres are separately treated in chapter X. Here again one is surprised to read, page 218, that Chardonnet silk "has still a fairly good market." One is also tempted to assume that the acetate rayon which shows a loss in tensile strength of 60 per cent. "on soaking in water" (page 221), compared with a presumably corresponding loss of 50 per cent. for viscose (page 220), was produced by the method described in the text. (Cf. Lipscombe, "Cellulose Acetate," Benn, 1933, page 214). In this connexion also the author leaves us in doubt as to what he means by a "fibrous" material (page 220) and does not distinguish between acetic acid yield and the "acetyl" more current in America (pages 157, 158).

Summing up one may say the author has made a valiant effort to accomplish an almost impossible task. The theoretical survey is comprehensive and detailed, but factual inaccuracies have robbed the technological side of the work of much of its potential value.

V.E.Y.

Cotton and Rayon Machinery and Processing Developments. Foreword by Sir Raymond Streat, C.B.E. (Published by the Recruitment and Training Department of the Cotton Board. pp. 110, 60 illustrations. Price 3/6.)

In this little book are reprinted seven papers read at the Refresher Conference for Textile Teachers, organised by the Recruitment and Training Department of the Cotton Board in September, 1944. The papers cover, in so far as is possible with such a small number of contributions, developments at all stages of textile production. The discussions that followed the reading of the papers must have been on a high level and summaries of them would have added appreciably to the value of the volume. The illustrations deserve high praise, particularly when one recalls the many pitiful efforts that are to be found so commonly in textile publications.

It would be unfair to single out for special mention any detail in a book which maintains such a high quality throughout. To the Textile Institute, however, it is a pleasure to note a call in the paper on "Cotton Yarn Preparation Developments" for the limitation of the number of cotton yarns of different counts.

The graceful and informative foreword by the Chairman of the Cotton Board stressing the need of the industry for highly trained personnel and technical teaching of the highest quality forms a valuable introduction to the volume.

The Vital Issue. An Economic Policy for Britain and the Empire. Published by the Empire Industries Association, 9, Victoria Street, London S.W.1. (3d. per copy or 12/6d. per hundred).

A pamphlet issued by the Empire Industries Association, of which the Rt. Hon. L. S. Amery, C.H., is President. It deals with British economic policy in view of world changes, and more especially with the subject of Imperial Preference which has been brought to a head in the discussions in the United States of America. It points out that this vital matter is no party issue but one which now affects every man, woman and child in the British Commonwealth and Empire.

Investigations into the Conditions Affecting Rate of Dyeing. Technological Monograph No. 1. by T. Vickerstaff. Published by the Dyestuffs Division of Imperial Chemical Industries Ltd.

This booklet, apparently the first of a series of Technological Monographs, is a fine example of the service which modern progressive firms render to the users of their products.

The record of the investigations is admirably set out and the printer can justifiably be proud of his work.
Reviews


An 18-page booklet by the Education Officer of Messrs. Rowntree & Co. Ltd., setting out briefly the bases of personnel management stressing the need for treatment of men and women as human beings, rather than as "hands" or the bearers of clock-card numbers.


A 56-page pamphlet giving a general picture of modern enlightened industrial practice of great value to employers, and such members of their staff as are concerned with welfare, etc. An extensive appendix covers bibliography, etc.


A well-presented historical account of development during the war years, followed by a very readable account of "The Practice of Personnel Management," and its special developments in war factories during the 1939-1944 period.


In this finely printed and amusingly illustrated booklet, the Chairman of the Hosiery and Knitwear Export Group gives a very breezy account of his four months' visit to the United States, Canada and Mexico. It is indeed unusual to find so much "in a lighter vein" under such a title.

Perhaps the keynote to his message appears in his last two paragraphs:—

"So ends my story, there is little enough information, but if reading it leads to a desire to do likewise its publication is justified—a satisfactory export trade can be built only on mutual understanding and this doesn’t arise from an exchange of correspondence.

The men you meet are he-men, they fight hard and long for a high standard of living, but they’re very human and my greatest pleasure lay in meeting them. I am most grateful to the hundreds of busy executives who spared long hours of their precious time in giving me wise disinterested advice and a wealth of useful information, not least for the hospitality they extended in my infrequent hours of relaxation; the refinements of an American home are alone a liberal education, while their Clubs baffle description."

Such a publication may easily do as much good as a great pile of "dry as dust" statistics.


This is an interesting and rather unusual treatment of the properties of textile fibres. The paper formed the Edgar Marburg Lecture of 1944. As Dr. De Witt Smith is a Fellow of the Textile Institute and a Life Member, it is considered that members may be interested in his discussion of this subject.

On his invitation to be Marburg Lecturer for 1944, Dr. De Witt Smith joined a distinguished company, as perusal of the list of lecturers on the inside back of the pamphlet will show.

Science: The Endless Frontier. Report to the President on a Program for Postwar Scientific Research by Vannevar Bush, Director of the Office of Scientific Research and Development, Washington. (Received through the Parliamentary and Scientific Committee, [An unofficial group of Members of both Houses of Parliament, and representatives of certain scientific and technical institutions] 5th October, 1945).

Dr. Vannevar Bush, Director of the Office of Scientific Research and Development, Washington D.C., received what may be regarded as his terms of reference from the late President, Franklin D. Roosevelt in the letter of 17th November, 1944. From this letter Dr. Bush selected the following sentence and
gave it a prominent place. "New frontiers of the mind are before us, and if they are pioneered with the same vision, boldness and drive with which we have waged this war we can create a fuller and more fruitful employment and a fuller and more fruitful life."

It will surprise none that a forceful statement such as this came from a fearless idealist, as the late President was well known to be. Dr. Bush must have worked quickly. His report to the President is dated July 1945, and it is clear that without the extensive delegation of some of the duties laid upon him, he must have required far more time. The questions put to him by the late President were definite, and the answers provided by the Committees he consulted are striking and forthright. It is indeed true that "there is no reason why the lessons to be found in this experiment [team work and co-operation in co-ordinating scientific research for the purpose of prosecuting the war] cannot be profitably employed in times of peace." The report is excellent and stimulating.

Such a brief notice as space permits cannot but fail to do justice to Dr. Bush's report. It is good to observe that an examination of the present conditions in this country on somewhat similar lines is exercising the minds of many thoughtful men. Governments must encourage the pursuit of science. As Dr. Bush observes in the closing sentence of the letter accompanying the report, "Scientific progress is one essential key to our security as a nation, to our better health, to more jobs, to a higher standard of living, and to our cultural progress."

**Salaries of Technical Teachers.** The new Scales of Salaries for Teachers in Technical Colleges and Institutes, Art Colleges and Schools formulated by the Burnham Committee and approved and published by the Ministry of Education (H.M. Stationery Office, 6d. net) are a great improvement on those they replace. For example, the scales for provincial non-graduate assistant teachers used to be: men, £186-£12-£384, women, £174-£9-£306; they are now £300-£15-£525, £270-£12-£420 respectively. There are additions to the basic scales for each year of approved study and/or training beyond the first two and for the possession of a University degree or an academic or professional qualification, but the difference between the scales for graduates and non-graduates is not as great as it was. The list of approved degree equivalents includes the Associateship, by examination (Parts I & II), of the Textile Institute. It is difficult to understand why no mention is made of examinations giving exemption from the examination in Part I although these are specifically accepted in the arrangements for other Professional Institutions.

For Assistant Teachers there are to be special posts carrying extra allowances per annum of from £50 to £100 for men and from £40 to £80 for women for special responsibility, special qualifications or appropriate circumstances. There is also to be a "College" establishment of Senior Assistantships, based upon the number of students preparing for higher examinations, carrying scales of £600-£25-£750 for men and £480-£20-£600 for women.

Heads of Departments are classified in four grades, the lowest carrying the scales for Senior Assistantships and the highest scales starting at over £1,000 for men and over £800 for women.

It is satisfactory to find that the former grade of Instructor has disappeared, that the avenue of promotion is clearly indicated and that there is no longer uncertainty about the remuneration of Heads of Departments. Definite steps are to be taken to review the salaries of Principals with a view to considering scales for them.

There is now some reason to hope that the salaries offered will prove attractive to the men and women who are needed for the development of technical education outlined in the Education Act of 1944.

**Planning County Colleges.** Many employers and parents have been doubtful, to say the least, about the effects of that section of the Education Act of 1944 which provides that after an appointed day, all young persons not already
in attendance at full-time schools shall attend County Colleges for one day a week until they are 18 years of age. It is true that voluntary part-time release of young people for attendance at day classes is increasing, but compulsory release of all young employees is a different matter. Although it is not likely that the appointed day will fall before 1950, it is very desirable that doubts shall be dispelled and schemes formulated well in advance. To this end the Ministry of Education has published a Pamphlet entitled "Youth's Opportunity" (Pamphlet No. 3, H.M. Stationery Office, 1/- net), which all who are interested in the employment, training and welfare of young people are strongly recommended to study.

The pamphlet analyses the causes of the failure of the Day Continuation proposals of the Fisher Act of 1918, assesses the importance of public opinion in the failure and proceeds to make suggestions, some definite and some tentative, pointing the way to greater success in the renewed effort. It says truly: "If this development, when taken in hand, is to be made fully effective, it will demand both careful planning and imaginative vision, not least to secure the willing co-operation of those who are most concerned—the young people themselves."

The keynote is struck in the statement: "It is important, at the outset, to be reminded of the kind of human material for which the scheme will be planned, if only because it is all too easy to become absorbed in the details of an administrative machine and to forget those in whose interests the machine is going to work." This is followed by an able summary of the characteristics of adolescence and the needs of the young student, which conditions the succeeding chapters on the organisation, the premises and equipment, the staffing, the curriculum and the internal problems of the County Colleges, and on the special needs of girls and of rural areas. The list of the aims of education in the Colleges is worthy of careful consideration. It is comprehensive, well-balanced, liberal and appropriate to the conditions of part-time attendance. The suggestions for achieving these aims are marked by understanding, wisdom and freshness, and will surely "make an appeal to vigorous and original minds."

The authors insist "that the field of further education is one, and, hence, that compulsory part-time education must be regarded as part of it and not as something separate and self-contained." The provision of County Colleges is, therefore, to be planned in the closest possible relationship with existing or prospective institutions of further education, and the links with the Central College of Further Education on the one hand, and with the Community Centre on the other are discussed. It is suggested that not more than five out of the eight periods of the students' attendance may be devoted to courses of a vocational character, "in the normally accepted sense," by the students for whom such courses are appropriate.

The contents of the pamphlet justify its concluding sentences: "The aims that have been formulated for the County Colleges are as old as liberal education itself. The educational traditions of the country, individuality, craftsmanship, scholarliness and freedom from rigid codes, will meet and influence each other in a way that has never been possible before. They will provide an opportunity for the young people of this country to make better use of their powers and to give better service to humanity; to learn, in short, the real relationship between rights and obligations and between work and happiness." D.

Higher Technological Education. It is generally agreed that in the industrial rehabilitation of this country the quality of our products will be even more important than their quantity, and that the attainment and maintenance of high quality will depend upon the ability of our technicians to keep abreast of scientific progress. This will require a full provision of thoroughly efficient
technical training, in the planning and development of which industrialists and educationists must cooperate closely, especially at the higher stages.

Hitherto, Universities and Technical Colleges have participated in the provision of technical education without much collaboration, or definition of their respective functions, or any systematic planning. "Indeed, it was abundantly clear, even before the war, that the whole system requires overhauling if it is to play its part in assisting British industry to hold its own in foreign markets."

The above quotation is from the Prefatory Note to the Report of a Committee, under the Chairmanship of Lord Eustace Percy, which was appointed in 1944 by the Minister of Education with the following terms of reference:—

"Having regard to the requirements of industry, to consider the needs of higher technological education in England and Wales and the respective contributions to be made thereto by Universities and Technical Colleges; and to make recommendations, among other things, as to the means for maintaining appropriate collaboration between Universities and Technical Colleges in this field." This report (Higher Technological Education, H.M. Stationery Office, 6d. net) is of the utmost importance to industrialists as well as to educationists.

"The original intention was to submit successive reports on the requirements of different industries and the educational provision which should be made to meet them." Inquiry convinced the Committee, however, "of the need for a standing organisation both to survey industry and to co-ordinate education." They, therefore, turned their attention to recommendations for the constitution of such an organisation, illustrating these recommendations from the broad field of Mechanical, Electrical and Civil Engineering.

The Committee recommend the selection of a strictly limited number of Technical Colleges, to be styled Colleges of Technology (up to six in the Provinces for Engineering) in which there should be developed technological courses requiring full-time study over substantial periods and different from University degree courses but of a comparable standard. Technological studies in Universities, Colleges of Technology and other Technical Colleges of eight suggested regions covering England and Wales should be co-ordinated by Regional Advisory Councils which would create Regional Academic Boards to advise the Councils and Governing Bodies. These Boards should make their own arrangements for close consultation with industry.

The national counterpart of the regional machinery would be a National Council of Technology which would consider national aspects of regional policies and advise the Minister of Education and the University Grants Committee upon them. The National Council through its Academic Board would consider courses of study, standards of staffing and equipment and examination arrangements in Colleges of Technology and award a State qualification in approved cases. The Committee disagree on the title of the State qualification corresponding to a University first degree, some suggesting "Bachelor of Technology," and others "Diploma in Technology" while the Chairman in a special note suggests that the Colleges might be given the status of "Royal Colleges of Technology" and grant Associateships and Fellowships. The Committee agree, however, that the higher qualification should be Doctor of Technology.

The Report contains other important recommendations upon such subjects as recruitment, State Bursaries, consultation between Universities and Technical Colleges and transfer of students between them, instruction in Industrial Management and college and industrial refresher arrangements for teachers. It is to receive careful and detailed consideration by the Minister of Education, and, it is to be hoped, by the Universities, Local Education Authorities and industry. Their co-operation in implementing its recommendations would do much to put technical education on the way to greater coherence, efficiency and esteem.
DDT

Recently it was announced that limited quantities of DDT were being released for civilian use. During the war the whole production was earmarked for purposes directly concerned with war. It was not until August, 1944, that the story of DDT was officially released in this country. It told of the efforts of scientists, technologists and industrialists all over the free world to make and apply the new insecticide.

As in many other modern developments in chemistry DDT arose from years of systematic scientific research in the laboratories of J.R. Geigy of Basle, the well-known manufacturers of dyes, drugs and chemicals. The firm was established in 1764. During the last twenty years the Geigy Company, in close association with the textile industry, has been engaged on research into moth-proofing agents. This culminated in the publication in a Swiss chemical journal of the intensive work directed by Drs. Lauger, Martin and Muller of the Geigy Company. The long experience of the Geigy colour chemists was freely drawn upon. Thus it was realised at an early stage that the proofing agent in addition to being toxic to the moth larva, must also impart a permanent toxicity to the wool. Other obvious requirements were good affinity for the wool fibre without altering the colour, good fastness to light, and the usual wet fastness properties. Further it was clearly desirable that it should be harmless to warm-blooded animals, especially human beings, and have no offensive odour.

The research led to the discovery of Mitin, a product suitable for the treatment of wool as a permanent mothproof. From this it was a natural development to search for a general insecticide. The work was, therefore, put on a wider basis, and the effects on insects generally, for a range of substances, were investigated. Much was learned from the examination of natural insecticides such as the vulpinic acid of certain lichens (Cetraria vulpina), rotenone, pyrethrum, cumarín derivatives, etc., but they all failed to come up to the specification in that they were unstable when exposed to light.

Insects which consume a varied diet such as green leaves, stalks, fruit, etc., must employ a larger range of digestive ferments than the keratin eaters (moths). Consequently they should be more easily affected by poisonous substances since it is necessary to destroy certain ferments only in order to starve or otherwise kill the pests. It was in research carried out by Dr. P. Muller on these lines that the effects of diphenyl-trichloro-ethane were discovered. From this basis another substance of this group αa-dichloro-diphenyl-βββ-trichloro-ethane was prepared. This possessed insecticidal properties never previously observed. It was what is now called DDT.

Dr. Paul Muller tested DDT against the Colorado beetle by sprinkling a dust preparation on a potato plant which was infested. He noticed that almost immediately the larvae dropped to the ground, and he took up a spadeful of soil which he carried into the laboratory. Next morning he found that all the larvae were dead. He reasoned that as they had dropped from the foliage immediately, they had not had time to eat any part of the plant dusted with DDT, so that they must have died by mere contact with the powder.

It was in this way that the contact effect of DDT was discovered. This story is of particular interest, as the direct application of DDT to large scale field work was first made in Switzerland against the Colorado beetle, and at a time when pyrethrum and derris were unobtainable, it saved the Swiss potato crop from a particularly serious infestation.

In 1942 the Geigy Company communicated to the British Legation in Berne the interesting results obtained to date with DDT which at that time was known under the Geigy trade names of Guesarol and Neocid, the former referring to agricultural applications and the latter to medical preparations against parasites such as the louse and the mosquito. The Geigy Company in
Manchester also introduced the material to the chief testing stations, both agricultural and medical, of the United Kingdom.

Before an insecticide can be safely used on a large scale, a great deal has to be known not only about its power to kill insects, but also about the best methods of application, the necessary concentrations in various circumstances and, even more important, the possible risk to health which may attend its use. The early laboratory tests carried out in England by chemists, entomologists and other scientists concentrated the work of several years into a slightly higher number of weeks. DDT was soon shown to be unique, with properties superior to those of any insecticide yet made. Its applications in connection with war were immediately obvious.

Of the many materials, natural or synthetic, which up to 1942 had been tested for their toxic effect on mosquitoes and flies, pyrethrum flowers, belonging to the genus Chrysanthemum, had been proved to be by far the most effective. In the period immediately preceding the war, the world production of pyrethrum flowers was approximately 15,000 tons per annum of which 70 per cent. came from Japan. Kenya began commercial production in 1933 and by 1938 was producing 2,000 tons per annum of very high quality flowers. America was by far the largest consumer and practically the whole of the Kenya crop was shipped to that country for the extraction of their physiologically active ingredients, the pyrethrins. With the entrance of Japan into the war, the supplies of both pyrethrum and rotenone, another important insecticide, were cut off, while the total demand for the armed forces of the allied nations rapidly increased and, even after the elimination of all domestic requirements, were far in excess of available output.

In order to deal with the supply position, an Insecticide Development Panel was set up under the Chairmanship of Professor I. M. Heilbron, F.R.S., during the winter of 1942. This was composed of entomologists, malariologists and chemists, and included Supply and Service specialists and representatives of the Dominions and U.S.A. The Panel examined all the synthetic insecticides available, and from these it chose DDT for its effectiveness as an insecticide, its harmlessness to human beings and warm-blooded animals, and the fact that it could be manufactured from raw materials available in the country. Pilot-scale production was immediately commenced and in collaboration with the British Geigy Company, plans for large scale production were prepared. Its full potentialities and methods of application were simultaneously worked out by teams of Government, University and industrial scientists, in collaboration with experts from the three Services. Close liaison was established with American and Dominion scientists, who were already working on similar lines, and now many hundreds of workers are collaborating in developing all aspects of its use and application.

As DDT became known, Service demands increased. They are still high and take priority so that only limited quantities of DDT can yet be made available for the numerous uses which it will have in every-day life. It may be of interest here to state that on the occasion of his visit to Normandy Mr. Churchill was so impressed with the importance of DDT that he gave it a priority on a level with Penicillin.

DDT was in the first place used in this country for the louse-proofing of garments for use by the armed forces, and impregnated shirts have been an issue to our front-line troops since 1943. They have proved very effective, since they withstand several launderings without serious loss of activity. It is no exaggeration to say that our troops were virtually louse-free, in striking contrast to German prisoners of war. It is considered by some leading scientists that the use of DDT coupled with vaccine will, in future, very greatly reduce the incidence of typhus in every part of the world.

The first full-scale use of DDT in a war sector was in Naples. Here in December, 1943, typhus broke out in the overcrowded civilian population which
in the main was poverty stricken, dirty and louse-ridden. As soon as the allied forces were in control, vigorous steps were taken to suppress the outbreak by mass disinfestation. This was first done by dusting with ordinary lousicides, but as soon as DDT became available it was used solely and with signal success. During January, 1944, 1,300,000 civilians were dusted at two-de-lousing stations (72,000 on the peak day) and within three weeks the outbreak in the city of Naples was completely under control, the weekly number of civilian cases reported falling sharply from 305 in the peak week ending January 11th to 155 the following week. DDT has thus already made medical history of tremendous significance, as never before has a typhus outbreak been arrested in mid-winter.

For the troops, however, protection against malaria and dysentery is even more important, and in the operations which were carried out in the Far East, DDT found its most important war use. In this theatre of war large areas are made practically untenable by the enormous population of malaria-carrying mosquitoes. Added to oil, however, which has been used against mosquito larvae ever since the Panama Canal was built, DDT produces a larvicide of such potency that only a fraction of the oil previously employed will henceforth be required, and this new preparation will remain toxic to the mosquito larvae for several days.

The majority of casualties in all wars are not directly due to enemy action. In Sicily the 7th and 8th Armies suffered more casualties from malaria than from battle. Many more people are afflicted by disease than are killed or wounded and so far as our knowledge extends, more people die from the epidemics following war than are killed by enemy action during it.

As the quantity of DDT solution required is small, relatively large areas can be treated from the ground by means of hand or power sprayers. For larger areas, or where ground application is not possible, spraying from aircraft has given results of the highest significance. In this manner large areas have been successfully treated; the use of but \( \frac{1}{2} \) lb. or less of DDT per acre results in almost complete destruction of larvae and also a very high mortality among adult mosquitoes, both by direct contact and by the residual effect of the insecticide. Whilst the DDT spray can be applied by means of the familiar fit gun, power-operated sprays or the new gas-operated sprays, the U.S. Army developed the Aerosol bomb which, owing to its compactness and ease of transport renders it extremely valuable for use by front-line troops in tents, native huts, foxholes, etc. It is fitting to quote here the statement which Mr. Churchill, as Prime Minister, made in the House of Commons on the 28th September, 1944: "The excellent DDT powder has been fully experimented with and found to yield astonishing results which will certainly be used on a great scale by the British forces in Burma and by American and Australian forces in the Pacific, and indeed all theatres." The latest large-scale application of DDT took place when the allied armies liberated the various concentration camps in Germany, such as Belsen, Buchenwald, etc., and so brought relief to the inmates who were ridden with insects and suffered untold agonies as a result of infestation. Many as the war-time applications of DDT were, those for times of peace are likely to be far more numerous. Such pests as the louse, the flea, the bed bug, the cockroach, the cricket, the silver fish and the common house fly, (the carrier of so many intestinal diseases and the cause of great losses of foodstuffs), can all be dealt with by DDT. Preparations can also be made up for the purpose of dusting or spraying on furnishing fabrics and carpets to protect them against moth larvae, and they can be rubbed into furs before being put away for the summer. In dairy, poultry, sheep farming, etc. DDT has wide fields of application in dealing with lice, fleas, warble flies, keds and ticks, and for the disinfestation of stables, shippons, henhouses, dog kennels, etc. DDT preparations have been applied direct to cows, horses, pigs, hens, sheep and to
all classes of dogs from army dogs to greyhounds. In agriculture DDT is used against soil, root and plant pests such as wire worms, carrot, onion and cabbage root flies, as well as caterpillars, and one of its greatest benefits arises in orchards and soft fruit plantations where it is used for the control of many pests, notably the apple blossom weevil.

One of the latest developments is the application of DDT in distempers and paints. The result obtained in factory canteens with DDT oil-bound water paint is excellent, and should be of particular interest in jam, biscuit and sweet factories. Oil-bound water paints containing DDT can be used for preventing the development of pests as well as for disinestation.

DDT is not a repellent. Insects do not avoid surfaces treated with DDT, nor do they show immediate ill-effects after having come in contact with it. But contact is fatal. The insects cannot recover even under the best conditions. DDT has a lasting effect, and is active for weeks or months after application, according to the method by which it is applied.

It is clear, therefore, that the possible uses of DDT in connection with textiles are of great importance. Producers and users of textiles cannot fail to be interested in an agent which appears to have such wide fields of application.

London Section

(Meeting held on Thursday, 8th November, 1945, in the theatre of Messrs. Gaumont-British, Film House, Wardour Street, London, W.1).

At this meeting inaugurating the 1945-6 programme, Mr. Meredith, Chairman of the Section, briefly expressed the hope that the London Section would stage a vigorous revival on the return of the country to the conditions of peace. He referred to the dislocation, during the war, of the section activities owing to the unwelcome attention of the enemy to London, and the consequent blackout. His committee wished to enlarge the section by attracting visitors.

An extremely interesting exhibition of textile films followed these introductory remarks. The films included:—

(1) Messrs. Lister & Co. Ltd.'s colour film showing combing, spinning, preparing, weaving and dyeing of textiles including flat and pile fabrics.

(2) Merely the Trimmings. Produced and filmed by Alan Turner, Esq. (In colour).

(3) This is Colour, from the Central Film Library, Imperial Institute. Produced by I.C.I. Ltd., in colour and sound.

The films were enthusiastically received, and there was no doubt that they were highly appreciated.

In closing the meeting with announcements of future events, Mr. Meredith acknowledged the section's indebtedness to the Acting Honorary Secretary, Mr. A. R. Down. To Mr. Down was due almost entirely the credit for this very successful meeting. His present filling of the office of Honorary Secretary was evidence of the extent to which he had the welfare of the section at heart, particularly when it was remembered that he had held the post previously for many years until he himself insisted that a change was overdue.
Lancashire Section

(Bolton Branch)

(Meeting held at the Bolton Technical College, on 13th November, 1945, Councillor A. Hollas in the chair).

Mr. L. Armstrong began his lecture on "A Modern Fancy Loom" with a brief review of the economic position of the country in general, and of the problems of Lancashire in particular, stressing the need for great increases in Britain's export trade. He considered that in Lancashire the best way immediately to increase exports was to produce the more expensive kinds of cotton and rayon cloths rather than the bulk production "bread and butter" styles.

Referring to the adoption in the U.S.A. of automatic looms and the consequent increase in production per man-hour, he expressed his conviction that Lancashire could do much to further this desirable end by the application of the automatic loom to the production of fancy cloths.

He proceeded to a detailed discussion of the Crompton & Knowles automatic box loom from the engineering point of view without losing sight of its potentialities as a producer of fine fabrics. His remarks were illustrated by photographs projected by the epidiascope, and by numerous samples of fabric as well as actual parts of the loom and its accessories.

In the discussion that followed, doubt was expressed regarding some of Mr. Armstrong's claims regarding production in the States. It was clear that the audience would need incontrovertible data before accepting the claims. Appreciation of the lecture on the loom was freely expressed.

Visit to Messrs. Turnbull & Stockdale Ltd., Rosebank Print Works, Ramsbottom.

On Wednesday, October 3rd, a party limited to 30 members visited the Rosebank Works of Messrs. Turnbull & Stockdale Ltd. After a welcome by the Managing Director, Mr. R. T. Turnbull, J.P., the party divided into small sections, which were conducted through the works by competent guides. They were shown the whole sequence of operations from the preparation of the grey cloth to the packing of finished prints. All the printing processes were shown as well as the making of the blocks for hand printing.

The firm entertained the party to tea in the Canteen. A vote of thanks to the Directors and staff was proposed by Mr. S. Heap and seconded by Mr. H. C. Barnes. Mr. W. Turnbull, Jnr. replied. Without a doubt this visit was a memorable occasion for all who participated in it.

Institute Diplomas

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

FELLOWSHIP
JAMES ALFRED HANKINSON, A.T.I., Assistant Group Works Manager, Co-operative Wholesale Society, Manchester.

ASSOCIATESHIP
HAROLD NICHOLS CLIFFE, Assistant Research Chemist, I.C.I. (Explosives) Ltd., Ayrshire.
HUGH ALEXANDER HALDANE McGILL, B.Sc., Sales and Technical Director, Platt Bros. & Co. Ltd., Oldham.
SYDNEY MULLOCK, Head of Quality Control Department, Carding and Spinning Division, Turner Bros., Rochdale.
Institute Membership

The following applicants were elected to membership at the November meeting of Council:—

Ordinary.

Arthur Walmsley Bagshaw, "Thornleigh," Rochdale Road East, Heywood (Preparation Manager, Mutual Mills Ltd., Aspinall Street, Heywood).

Morris Benson, Ministry of Supply, 6, Whitehall Crescent, Dundee (Textile Inspector).


Albert Boyes, 6, Holmebank, Ashgate Road, Chesterfield (Weaving Manager, Robinsons & Sons, Wheatbridge Mills, Chesterfield).

Harvey Brockenshaw, 2, Manor Mead, Queens Road, Weston-super-Mare (Research and Development Manager, Price Bros. & Co. Ltd., Wellington, Somerset).


Tom Chadderton, 11, Parkgates Avenue, Cheadle Hulme, Cheshire (I.C.I. Ltd., Dyestuffs Division, Hexagon House, Blackley, Manchester).


Harold Collier Cowgill, 434, Colne Road, Queengate, Burnley (Liaison Officer, British Cotton Industry Research Association, Shirley Institute, Manchester).

Roland Day, 3, Sandringham Avenue, Denton, Nr. Manchester (Secretary of Ashton & District Cotton Employers' Association, 32, Booth Street, Ashton-under-Lyne).


Raymond Downs, 7, Cassels Road, Brunswick, Victoria, Australia (Manager, c/o Downs and Son Pty. Ltd., Brunswick).


Norman Frederick Dutfield, "Compton," St. Johns Avenue, Kidderminster (Company Director, Morris & Co. (Kidderminster) Ltd., Hoobrook Mill, Kidderminster).

Irvin Dyson, Leeming Reservoir House, Oxenhope, Keighley, Yorks (Assistant Manager, Hield Bros. Ltd., Brigella Mills, Bradford).

Robert Victor Walmsley Thomas Evelyn, 73, Cumberland Road, Urmston, Manchester (Dyeworks Superintendent, Isaac Bury Ltd., Adelphi Dyeing and Finishing Works, Salford).


Ernest Hobson, 143, Springfield Road, Kearsley, Nr. Bolton (Liaison Officer, British Cotton Industry Research Association, Shirley Institute, Manchester).


Hugh Craig Houston, 40, Palmerston Road, Dublin (Managing Director, Irish Thread Mfg. Co. Ltd., 23, Thomas Street, Dublin).

Leslie B. Jones, Brighton House, Baltray, Near Drogheda (Factory Manager, Greenmount & Boyne Linen Co. Ltd., Boyne Mills, Drogheda).
Herman Judd, 4, Clifystone Drive, East Morton, Bingley, Yorks (Technical Advisor, Prince Smith & Stells Ltd., Keighley).

Arthur Langborn, 3, West Clowes Street, Salford, 5 (Technical Secretary, British Cotton Industry Research Asscn., Shirley Institute, Manchester).


John William Lewis, 31, Knowsley Street, Bury (Overlooker, Unity Ring Mill Ltd., Broadfield, Heywood, Lancs.).

Frank Hubert Marsh, B.Sc. (Hons), F.R.I.C., 21, Fearnville View, Leeds, 8 (Technical Director, Longclose Engineering Co. Ltd., Bowman Lane, Leeds, 10).


Jim Ramsbottom, 83, Ellesmere Park, Eccles (Manager of group of works, Winterbottom Book Cloth Co. Ltd., Weaste, Salford, 5).

James Rushworth, Grout & Co. Ltd., Great Yarmouth, Norfolk (General Manager).

Louis J. Sheps, B.Sc. (Hon), Ph.D., Richards Chemical Works Ltd., St. Johns, Quebec, Canada (General Manager).

Dhirajlal Nemchand Shroff, New Era Textile Mills Ltd., Tulsi Pipe Road, Mahim, Bombay, 16, India (Managing Director).

Charles Tattersall, 68, Green Lane, Garden Suburbs, Oldham (Cone Winding Overlooker, Lancashire Cotton Corporation Ltd., Brunswick Mill, Manchester, 10).

Richard Wadman, Borrowdale, Heywood Hall Road, Heywood, Lancs. (Spinning Manager, Mutual Mills Ltd., Heywood).


Robert Willer, B.Sc., c/o I.C.I. Ltd., o/s Sales Dept., Hexagon House, Manchester, 9 (Chemist, Dyestuffs Division).

Arthur Stanley Wright, 3, Park Drive, Ilkeston, Derbyshire (Hose and Circular Knit Mechanic, British Celanese Ltd., Spondon, Nr. Derby).

Frederick James Wrigley, 13, Maretimio Villas, Blackrock, Co. Dublin (Assistant Secretary, Apex Mfg. Co. (1935) Ltd., Carysfort Avenue, Blackrock).

Junior.

Miltes Antunes, N.S. do Carmo, Sorocaba, State of S. Paulo, Brazil, S. America (Mill Manager's Assistant).

George Arthur Stephen Bell, 29, Cope Street, Hyson Green, Nottingham (Laboratory Assistant, University College, Textile Department, Shakespeare Street, Nottingham).

John Llewelyn Crowther, 36, South Parade, Elland, Yorks (Student, Leeds University).

Kenneth Walter Lloyd Kenchington, Textile Section, Armament Research Dept., Woolwich, London S.E.18 (Assistant Experimental Officer).

Philip Dawson Smith, 25, Broad Avenue, Coleman Road, Leicester (Knitting Research, Wolsey Ltd., Abbey Park Mills, Leicester).

John Howard Wolsey, "Hazeldene," Burras Lane, Otley, Yorks (Student, Department of Textile Industries, The University, Leeds).
Employment Register

No. 204—Young man, 31 years of age, desires position in textile trade with future prospects. City and Guilds Full Technological Certificate in Cotton Weaving. Certificates in Woollen and Worsted Weaving and Finishing. Six years’ experience in weaving mill and two years’ in finishing mill. School of Accountancy Diploma in Bookkeeping.

No. 234—Textile finishers are offered the opportunity of availing themselves of the services of a technical man (Chemist, F.T.I., 40) with a unique experience in the finishing of Rayon and Cotton in piece and yarn, research, management and organisation. Only a position with high responsibility and wide scope of activity will be considered.


No. 252—A.T.I., 38 years of age, desires executive position with large firm of Cotton Spinners, Doublers and Shippers. City and Guilds Full Technological Certificate in Cotton Spinning. Associate of Salford Royal Technical College. Wide experience in continental and world markets, all classes of unprocessed and processed yarns, particularly hosiery.

No. 253—Young man, 29 years of age, A.T.I. desires administrative position in Textile manufacturers either in England or abroad. Several years’ experience in production, costing, designing and administration.

No. 256—A.T.I. 44 years of age, desires position as Manager or Assistant Manager, 20 years’ experience Cotton, Linen and Rayon Piece Goods (specialising Vat colours) also Woollen yarn dyeing. Full Technological Certificate of the City and Guilds of London Institute in Cotton Dyeing. Would also consider position as technical sales representative.

No. 257—Young man requires post as Assistant Manager in a Worsted Spinning Mill with preference abroad. City and Guilds Full Technological Certificate. Higher National Certificate with distinction in Worsted Spinning.
INSTITUTE MEETINGS

IRISH SECTION

Thursday, 6th December, 1945—Belfast. 7.45 p.m. Lecture: "Rayon Weaving," by A. Glover, F.T.I. (Courtaulds Ltd.) at the College of Technology.

Thursday, 13th December, 1945—Belfast. 7.45 p.m. Lecture: "Spinning of Fibro," by H. Ashton, F.T.I. (Courtaulds Ltd.) at the College of Technology.

LANCASHIRE SECTION

Friday, 7th December, 1945—Manchester. 6.30 p.m. Lecture: "Carpet Manufacture," by W. J. Hopkins (Carpet Trades Ltd.) at the Textile Institute.


Friday, 14th December, 1945—Manchester. 1.0 p.m. Lunch-time meeting at the Institute's premises. "Laminated Plastics," by J. H. Jarman (Tufnol Ltd.).

MIDLANDS SECTION

Thursday, 6th December, 1945—Derby. 6.45 p.m. Lecture: "Woven Fabrics," by A. Pollard, M.Sc. (Head of Department of Textiles, College of Technology, Leicester) at the Technical College, Derby.

YORKSHIRE SECTION

Section Honorary Secretaries

For the benefit of members, the following information is given showing the names and addresses of Honorary Secretaries of Sections of the Institute.

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The Textile Institute,
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Telephone: Blackfriars 2016.
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THE JOURNAL OF THE
TEXTILE INSTITUTE

TRANSACTIONS

23—MEASURES TO CHECK DETERIORATION IN EGYPTIAN COTTON VARIETIES

Part I—THE GIZA SEED MAINTENANCE SYSTEM

By H. A. Hancock

i. Introduction

The high economic value of modern cotton crops has been developed by human selection, operating on variable material, in the course of centuries of cultivation. That further advances are very far from exhausted, is shown by the results of intensive selection possible by modern techniques; but in recent Egyptian crops, and probably in most of the world's cotton crops, the difficulty has been to maintain economic advances when they are discovered. Highly evolved crops tend to fall back from their new economic level a few years after the new varieties expand in commercial production. The pressure of natural selection operates on heterogeneity which always exists although it may not be apparent in the field crops. How to avoid deterioration and so realise the advantages of artificial selection is a problem as important to spinners as it is to growers, since it is a major factor in deciding costs of production.

Deterioration in cotton varieties has been a subject of complaint by spinners for the better part of a century; and in recent years the International Federation of Master Cotton Spinners has been particularly active and useful in drawing attention to the question. The complaints have referred to Sea Island, West Indian, Egyptian, Peruvian, Brazilian, Russian, American, South, East and West African, Indian, both the longer and the shorter stapled types, Chinese, and many lesser growths.

As they became aware of the financial losses involved, most of the cotton growing countries have paid increasing attention to deterioration during the past twenty or thirty years; but there seems little doubt that spinners were always more conscious of the problem and its importance than were the growers. This is perhaps because deterioration is mainly in spinning quality and not in agricultural yield, although the latter also is sometimes affected. Yet the grower suffers financial loss in either case, for of course he gets a lower return for a lower quality product; and especially is it true for high quality cottons, in which deterioration is apt to be the most marked.

Although many spinners rightly placed the chief responsibility upon the seed used, naturally they were unable to suggest a remedy. The growers' solution was to change over to entirely new varieties when the existing ones became hopelessly deteriorated. These new types were developed mostly by private individuals who served a very useful purpose with the limited means at their disposal; but as we now know, seed produced by the
methods in vogue was bound to suffer deterioration, which in fact with some reason came to be accepted as a natural characteristic of cotton varieties. Thus there came about a continual procession of "improved new varieties" in every cotton-growing country.

While they served the needs of the moment, there was probably not much improvement in most of these "improved" varieties, taking the long view. In Egypt each newcomer was compared with a predecessor usually well along the road towards deterioration; but had it been possible to compare both varieties at the same stage of development, most of the improvement would have been seen to be only temporary. Yet by slow and uncertain steps, not all of them forward perhaps, long-term advances in quality, if not in yield, do seem to have been made even with this happy-go-lucky state of affairs. Sakel almost certainly was a better economic proposition than any Egyptian variety before it.

Not everyone was deceived about the rate of progress made, however, and certainly the continual chop and change in varieties did not satisfy Egyptian growers and exporters, who realised that it made established marketing difficult. When Lancashire spinners pressed for action to be taken about these cotton problems, the idea therefore found a ready response in Egypt; and in 1911 the newly founded Department of Agriculture (now the Ministry) was authorised to begin distribution of seed on an organised basis. Part I of the present paper deals with the seed system which subsequently developed, concerned mainly with maintenance of established varieties, and not directed mainly, in the beginning at least, to improvement by selection. The developments with new varieties, in which selection for higher economic value is the main objective, are discussed in Part II. And the bearing of these subjects on the extent and nature of deterioration, together with the general problem as the writer sees it, are discussed in Part III.

### Table I

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<th>Offtypes which would be missed by roguing in the field</th>
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<td>Cotton grown from seed picked out from commercial bulks of the varieties named, and found to give low spinning values when compared with the normal variety grown alongside. No differences in plant form were distinguished between offtype and normal lots; and in the case of Sakel, the offtypes were not distinguished by visible differences in the seed either. (The offtype Sakel was a mixture of four deteriorated lots, the lowest spinning of 47 lots. Yarn strength is the lea product of 60s carded ring twist).</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Plant Form</th>
<th>Normal Offtype</th>
<th>Normal Offtype</th>
<th>Normal Offtype</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seed Fuzz</td>
<td>Normal Slight Fuzz</td>
<td>Normal Almost Naked</td>
<td>Normal Half Naked</td>
</tr>
<tr>
<td>Weight of 100 seeds (grams)</td>
<td>12.4</td>
<td>9.9</td>
<td>10.7</td>
</tr>
<tr>
<td>Hairweight per cm</td>
<td>118</td>
<td>137</td>
<td>128</td>
</tr>
<tr>
<td>Staple length 1/32 in. units</td>
<td>52</td>
<td>45</td>
<td>51</td>
</tr>
<tr>
<td>Yarn Strength</td>
<td>2,955</td>
<td>2,170</td>
<td>2,710</td>
</tr>
</tbody>
</table>

### ii. Development of Early Methods in Egypt

Egyptian seed maintenance in 1911, as in all the cotton crops of the world at that time, depended on the visual detection of offtype plants and seeds. Either such offtypes were eliminated from small bulks in course of purification before expansion into a commercial crop; or else there was a modification of this procedure, called Mass Selection, when a number of apparently similar plants or seeds were selected, bulked together and expanded, the parent bulk being discarded. Field selection methods were followed in Egypt for all seed distributed under the Government Seed Renewal Schemes up to about 1925; but there are two fundamental defects
in such methods, at least so far as they were applied to the Egyptian crop, to which this account is restricted.

In the first place, single plant selection is inefficient because although certain offtype plants or seeds can be detected by eye, many genetic variants are entirely normal in plant or seed form (Table I), and are therefore wrongly accepted or selected as normal plants. Furthermore, as Hutchinson and his colleagues\(^4\text{–}^5\) have pointed out, variants in lint quality or yield cannot be picked out among single plants, except very crudely, because genetic variance is hidden largely by accidents of growth. Secondly, a good deal of natural crossing occurs between closely adjacent offtype and normal plants in the field; so that even if the offtypes could be picked out, they are liable to leave impurity in the "purified" population remaining, or in selections out of it.

Crops maintained by mass selection methods are therefore very liable to changes arising from the differential expansion of undetected offtypes; and if the offtypes are more prolific and of lower quality than the original crop, the general level of the crop will fall. The danger of contamination in open-pollinated material now seems very obvious, but for years no suspicion was attached to these primitive methods. Mechanical mixing was generally believed to be the cause of deterioration always found after a few years when the supposedly pure seed was expanded into a large crop. Mixing at the ginneries was especially suspected, also mixing with intent to defraud; and there was a wide range of other explanations.

In 1904 W. L. Balls joined the Khedivial Agricultural Society of Egypt to begin his classical work\(^6\text{–}^7\) on cotton plants. In the following eight or ten years he studied the question of impurity in cotton varieties with Mendel's and Johannsen's principles in mind, and then began to put forward some revolutionary ideas. He maintained that impurities must develop in the crop unless they were eliminated from the strain in the beginning; he insisted on the need for pure strains, and showed how they might be obtained by continued selection within a self-pollinated line, beginning each expansion afresh from a single plant; and he drew attention to the dangers of cross-pollination by insects, a hitherto neglected factor in Egyptian seed maintenance. As Balls wrote in 1912: "We have first to begin operations with pure strains, then to propagate those strains without permitting any natural crossing from without; and lastly, to handle our seed so as to avoid mixture." Here for the first time was the sequence of operations placed in the order of priority recognised in the modern seed maintenance system.

Thus armed with sound basic principles, Balls became botanist to the newly-formed Department of Agriculture, where his new method was received with a marked lack of enthusiasm. As it transpired later, the senior officers 'favoured a more practical method of cotton breeding, in the form of field selection, which has proved so satisfactory in other cotton-growing countries.' At any rate, when Balls left Egypt in 1914, under something of an agricultural cloud, the old methods strongly held the field. In the meantime, workers in other countries had adopted the pure line concept, notably H. Martin Leake\(^8\) and B. C. Burt\(^9\) in India, and S. C. Harland\(^10\) in the West Indies. The improvement effected by Harland in competitive West Indian cotton was particularly difficult for Egypt to ignore. So when Balls returned to Egypt in 1927, he found that the new method had been adopted here after all, and had been partly in operation for nine years, with its merits just beginning to be appreciated.

This principle of continued selection within a selfed line, every generation being the expansion from a single plant in the preceding generation, has been the essential feature of the Giza method since 1927. The system has proved to have quite unforeseen merits apart from the question of purity, and has been elaborated in several directions. Although every
population is referred back to its single plant ancestor in the selfed line, the progeny test is now the essential basis for selection, only secondary importance being attached to measurements on the single plants. The source of new selections, originally field crop material, has been transferred almost entirely to artificial populations obtained by hybridising previous selections, a step which has led to remarkable results. The technique is also notable in the application of spinning tests at every stage of the plant breeding; and especially important is the development of seed control methods for pruning away commercial seed which has been too long in circulation, now recognised to be an essential feature of the seed maintenance system.

iii. The Present Seed Maintenance System

So long as it passes certain tests for purity, seed produced by any person or organisation is allowed for sowing in Egypt, but in practice 99 per cent. of the commercial crop is now derived from Ministry of Agriculture seed. Private enterprise has been driven from the field by the obvious merit of Government seed, without recourse to legislation. Practically the whole seed maintenance system of Egypt is thus centred on the Giza farm, controlled by the assembly of departments known as the Cotton Research Board, with links radiating to other Government and private farms throughout the length of Egypt.

Renewal Nucleus.—For each variety in cultivation, a renewal nucleus of pedigree plants is maintained on an area of ten or twenty acres, from which all the commercial crop of that variety is ultimately derived. The renewal nucleus in course of becoming a commercial crop is expanded at first either by the State Domains or other Government farms; or by selected private growers under contract to return the seed (First Propagation Seed) for Government distribution the following year. A similar system with modified form of contract is continued among private growers for two or three more years of expansion (Second Propagation Seed), by which time Ministry of Agriculture seed is available for about one-sixth of the country's total cotton area. All operations are carried out on land surrounded by big areas of the variety in question, generally in zones with the newest seed towards the centre. Thus the new seed is protected from outside contamination.

This seed then circulates among growers for a few years, not under Government control except that it comes up for examination each year under the provisions of the Seed Control Law, and is classed as ordinary commercial seed. Finally it fails to pass the Government standards of seed purity and is eliminated from the supply system, to go for crushing. In the meantime, fresh waves of pedigree seed have been expanded from a later renewal nucleus, a new selection improved in purity and often improved in lint quality or yield, and so the replacement system continues indefinitely. The kind of improvement referred to here, is such that the product is not changed enough to call for a new name and so cause disturbance in the marketing; development of new varieties is not the normal function of a maintenance system.

The modern conception of a variety, Ashmouni for instance, is thus a succession of crops from successive Ashmouni nucleus families, all probably slightly different though all derived from the parent Ashmouni. The idea of a single permanent nucleus, maintained by roguing or similar methods, is entirely abandoned; before the nucleus stage, once regarded as the starting point for seed maintenance, there is now a plant breeding organisation on an extensive scale. For Ashmouni and Giza 7 (as for Sakel until it died out), this organisation hinges on the pedigree lines; for newer varieties it hinges on the hybrid lines to be described later, of different origin but operated by the same technique. (Table II).
Table II
Summary of the Giza Seed Systems

(A) First Renewal Nucleus
(1) Single plant selection
(2) Pedigree or Hybrid Lines (for several years).
(3) Single plant selection expanded in Purity Chequer
(4) Type-group expanded in Cage
(5) Cage, second year
(6) Centre of large bulk of the same variety
(7) First renewal nucleus

(B) Continued Maintenance of Renewal Nucleus
Repeated Passages through Purity Chequer
Bulk seed taken from (4) or (5) above
Purity Chequer
Type-group expanded in Cage
Centre of preceding nucleus
Second Renewal Nucleus

or

Selection from Target Diagram
Single plant selection from (3) above
Pedigree or Hybrid Lines (for several years)
Single Plant Selection expanded in Purity Chequer
Type-group expanded in Cage
Centre of preceding nucleus
Second Renewal Nucleus

or

Continued Maintenance within the Renewal Nucleus Area
Single plant selection from (3) above
Selfed without selection for a few years
100 plants at centre of preceding nucleus area (10 or 20 selected)
10 or 20 families in a miniature chequer (5 selected)
5 selections and control in a yield chequer
Centre plot of preceding nucleus, the selection and runner-up being re-compared in further yield chequers.
Second Renewal Nucleus

Pedigree Lines.—Practically every plant from field populations, examined with sufficient care, is found to throw off variants in its daughter offspring. Considering only self-pollinated plants with contamination from outside sources excluded, the offspring of the daughters in their turn are found to split up into a wider range of grand-daughters; and this process of segregation continues for many generations. The variants frequently are not distinguished by anything unusual in the appearance of the plants or seeds; also differences in the lint are often small and difficult to detect by the ordinary tests; but the spinning-test is so sensitive in the detection of genetic differences, that continued segregation is more clearly shown in the yarn strength than in any character of the plant.

More scope for selection is given by the wider range of characters following segregation; and the opportunities are repeated, the advantages of selection being accumulated, from parent, to daughter, to grand-daughter and so on. Such selfed lines are called Pedigree Lines, and the purpose of selection in them is to persuade the strain towards a course of evolution considered satisfactory by man.

If the original parent was very impure, genetic differences in the sister plants, or in their lint, are sometimes big enough to be detected by eye during the first few generations. But if the parent was not very impure, and by about the fifth generation in any case, genetic differences between sister
plants are entirely masked by accidental variation arising from the conditions of growth. Selection based on single plants thus becomes ineffective at an early stage, even though important genetic variation still remains; and for better discrimination it is necessary to take the seeds from each single plant separately, and to expand them into families.

A certain amount of useful selection can be based on families from single plants at the first expansion, when there are usually from 50 to 300 plants per family, occupying one to five ridges in the field. But all final decisions at Giza are based on families at the second or third expansion, when there is enough seed for them to be compared in the miniature or yield chequers, with many replications. Random errors then diminish enough for genetic differences to be recognised in the chequers long after they can be picked out in the single plants; and segregation has been detected as far on as the thirteenth generation. Thus although it is convenient to refer to selection "in the pedigree lines," actually all final selection depends on the results of yield or miniature chequers running parallel.

Some account of the wealth of material to be found in the pedigree lines will be given on Part II of this paper. For the moment it will be assumed that the chequer tests have shown one of the early selections to be better in yield and/or spinning quality than the variety out of which it was selected, and that the family is otherwise suitable to become the renewal nucleus family. This nucleus can be referred to as the Primary Selection, any subsequent selections from it being the Secondary Selections. Seed representing the primary selection is now taken, using selfed seed reserved from the single plant in the pedigree line, and expanded for a year in the Purity Chequer (12).

The Purity Chequer.—The selected family is now in course of expansion into a bulk which will be the renewal nucleus, and the purpose of the purity chequer is, or was, (a) to eliminate offtype plants still remaining in the pedigree line strain; (b) to offer a new opportunity for selection in the strain; and (c) to compare the purity of related strains in a short list of final selections, to ensure that badly impure strains are not selected for immediate propagation. With regard to (c), the purity chequer technique still has some value as a safeguard against accidental mixtures of seed getting into the renewal nucleus. But apart from this unlikely contingency, Giza families are now mostly too uniform for the technique to be effective, for it is based on single plant selection although the observations are quantitative. The technique is now used, therefore, for renewal nucleus families at their first expansion only, and not for later expansions.

Each family in the purity chequer has ten wide-spaced plants per ridge with ten replications. (As first described by Balls, it was a chequer of single plants, not of ridges). Of the 100 plants in the total, about ten usually die off or give insufficient cotton for one reason or another, leaving some 90 plants to be harvested separately and have the results plotted. Flowers opening at the beginning and end of the season are self-pollinated, and this seed alone is used for future propagation. Results are plotted as scatter diagrams, called Target Diagrams at Giza, the 90 or so plants on the diagram representing the 90 or so single plants in the family (Fig 1).

Although other plottings are considered, the most useful diagram is that with staple (halo) length plotted against ginning out-turn, this distribution having the least proportion of environmental variance. A type-group of 50 plants nearest to the bull's eye on the target diagram is chosen to be the future nucleus family. Plants outside the type-group, offtype in undesirable directions such as low ginning out-turn or short staple, are discarded. Plants outside the type-group but varying in a desirable direction, were formerly the source of new material for selections, as will be described presently. The plants selected now are those in the type-group alone.
Fig. 1.—Target diagrams from the Purity Chequer, plotting Halo (i.e. Staple) Length against Ginning Out-turn per cent. (1) Original diagram of about 90 points, representing 90 single plants. (2) The "type group" of 50 plants selected for expansion into the renewal nucleus.

Propagation of the Type-Group.—The 50 plants represented by points within the type-group (Fig. 1) are bulked and have now to be expanded into a renewal nucleus occupying ten or twenty acres, at the maximum rate of expansion, and with the minimum of contamination from outside during the process.

Propagation for the first two years is carried on inside the Giza cages, stainless steel wire gauze compartments covering about half an acre each, designed to minimise natural crossing without the labour of hand selfing on a big scale. In the third year the seed is field sown at the centre of a large bulk of the same variety; and is ginned separately, with special precautions against mixing, to become the renewal nucleus the following year.

This is the source of pedigree seed released on contract by the Ministry as already mentioned, either directly to cultivators or through the intermediary of the Agricultural Bank. There is usually no need for special effort to get the seed into circulation; the system has the best possible basis for support, it depends on the recognised merit of the seed supplied. The demand for propagation seed is in fact often much greater than the available supply, especially with new varieties. The Ministry then has considerable freedom of action in placing seed with different cultivators, and this makes it easier to arrange deep zones of propagation areas for the better protection of the nucleus.

iv. Continued Maintenance of the Renewal Nucleus

Method of Repeated Passages.—Even before the renewal nucleus is established, steps are taken to build up its successor. Until recently this was often done by taking bulk seed from the renewed nucleus family at its first or second expansion in the cages, and then passing this "nucleolus" seed through the purity chequer a second time, the type-group so obtained becoming the renewal nucleus two or three years later. Some nucleus families were renewed three or four times by such repeated passages through the purity chequer.

This method was not satisfactory because the repeated families became too many generations removed from the original single plant parent by the time they reached commercial propagation. If heterozygous plants were present initially, the offtypes continuously increased in range, because the plants were continuously selfed until they reached the nucleus area. But the increased range was not detected except in regard to the few characters measured in the purity chequer, and without high
accuracy even for these. Undesirable offtypes in regard to other characters, liable to increase out of proportion or not, could thus segregate within the strain, free from human interference since they were not recognised. That extreme offtypes did occur was proved when single plants were picked out from a bulk after its third passage, expanded into families, and had the lint tested for spinning quality. The range of variation found came as an unpleasant surprise to the writer, and still more to the plant breeders.

The method of repeated passages is no longer used at Giza, but is mentioned here because it illustrates how impurities can develop and expand in a strain even when it is protected from outside contamination. Impurity is always present from the beginning, except perhaps in strains descended from a very highly inbred parent, and the breeder cannot afford to miss any opportunity for its elimination. Selfing alone is not enough; there must be continued re-selection and expansion from a single plant afresh, and the method of repeated passages ignored this important principle.

Selection from the Target Diagrams.—Several nucleus families until recently in commercial propagation were expansions from new material picked out from the target diagrams, the plants outside the type-group already mentioned as showing variation in a desirable direction. These expansions from single plants re-entered the pedigree lines with the selfed line unbroken; and secondary selection was carried on usually for two or three generations, final decisions as usual being based on chequer tests for yield and spinning quality. The selected family, certainly purer and usually better otherwise, then passed through the purity chequer to become the next renewal nucleus, exactly as described for the first nucleus.

This method met with considerable success in finding improved families, both of established varieties and of entirely new strains. It was first operated about 1927, but did not reach full development until some ten years later, when it became possible to carry out spinning-tests on all pedigree line families. The extent of segregation was then seen to be greater than was previously suspected, and this encouraged further search for yield segregation, which also was found. Many exceptions were found to the inverse correlation between high spinning quality and high yield which is the general rule, and important possibilities in secondary selection were thus recognised. The limit to the possibilities is not actually known in practice, because every Giza family continues to show at least small improvements every time they are sought for.

Maintenance within the Renewal Nucleus Area.—Selections out of the purity chequer and pedigree lines were apt to be slow in reaching the commercial crop, because propagation of selfed seed was delayed for two or three years until the full chequer results were known. So many families under trial made it impossible to expand selfed seed of each in readiness, and the chequer seed of the finally selected family was of course too impure for propagation. For established varieties, continued maintenance of the renewal nucleus is now speeded up by a new system. The first renewal nucleus is established by the technique already described, selfed seed being obtained from the purity chequer; there is, however, no further passage through the purity chequer. Table II shows the difference between the systems.

In the new maintenance system which began in 1943, initial selection is now chiefly for high yielding single plants in the selfed line (an almost random choice as regards genetic factors since the environmental variance is high), final selection as always being based on progeny tests for yield and spinning quality; but both the original single plants and the subsequent chequers are situated within the ten or twenty acres comprising the renewal nucleus for the variety in question. Ten or twenty highest yielding plants are first selected from a plot of about a hundred plants; about half of the
selections are eliminated on the basis of progeny tests for yield and spinning quality, etc., the following year; and all but one selection of the remainder are eliminated in further progeny tests in the next two years. By this method the seed used for testing can also be used for propagation, it having suffered no contamination from other varieties by natural crossing. Propagation begins as soon as the chequer results are known, and improvements get into circulation at the fastest possible rate.

A rigorously unbroken selfed line is maintained in the background to correspond with each stage of selection, and from this line springs a new nucleus family every three or four years. Thus tried and tested seed is only three or four generations removed from the single plant parent, when it begins to expand in the commercial crop. The parent is at the end of a long line of repeated selfing and selection, by which to develop purer and better seed; and there is the minimum opportunity for unwanted offtypes to segregate and expand as the nucleus grows up to be a main crop.

v. The Seed Control Law

Probably a single variety will never be found economically suitable for the whole range of cotton growing conditions in Egypt, and there have been usually half a dozen or more varieties running at any time. Contamination by natural crossing is almost inevitable under such conditions, and eventually leads to deterioration in the better quality varieties, quite apart from the possibility of accidental or fraudulent mixing of seed. Measures must therefore be taken to eliminate seed which has been too long in commercial circulation.

Under the provisions of Law No. 5 of 1926 (Seed Control Law), seed intended for sowing must not be ginned without a licence, and ginning must be carried on under the supervision of a Ministry of Agriculture inspector, one being attached to every licensed ginnery. At the commencement of ginning, a specified amount of seed must be run to clear the conveyors, etc., and not until then is seed collected for sowing. The inspector takes a sample of seed and/or seed-cotton according to a specified routine, for examination in the Ministry of Agriculture laboratories. If the seed or seed-cotton fails to pass the standards laid down from year to year, a certificate is refused and the seed cannot be used for sowing.

Until 1942-43, acceptance or refusal was based entirely on the proportion of offtype seeds; and long before this a gradual stiffening of the standards led to an amazing improvement of seed regularity, as well as a great improvement in the uniformity of the plants as seen in the field. About 10,000 lots of seed annually are received for examination (with peace-time acreage), the standards being steadily raised so that about 2,000 lots always fail to pass. More than 90 per cent. of the seed in use, when the law originally came into operation, would have failed to pass the present standards.

Although the seed examination method was successful up to a point, the system was not infallible because certain deteriorated elements exist in the crop which cannot be detected in the seed (Table I). Sakel was particularly unfortunate in this respect, and eventually seed was being passed when it was hopelessly deteriorated, although nobody could tell until it was sown and harvested. Since less seed was rejected and withdrawn from circulation, there was less demand for Sakel renewal seed, worsening the situation in a vicious circle.

Starting in 1942-43, for the long-stapled varieties Amoun, Malaki, Karnak and Sakha 4 only, an important advance was made in basing acceptance or refusal on the spinning quality of the ginned lint, samples being received in the form of seed-cotton. Spinnings are carried out at the Giza mill on mass production lines, and the technique is described in a
Measures to Check Deterioration

recent issue of this Journal. Thus all the long-stapled cotton of Egypt is now grown directly from seed whose lint has passed the spinning standards, lot by lot.

vi. Possible Future Developments: The Dated Seed System

Direct control of crop quality by spinning tests has not previously been attempted on any cotton crop, and is doubtless an advance on anything before it, for a big crop. Yet both this and the seed examination method have an obvious defect: they cannot operate until measurable contamination is present. By the spinning-test, at least, there is good evidence that defective seed will be eliminated before deterioration becomes serious, although direct proof of this cannot become available for some years. But, however successful the spinning test method may prove to be, it is not the best conceivable. Still better might be a Dated Seed System, by which all lots are dated according to the year of their renewal nucleus, to be refused for sowing within a time limit of five years or so; and the first steps have been taken to put this principle into operation.

The value of such a system may be illustrated for the case of Ashmouni, the 1944 renewal nucleus of which represents an improvement greater than we have had for some years with this variety. Growers are quicker to appreciate improvements than might be imagined, and an increased demand for the new Ashmouni seed can be expected within two or three years. If the new seed is issued not simply as Ashmouni, but as Ashmouni/44 instead, the lots already circulating can be identified by growers; and older lots marked Ashmouni/43, Ashmouni/42, etc., will disappear from circulation more quickly, being thus recognised. The stress is shifted to the encouragement of new seed rather than the elimination of old, though this continues; and the system has the merit of getting more profitable new seed quickly into circulation, apart from the question of deterioration.

Difficulty in getting this scheme into operation is concerned with commercial interests, and is more likely to be of a psychological rather than of a technical nature, especially as regards the risk of evasions. Acceptance certificates checked from the records of the previous year may have to be given, although there are possible alternative methods of dealing with the problem. There is no chance of success without the willing support of the growers; but this can be expected if the extra profit from improved seed, and the losses due to deterioration, come to be appreciated. A seed pedigree system maintained right through the commercial crop, as well as inside the renewal nucleus system, will then perhaps come to be accepted as a matter of course.

These problems of seed maintenance, and particularly of seed elimination, are much greater for a big crop than for a small one. Not only is there difficulty in controlling large volumes of seed, the minimum time required for expansion of a renewal nucleus into a big crop is an important factor in deterioration. The discussion so far has referred chiefly to the maintenance of varieties such as Sakel and Ashmouni, which were already established when the Cotton Research Board began operations in 1920. The question of time will be mentioned again in Part II, in connection with the development of new varieties next to be discussed.

Summary

Complaints of deterioration in spinning quality have referred to most of the world’s cotton crops in recent times, and the control of deterioration is regarded as a major technical problem. In the seed maintenance system employed at Giza, every propagation bulk is expanded from a single plant selected out of a selfed line. The progeny of this plant pass first through a purity chequer, and are then expanded in wire gauze cages covering...
about half an acre, the aim being to minimise natural crossing. The seed is further expanded to become the renewal nucleus, from which all the commercial crop of that variety is ultimately derived. The nucleus is maintained at the centre of a large bulk of the same variety, propagation bulks from it being grown in surrounding zones, until there is seed sufficient to sow about one-sixth of the total commercial crop. Every three or four years a fresh renewal nucleus is expanded from another pedigree plant, a number of progenies being tested for yield and spinning quality, one only being selected. The possibilities in secondary selection are greater than was formerly realised, and improvement in a variety can often be achieved by a number of small advances.

Impure seed in the commercial crop was formerly eliminated entirely on the basis of counts of offtype seeds, authority to refuse permission for sowing being granted under the Seed Control Law. For the long-stapled varieties, refusal of seed is now based on spinning-tests; all the commercial crop of these varieties is grown directly from seed whose lint has passed the spinning standards, lot by lot. A system of elimination based on the date of commercial seed is under consideration.

References

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5 J. B. Hutchinson and H. L. Manning, Trinidad Cotton Research Station Memoirs, No. 20, 1943.
6 W. L. Balls, Development and Properties of Raw Cotton, Black. 1915.
10 H. Martin Leake, *J. Genetics*, 1911, p. 205.
Part II—DEVELOPMENT OF NEW VARIETIES

A cotton variety has to be regarded as "new" if it has a different combination of characters from anything else, even though each of its characters is to be found separately in other varieties. Thus several Egyptian varieties have the same plant form as Maarad (a Pima type), but they do not have the same lint and are therefore called different varieties. Similarly, varieties with lint almost identical have to be given different names if the seed or plant forms, or any other characters, are different. Inevitably the seed would be mixed if such varieties were given the same names, and the resulting hybrids would almost certainly evolve new types of plant and lint, making the mixture unstable.

It is remarkable how plants slightly off-type in one character or another, are continually thrown off in the course of maintaining an established variety. In the early days at Giza, these offtypes tended to be regarded as useless by-products which hampered the plant breeder in his business, although many were known to be improvements in yield or spinning quality. When their value at last came to be appreciated, the offtypes showing greatest improvement were picked out of the pedigree lines and propagated as new varieties by exactly the procedure described in sections iii and iv of Part I.

There was found to be a most encouraging demand by growers for the new kinds of seed on offer, and, of course, the new varieties could never have prospered without the spinners' support also. Thus it gradually came about that the Giza seed supply system intended for the maintenance of old varieties, actually became best known as a producer of entirely new types. At least as much time and effort were spent on the maintenance system as were ever spent on new varieties, but work on new varieties was by far the more fruitful.

The work on new varieties has been divided from the beginning into two branches, not very different in principle or methods, but administered in part by different personnel, and conveniently discussed separately. These two branches are:

1. Selection of offtypes out of established varieties.
2. Breeding and selection out of hybrids from controlled matings.

All but one of the most promising varieties now known were developed by method (2); but for long all the best strains, now regarded as being in the second rank, were picked out by method (1).

i. Selection out of an Established Variety: Ashmouni

Ashmouni can be used to illustrate the wide ranges of types found among the offspring of plants from a commercial crop, and more attention has been paid to this variety than to any other at Giza. Several plants out of commercial Ashmouni caught the plant breeder's eye and entered the Giza pedigree lines in 1918 (not always selfed lines at that time), and selection has continued among the descendants ever since.

These Ashmouni plants split up from the beginning into different strains, of which several were inferior to the original Ashmouni, both in yield and in spinning quality. They were therefore lower than the lowest quality variety in the Egyptian crop, being reversions to inferior plant types which have to be eliminated in any efficient maintenance system. Such inferior strains can still be found in commercial Ashmouni and in other varieties; they usually have rather small seeds, low ginning out-turn, and probably other characters which make them more prolific, and their expansion naturally leads to deterioration in the parent strain.
The breeders' interest was, of course, drawn more especially to strains found to be superior to the original Ashmouni in combined yield and spinning quality. Several early primary selections were good enough to be distinguished by Giza numbers, and they were divided into two classes, according to whether they resembled the parent Ashmouni or not. Those such as Giza 2 and Giza 19, with lint and plant characters very close to Ashmouni, became the first and second renewal nucleus families for subsequent Ashmouni crops, the improved seed being supplied simply as Ashmouni without change of name. But the majority of the improved strains, and invariably the best of them, were too different in plant form or lint to be propagated as Ashmouni. They were possibly descended from natural crosses between Ashmouni and contemporary varieties, although not necessarily so since Ashmouni certainly contained offtypes from the beginning; in any case, if they were to go on the market they had to be given new names.

Steady increases in yield of a few old-established types would give far more satisfaction than the development of more new varieties, but there is a reason for the irritating frequency with which the breeders' best efforts result in something new. Obviously there is a better chance of success when selection is not restricted to a few old-established types, just as the fisherman with a free choice of everything in the net will get bigger fish than will the man allowed to select the big herrings alone. Progress became much more rapid, therefore, when the breeders' field was not restricted to old-established types.

The first important variety selected from the offtype Ashmouni plants was Giza 7, with a better combined yield and quality than any variety then existing. It was not much improved by secondary selection, however, partly because the Giza methods were not then sufficiently developed, and partly because Giza 7 happened to be a rather pure primary selection.

A different selection out of Ashmouni which has responded continuously to secondary selection is the new variety called Giza 31. It is 10 per cent. higher in yield, and 20 per cent. higher in yarn strength than the parent Ashmouni, and is still segregating after being self-pollinated for eleven successive generations. Giza 31 was derived from Ashmouni by way of Giza 3, and already had been under selection for twelve generations, of which only four were selfed, before it became a continuously selfed line. The strain has thus responded to selection over a period of 23 generations; and although recent advances have been small, there is no reason to suppose that opportunities for further selection have entirely ceased.

Giza 31 has the unusual merit of holding on to its bolls under severe climatic conditions where other varieties (including the parent Ashmouni) are subject to extreme shedding. The selections were chosen on the basis of their performance, not at Giza, but at the extreme south of Egypt; the strain was thus continuously persuaded, by selection, towards an environment unsuited to the parent strain as a whole. Its present development is held up by war-time acreage restrictions; when it is released, Giza 31 is likely to extend the cotton-growing area some 40 or 50 miles beyond the present economic limit in the south of Egypt.

These long continued studies of single plant progenies give an illuminating picture of the welter of mongrel types in the commercial varieties 25 years ago. Of the different types found to segregate out of the Ashmouni offtypes, naturally many more were discarded than were selected as improvements; yet, in all, 19 new types out of this variety had sufficient merit in some character to justify being distinguished by Giza numbers. About a
dozen improved types were also selected from other contemporary varieties, especially from Sakel. Two strains only—selections out of Sea Islands—were direct importations from abroad; all other Giza varieties were selections out of material already in Egypt. A list of the Giza varieties selected out of commercial strains, together with renewal nucleus families introduced since 1925, is included in Table III.

### ii. Selections out of New Crosses

Sister families of pedigree strains are usually so nearly uniform by about the ninth generation, that further selection becomes tedious, especially as regards yield. Many Giza strains have been carried beyond the ninth generation, but none has been taken actually to the limit of possible improvement, because another line of attack proved to be more effective. This was the hybridisation method, with controlled matings.

By using selections from the pedigree lines as parents for hybrids, variability was again introduced; and after selection for a few generations, it was found that strains were segregating out at a level of economic improvement higher than anything previously known. Later generations from the hybrids so produced were then in their turn used as parents, and yet further advances were made and are still being made. These hybrid families from known parents are carried on in the hybrid lines at Giza or at Sakha, and are continuously selfed, expanded, and tested, by the same technique as that described (Part I, Section iii) for the pedigree lines.

**Hybrid Selection Procedure.**—When a new cross is made, usually from parents at F₆ or higher, about five plants at the first generation are expanded into about 100 plants at the second generation, either in the winter greenhouse or in the field the following year. Five or ten F₂ sister plants are then selected almost at random, and expanded into five or ten F₃ sister families of about 40 plants each, wide spaced. Only the crudest idea of yield is yet possible, but there is enough cotton for spinning and other tests, and effective selection for all characters except yield begins with these F₂ sister families.

Some families are discarded at once on the grounds of low ginning out-turn, unsuitable plant habit, or yield so low that the deficiency can be detected by eye. Lint from the remaining families is spun, and rejection then begins at a heavy rate. Weak yarn is the commonest cause of rejection, but whatever their yarn strength, a good many strains are discarded on the grounds of short and fine staple—a combination which gives neppy card webs. Strong and regular yarn is considered the most desirable character, especially if coupled with high hairweight, good colour, high lustre, and low comber waste. Strains so endowed which also run at high grade, indicating resistance to pests, are especially treasured.

Taken over all strains, about nine out of every ten families are discarded for one reason or another at F₃. A further nine out of ten are discarded at F₄ and again at F₅, selfed seed from each selection being expanded into about ten sister families for trial at the next generation. Natural bulks of a few hundred plants are included for testing after F₁, so as to give more cotton for comparison. Not much is likely to be wrong with the lint of any F₅ survivors, the best of which are expanded a further year or two for yield tests in the chequers. Many families fail to reach the steadily rising standards for yield, although they might have been counted successes a few years before, and a further seven out of ten families are discarded accordingly. Similar selection and rejection proceeds through the F₆, F₇, and F₈ generations.
### Table III
List of Established Giza and Sakha Varieties

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* Maarad was a Pima type introduced by the Royal Agricultural Society.

**Dates of Issue of Renewal Nucleus Families since 1925:**

(Each was of provedly better yield, spinning quality, or seed purity than any previous family at the time of change, and practically all were issued without change of name).

- **Ashmouni**: 1925, 1933, 1935, 1937, 1942, 1943, and a new one with marked improvement in 1944.
- **Sakel**: 1925, 1933, 1936. (The one in 1936 was not fully used).
- **Sakha 4**: 1930, 1933, 1936, 1937, 1939, 1940, 1941, 1942.
- **Giza 29**: 1937, 1939, 1940, 1941, 1945.

Results for any new variety are considered in relation to comparable tests on an appropriate standard variety, so that character-differences rather than characters are measured. The product of Lint Yield × Price is the criterion for success, price being inferred mainly from the spinning performance, with second order allowances for other characters. Those varieties not up to standard in over-all value, but with a desirable character at some new extreme value, are frequently used as parents for new hybrids before being discarded. In any year, only one or two hybrid lines survive as far as F₂; and the best of these undergo trials in 20 or 30 yield chequers per year, as well as in larger plots, with an eye to propagation as new varieties. About one out of five actually becomes known to spinners, the successful varieties then being given a name such as Malaki, Karnak, Menoufi, or Amoun, instead of the rather confusing Giza numbers. A list of Giza strains derived from hybrids, together with a list of the parents, is included in Table III.
iii. Range of Variability

Both in yield and in yarn strength, which are compound characters involving many components, the distribution of values obtained from sister families is usually continuous both at earlier and at later generations; the distribution is not usually divided into several modes, so far as can be determined by experiment. There are not just a few Egyptian types; there is a continuous gradation of types from the bottom of the yield and quality range, all the way up to the top. Several thousands of recognisably distinct types have been examined at Giza in the past ten years (discrimination being based on any significant difference, however small); and the two main economic characters of the cotton plant are evidently controlled by many genes. No reliable estimate of the number of genes segregating has yet been possible, especially as regards the upper limit; but there are indications as to what must be the lower limit in the average F, plant, judging by the rate of approach to purity.

Table IV

Examples of Segregation in Sister Families

The examples are usually the highest and lowest lea products within groups of from two to five sister families tested in chequer, and are not necessarily nor even usually the families which were selected for further study.

Yarn strengths are expressed as the Lea Strength x Counts Product of 60s carded ring twist, without correction for grade of cotton. Yields are in lb. of lint per acre. All comparisons are based on lines with unbroken selfing tested in yield or miniature chequer trials, the number of chequers averaged for each pair being shown in brackets.

<table>
<thead>
<tr>
<th>F.3 Sister Families</th>
<th>Lea Product</th>
<th>Lint Yield</th>
<th>No. of Cheqs.</th>
<th>F.9 Sister Families</th>
<th>Lea Product</th>
<th>Lint Yield</th>
<th>No. of Cheqs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>H 117/39 (a)</td>
<td>2740</td>
<td>505</td>
<td>(7)</td>
<td>H 250/37 (f)</td>
<td>2855</td>
<td>531</td>
<td>(3)</td>
</tr>
<tr>
<td>H 119/39</td>
<td>2420</td>
<td>553</td>
<td></td>
<td>H 248/37</td>
<td>2770</td>
<td>540</td>
<td></td>
</tr>
<tr>
<td>H 193/39 (b)</td>
<td>3060</td>
<td>417</td>
<td>(4)</td>
<td>H 251/37 (f)</td>
<td>2860</td>
<td>604</td>
<td>(5)</td>
</tr>
<tr>
<td>H 194/39</td>
<td>3035</td>
<td>468</td>
<td></td>
<td>H 249/37</td>
<td>2850</td>
<td>619</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F.6 Sister Families</th>
<th>Lea Product</th>
<th>Lint Yield</th>
<th>No. of Cheqs.</th>
<th>F.10 Sister Families</th>
<th>Lea Product</th>
<th>Lint Yield</th>
<th>No. of Cheqs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>H 188/40 (c)</td>
<td>2350</td>
<td>523</td>
<td>(3)</td>
<td>FB 147/37 (g)</td>
<td>3155</td>
<td>428</td>
<td>(12)</td>
</tr>
<tr>
<td>H 189/40</td>
<td>2245</td>
<td>558</td>
<td></td>
<td>FB 149/37</td>
<td>3050</td>
<td>465</td>
<td></td>
</tr>
<tr>
<td>H 239/40 (d)</td>
<td>3150</td>
<td>427</td>
<td>(6)</td>
<td>F.11 Sister Families</td>
<td>FB 238/38</td>
<td>3155</td>
<td>362</td>
</tr>
<tr>
<td>H 238/40</td>
<td>3050</td>
<td>453</td>
<td></td>
<td>FB 238/38</td>
<td>3090</td>
<td>370</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F.7 Sister Families</th>
<th>Lea Product</th>
<th>Lint Yield</th>
<th>No. of Cheqs.</th>
<th>F.12 Sister Families</th>
<th>Lea Product</th>
<th>Lint Yield</th>
<th>No. of Cheqs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Giza 45A</td>
<td>2155</td>
<td>885</td>
<td>(8)</td>
<td>FB 146/35 (j)</td>
<td>2260</td>
<td>702</td>
<td>(5)</td>
</tr>
<tr>
<td>Giza 35B</td>
<td>2090</td>
<td>895</td>
<td></td>
<td>FB 144/35</td>
<td>2150</td>
<td>740</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F.8 Sister Families</th>
<th>Lea Product</th>
<th>Lint Yield</th>
<th>No. of Cheqs.</th>
<th>F.13 Sister Families</th>
<th>Lea Product</th>
<th>Lint Yield</th>
<th>No. of Cheqs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Giza 34B</td>
<td>2340</td>
<td>830</td>
<td>(8)</td>
<td>FB 75/42 (f)</td>
<td>2820</td>
<td>546</td>
<td>(4)</td>
</tr>
<tr>
<td>Giza 34C</td>
<td>2270</td>
<td>828</td>
<td></td>
<td>FB 79/42</td>
<td>2800</td>
<td>574</td>
<td></td>
</tr>
<tr>
<td>Giza 36B</td>
<td>2710</td>
<td>687</td>
<td>(17)</td>
<td>FB 128/36 (j)</td>
<td>2300</td>
<td>750</td>
<td>(2)</td>
</tr>
<tr>
<td>Giza 36A</td>
<td>2610</td>
<td>698</td>
<td></td>
<td>FB 126/36</td>
<td>2200</td>
<td>674</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F.14 Sister Families</th>
<th>Lea Product</th>
<th>Lint Yield</th>
<th>No. of Cheqs.</th>
<th>F.13 Sister Families</th>
<th>Lea Product</th>
<th>Lint Yield</th>
<th>No. of Cheqs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Giza 37A</td>
<td>2715</td>
<td>752</td>
<td>(5)</td>
<td>FB 128/37 (i)</td>
<td>2245</td>
<td>512</td>
<td>(3)</td>
</tr>
<tr>
<td>Giza 37B</td>
<td>2635</td>
<td>749</td>
<td></td>
<td>FB 129/37</td>
<td>2145</td>
<td>519</td>
<td></td>
</tr>
</tbody>
</table>

Notes:—(a) G.27 x G.31. (b) G.28 x G.7. (c) G.41. (d) G.39. (e) G.40. (f) G.29. (g) G.26. (h) G.26 ex FB 147/37. (i) G.26 ex FB 149/37. (j) G.23.
Rate of Approach to Purity.—In experiments such as Mendel's, on green and yellow peas with only one gene pair controlling the colour, the progeny of a cross rapidly approach purity after a few generations of self-pollination. Thus, although 100 per cent. of the F₁ plants are impure for colour, only 50 per cent. of the F₂'s, 25 per cent. of the F₃'s, 12⅔ per cent. of the F₄'s, and 6⅔ per cent. of the F₅'s are impure. Only one plant in 250, on the average, is still segregating for colour at F₅; and only one plant in 4,000 at F₆. In cases where many factors are involved, the approach to purity is slower; and this seems to be the situation found in cotton, the approach to purity being extraordinarily slow.

All cotton plants adequately studied at Giza have shown segregation for yarn strength at F₁. All or most of the selected lines carried on still showed segregation at F₇; and measurable separation into types continued even among the scanty examples available at F₁₂, or higher. These data (Table IV) are strongly biased by selection, most of the sister families closely examined having been selected because they gave indications of a significant difference in preliminary tests. But there are on record several examples of sister families at F₉ or higher, among which accurate testing revealed differences unsuspected initially, and offspring appreciably better than the parent were obtained. The rate of approach to purity thus seems very slow; and after making the maximum reasonable allowance for the effects of selection in the material, or bias in the data, the number of heterozygous pairs concerned with spinning quality in the average F₅ at Giza is taken to be at least several scores of genes. Harland's¹ suggestion of up to 200 genes affecting such characters as lint index, seed weight, and lint length in cotton, may also be mentioned in this connection.

Possibility of Errors and Mutations.—It is advisable to discuss the possibility that imperfect methods of selfing are responsible for the slow approach to purity in selfed lines.

At some stages in the pedigree lines, selfing is implicit in that plants are grown inside the wire-gauze cages, from which cross-fertilising insects are assumed to be excluded. This method is not beyond criticism, although it may be remarked that increased segregation has not so far been noticed after cage selfings, compared with normal selfings. In the hybrid lines, on the other hand, selfing is always done, at least as far as F₉, by gumming a paper cone over the corolla before the flower opens. It would be impossible to fit the cone if the flower had partially opened, and this seems to be as positive a method as could be devised. If mistakes sometimes happen, as they must, they certainly do not happen with every strain; it is therefore impossible to believe that imperfect selfing is responsible for the general result.

A few observers have recorded deviations in cotton characters at unexpectedly high generations, notably Harland¹, who mentioned effective selection for lint length as far on as F₁₇. Harland suggested that new mutations might be rather frequent; and support is given to his view by the high mutation rates indicated by Hutchinson² and by Silow³.

In the Giza material, variance in the sister families certainly diminishes as the generations advance, a characteristic of segregation rather than of mutation; but there remains the possibility that both segregation and new mutations occur. If allowance cannot be made for this, calculations based on the rate of approach to purity give too high an estimate for the number of gene-pairs in operation, although the mutation rate would need to be very high to upset the calculation seriously, at the present stage. During the next few years much more information on Giza families at generations higher than F₉ will become available, by which to amplify present data; and in the meantime the estimate given earlier in this section ("at least several
scores of gene-pairs") has been made conservative. It is low compared with the estimates for some other organisms; with reference to oil content in maize, R. A. Fisher writes: "All commercial varieties must be segregating in hundreds, and quite possibly in thousands, of factors."

**Effect of Human Selection.**—At first sight it is puzzling to find modifying genes in such profusion, because the lint on cotton seeds can hardly be of vital importance to the plant. The hairs cannot assist much in seed dispersal, although they may help to collect moisture for germination; and if Denham's view of their function is accepted, cotton represents the elimination of excess polysaccharides, being in effect merely the plant's waste-heap. Most of the wild forms of cotton get along with very little lint, many with seeds almost lintless; certainly the spinner's interests were not consulted when these plants originally evolved. It does not seem reasonable, therefore, that scores of genes should have the control of spinning quality as their main function in the plant.

The explanation is presumed to be that mutations affecting the lint in a favourable direction have been accumulated in cultivated crops by human selection acting over the course of centuries. Favourable genes from the many varieties hybridising with cultivated crops would thus tend to be preserved, although many such genes and others linked with them would not normally be favoured under the conditions of natural selection; and it may be conceived that there exist many genes concerned mainly with non-lint characters, but having secondary effects on the lint. However the variability arises, the result is ample material for selection by the modern plant breeder; opportunities seem to be available in every character under selection.

iv. Inheritance of Extreme Characters

When a variety characterised by strong yarn is mated to one giving weaker yarn, the F₁ families usually have strength values distributed between the parental limits; but at later generations these limits frequently are found to be exceeded, and it is the same for many other plant characters. Although they are sometimes found earlier, such extreme characters are not usually noticed before F₅, that is after selection for three generations; and if one of the parents was already at the top of the Egyptian range, a new high record is established for that character.

It is very remarkable how the hybrid lines constantly produce new strains with yield and/or yarn strength beyond the limit formerly considered to be extreme. Nor is it uncommon to find a hybrid derivative less valuable than either parent, a result which is ascribed to the unpredictable effect of new combinations of genes. The breeder is amply compensated, however, when he finds some other combination which results in a line with yield higher than that of either parent; and his reward is complete when—as sometimes happens—the hybrid line is found to exceed either parent in spinning quality as well as in yield. The variety Amoun (Giza 39) from the cross Giza 26×Sakha 4 is such a case, exceeding either parent in yield by about 25 per cent., and in yarn strength by about 10 per cent.; it is thus a cotton exceeding Montserrat Sea Island in quality, and of yield approaching that of Giza 7.

Other examples of selected offspring with characters more extreme than were found in either parent are: the large boll of Giza 12; long staple of the cross Giza 29×Giza 26; high yarn strength of Giza 26; high yield of Giza 29; high ginning out-turn of Giza 30; large number of bolls carried by Giza 34; high hairweight of a Giza 35 selection; earliness of the cross Giza 39×Giza 38; low hairweight of Giza 39; and the whiteness of Giza 40. A new high record in one or another character under selection, and especially in the net return per acre, is established in the hybrid lines prac-
tically every year. There are now half a dozen new varieties with yield higher than that of any Egyptian variety ten years ago; and the former upper limit for yarn strength is being exceeded repeatedly.

A character of interest to spinners, and to which much attention has been paid at Giza, is that known as "high strength anomaly" for want of a better name. The anomaly is that yarn strength is higher than that to be expected on the basis of the cotton's staple length and hairweight, and the character is found at any point upwards from about the middle of the Egyptian quality range. The character was first noticed in Sakha 3, an offtype selected out of commercial Sakel, and has since been transmitted to several crosses. It has been possible to increase high strength anomaly by hybridisation and selection, and Giza 44 is endowed with this admirable character in high degree. The gene or group in Sakha 3 is especially valuable for stud purposes (although Sakha 3 itself was of little value for commerce), because the high strength is transmitted without the usual association of lower yield. A corresponding character, "low strength anomaly," is also found; in some cases this has been partly accounted for by low hair strength. The character is of interest because badly deteriorated varieties show marked low strength anomaly in their yarns.

Vigour of Inbred Lines.—Some of the text-books on cotton breeding refer to the belief that continued inbreeding in cotton is harmful to the yield. So far as Egyptian plants are concerned, at least as far as F5, this belief does not seem to have much foundation; nor did it apply to American varieties studied at the N. Carolina Station, strains selfed there for nine years showing no lack of vigour. A direct answer to the general question of hybrid vigour cannot be given on the basis of the Giza results; but they do show that if there is any loss from inbreeding, it is more than offset by that selection for higher yield which becomes possible after segregation. Families of Giza 31 at the ninth segregation, for instance, occasionally have given over a thousand pounds of lint per acre, a yield significantly greater than that of earlier families in the same selfed line, tested at the same time.

The fact that new extreme values can be selected in other characters, especially in yarn strength, while the selfed line becomes demonstrably purer, denies hybrid vigour as an important factor in the expression of these characters. A Giza plant breeder will occasionally pick out plants from field crops in the hope that they will prove to be better in over-all value than the corresponding pedigree line; but they never do prove to be better, although they are much more heterozygous than the plants in the pedigree line. Hybrid vigour is shown by inter-specific crosses between Egyptian and Hindi, but these plants are not of much economic value and never enter the breeding system.

v. Interpretation of Results in Selection

The steady advances in range of quantitative characters of Giza cottons, the former extreme limits being continually surpassed, are paralleled by the advances recorded by many other workers using the hybridisation method. Examples for cotton other than Egyptian are recorded by Harland. For other organisms, body weight in mice, fertility in guinea-pigs, bristle number in fruit flies, flower colour in day-lilies, resistance in wheat, early flowering in peas, are all examples of characters selected to be more extreme in the hybrid derivatives than were to be found in either parent, and recorded in the recent literature.

It now seems to be generally accepted that the expression of many quantitative characters in field crops is modified by numbers of genes with both plus and minus effects. Following the argument of "Student", these plus and minus modifiers "would roughly neutralise one another, each individual carrying a mixture of genes which would produce variations in
opposite directions, so that only a limited genetic variation would result; but with a change of environment this reservoir of genes would serve a very useful purpose as raw material for selection. . . . Thus the accumulation of small variations in the same direction could proceed far beyond the original range."

The conception of polygenic systems has been extended by other workers, especially by Mather working on bristle number in Drosophila hybrids. Bristle numbers both higher and lower than the parental values were obtained in the plus and minus lines after a few generations of inbreeding. Response to selection was ascribed to recombination of parental chromosomes, and also to recombination following crossing-over among plus and minus modifiers. In particular, arguments were developed to show that the balanced mechanism of polygenic systems does result from natural selection. Related to this conclusion is Hutchinson's view that human and natural forces tend to establish a balanced mixture in crops, rather than a single type to the exclusion of others. These views are adopted by the present writer for the interpretation of many Giza results.

A plus modifier can be defined in more ways than one; here it is defined as a gene, the expression of which enhances a character in the direction favoured by human selection, a minus modifier being the opposite. Considering any character controlled by several modifiers, if the constitution of a heterozygous plant can be designated thus:

\[
+ + - - - + ,
\]

then the extreme types to be found among the offspring, granted unlimited crossing-over, can be designated thus:

\[
+ + - + + + , \quad - - - - - .
\]

The type on the right showing accumulation of minus modifiers has peculiar interest to the cotton spinner, as will be shown in Part III. For the moment we are concerned only with selection of the type on the left, showing accumulation of plus modifiers. The breeders at Giza drew these modifiers mainly from the reservoir of genes in the Egyptian commercial crops of 25 years ago.

The heterogeneity of Egyptian crops is conditioned by the fact that natural crossing is extensive. A certain amount of crossing occurs between varieties in different fields, and many genes from exotic types under trial in the past must have had opportunity to disperse in contemporary varieties. A large reservoir of genes was probably available in the wide range of G. barbadense types developed elsewhere in isolation, and brought together in Egypt; and genes from other species able to cross with barbadense possibly added to our reservoir.

The especial importance of natural crossing, however, lies in the intercrossing that occurs in high degree between the closely adjacent field plants of any given variety. According to the best available estimates (not yet very strong estimates, it must be admitted), about one in four fertilisations is an intercross between neighbouring plants; and two out of every three plants are from seed affected by such crossing during the four preceding generations. This extensive intercrossing would not normally be regarded as crossing, nor would it matter, if the plants in the population were all of the same genetic constitution. But that is just what they are not. Initial impurity, or impurity introduced into the variety from outside by any means, is rapidly dispersed by this intercrossing; and the question takes on a different aspect when it is realised how many genes circulate in single dose.
even though they are most of small individual effect. The crops frequently appear very uniform to the eye, and especially has this been true of recent Egyptian crops; but it is a spurious uniformity, as is revealed when the plants are subjected to continued self-pollination, and that is the significance of the results from pedigree lines.

Even in the absence of crossing-over, the heterozygous plants originally selected for study in the pedigree lines would have segregated into types, some with characters more extreme than those at first selected; and the range presumably became more extreme by the accumulation of modifiers following crossing-over. Opportunities for selection and elimination occurred many times in most lines before increasing purity hindered operations, by which time the material was at an appreciably higher economic level than at the start. Judging by results, there seems little doubt that selection for high values was more effective in the pedigree lines than in field populations of equal size. And in the hybrid lines there is no reasonable doubt that selection is much more effective and fruitful than was the work on field crops.

\textit{Evolution* in the Hybrid Lines}.—Since practically every plant in field crops is recently derived from a natural hybrid, it might be concluded that a wide enough range of variability already exists in the field without need for further crossing by the plant breeder, and as good as he could arrange for himself. That, however, seems to be quite a wrong conclusion. Hybrid lines from selected pedigree parents are unnatural in the sense that many minus modifiers have been bred out of their ancestors. Still more is this so with hybrids at the second or third stage, having parents and grandparents themselves derived from controlled matings in the hybrid lines. Some individuals in the hybrid lines thus inherit advantages accumulated from scores of ancestors, selected on the basis of yield and spinning tests many times repeated. They have been deliberately evolved towards higher economic value, carrying more plus modifiers than the average plant in field populations; and great care is taken to prevent contamination of these isolated lines, so that minus modifiers have no opportunity to disperse again.

The chances are in fact millions to one against an accidental meeting in the field between two highly evolved plants such as are now commonly mated in the hybrid lines, and for all practical purposes the modern varieties could never have been found in the old commercial varieties, although these supplied the gene reservoir from which the desired recombinations were built up. R. A. Fisher’s description of natural selection—that it is a mechanism for generating a high degree of improbability—therefore applies well to the Giza method. This conception of pedigree strains with plus modifiers accumulated by artificial selection, has great significance in the study of deterioration.

It is not yet possible to define the parents best suited for the enhancement of any given character, except that probably one parent should have the desired character in high degree. Data are accumulating and ultimately will be analysed, but, so far, the development of extreme characters seems to arise from chance recombinations. Merely to list the range of modifiers in the gene reservoir would be a formidable task, because of their number and small individual effect. And although little is known about gene inter-

\* By “evolution” is usually meant a long-term process of development in which the operating factors are mainly new mututations; whereas development in the course of 20 or 30 generations as described here, the operating factors being a ready-made reservoir of genes, borders on what is called “adaptation”—meaning forced adaptation to the breeders’ requirements. The term evolution is preferred here, because it brings out the contrast with another form of adaptation found in cotton, and which is called deterioration.
actions, certainly it is not to be assumed that the expression of a combination is the sum of the individual expressions; simply additive. Hence there seems little prospect of success in the prediction of quantitative characters in cotton hybrids, and at present the empirical method entirely holds the Giza field—the more so since advances continue at an increasing rather than at a declining rate. The possibilities of further advances in Egyptian cotton seem to be very great in fact, by the empirical method alone. No more than a trifling fraction of all possible recombinations has yet been studied.

vi. Introduction of New Varieties

By the time a new strain proves to be good enough for introduction as a new variety, usually it has already reached the stage of one or two hundred acres in large scale trials. From these and other sources several lots of seed are available for propagation, ranging from small lots of F_1 or F_2 selfed, to large bulks of natural seed. It is obviously impossible, at first, to establish protecting zones for a renewal nucleus, as described in Part I, section iv; sufficiently concentrated acreage of the variety does not exist. Growers must first confirm which are the best districts for the new variety, and the Ministry encourages them to do so; but with widespread distribution of small lots contamination is inevitable. For that reason there is not much point in setting off the propagation with seed of very high purity, but purer seed must follow on as soon as possible.

The Giza practice has been to start commercial propagation with natural bulks, and as soon as a big enough area is available, the first renewal nucleus is set up inside it. Karnak can be used to illustrate how the system works out as regards time, although future varieties will probably be worked up a little faster.

All Karnak cotton is descended from a single F_1 plant grown in 1932; and last year’s renewal nucleus was descended from a continuously selfed F_5 single plant grown in 1936. This latter plant was expanded to become the nucleus in 1941, being then an F_7 bulk, five generations removed from the original single plant parent or, more concisely, an F_5/G_5 bulk. By 1946, about 250,000 acres (probably about half the Karnak crop) will be descended from it, and can be described at F_7/G_10; and most of the Karnak crop in 1947 and 1948, whatever its acreage, will be at the stage F_5/G_11 and F_5/G_12. Thus the single selfed F_5 plant expands into a family covering half a million acres or so, in 11 or 12 years.

In 1945, another renewal nucleus will replace the F_7 family, the new one being an F_13/G_5 family; and about 1949 a third, an F_16/G_4 family. Thus the renewal nucleus becomes purer, the longer a variety is under cultivation—just the opposite of what always happened in the past. The ideal is to have the crop at the highest possible F number, and the lowest possible G number; i.e. to have the source as pure as possible, with the minimum of propagation generations in which segregated offtypes can expand within the populations.

There is also a sound financial reason for getting new nucleus improvements into circulation as quickly as possible. The plant breeder with a 2 per cent. yield improvement in Karnak, for instance, has hold of a very valuable acquisition: each year saved in getting it into propagation is worth about £250,000 to the cotton growers of Egypt.

vii. Scale of Operations

Before leaving this account of technical methods, it may be of interest to outline the annual scale of operations concerned with seed supply, superintended by the Government departments represented at the Cotton Research Board.

In a sense, six to eight thousand single-plant measurements annually are the basis of selections; but although staple length, ginning out-turn, and often other measurements are taken on all these plants, the chief value is
probably in the record of single plant yields. Since the environmental variance exceeds the genetic variance by a factor of a hundred or more, high yielding plants are selected without much hope that their advantage will be true and inherited, but simply to guarantee a good start in subsequent expansion. Single plant selection is therefore almost at random, but is confined to families known to be of value from the progeny tests, trials being made in numbers sufficient to ensure the inclusion of variants in the direction of selection.

![Image showing scale of spinning values and modern varieties](image)

**Fig. 2.**—Higher spinning value of modern Egyptian varieties, grade Fully Good. The yarn strengths are lea products of 60s carded ring twist.

Six to eight hundred plants are expanded annually into families, at which stage effective selection begins. Rather more than a hundred families get into the miniature chequers, of which there are six to eight every year; and a dozen or so families reach the ordinary yield chequers, of which there are about twelve. (The miniature chequers total about 200 variety-positions in all, so that the average family is given tests in two localities, each with
five ridges replicated eight times; the yield chequers total about 80 variety-positions in all, each with six or seven Latin square replications of 1/12th acre plots.)

A yield chequer lay-out including two or three familiar varieties as well as four or five new varieties near to a final decision, is repeated at 25 to 30 different localities in the Delta every year. These chequers are usually on private growers’ farms, and serve the triple purpose of bringing new results home to the growers; of finding the best districts for the new varieties; and of testing them under a wide range of agricultural technique, because each cultivator treats them as he does his own crop. There are also some 20 or 30 other yield chequers similarly located, in which varietal reactions to manuring, spacing, watering, etc., are studied.

The seed expansion system for new nucleus families, or new varieties, has been already outlined; about 120,000 ardebs (15,000 tons) of propagation seed, derived from Government farms and private growers under contract, is sold annually at normal market prices.

Part Played by Spinning Tests.—Spinnings are carried out on all hybrid and pedigree line families giving more than 60 grams of lint, and on all miniature chequer families in first and second picks. Together with about a dozen blocks of miscellaneous experiments these amount to two or three thousand spinnings. The yield chequers are also tested, although the spinning quality of all strains in them is usually well known by this stage.

Under the Seed Control Law, as already mentioned, all long staple lots intended for sowing in the following season are accepted or refused on the basis of spinning-tests. These crop control lots amount to about 3,000 samples at present, but the number is rising rapidly. All of these samples, as well as some of those earlier mentioned, have to be tested within a period of about three and a half months, rising to crescendo in December when most growers are deciding what to grow next. Although the testings probably represent a big advance in crop control, their increasing volume is viewed with mixed feelings at the Giza spinning test mill.

Finally, samples representing the cotton actually exported to spinners all over the world, are supplied by the courtesy of about twenty leading export houses at Alexandria, each variety in two grades from each export house. These thoroughly representative samples combined from many sources are spun alongside corresponding samples from the previous year’s crop saved over, and the tests are reported for general information. (A copy of this report will be sent annually, on request.) Thus on the basis of about 6,000 spinnings annually, the Giza technologists have a finger on the pulse of Egyptian crop quality, dating ahead of the first selection of any component in the crop, up to the time of its rejection as a commercial bulk some eight or twelve years later. The present account is written against a background of results from about 3,000 yield tests and 30,000 spinning tests carried out during the past ten years.

viii. Reaction upon Agricultural Economics

The developments in seed production here recorded have had marked repercussions on the Egyptian commercial crop; but although the varieties now on offer are in bigger quantity and of better staple than those of a few years ago (Fig. 2), the changing situation has aroused apprehension among spinners. As was recently reported, “In Lancashire trade quarters, it is sometimes wondered whether the Egyptian authorities do not tend to forget the inconvenience caused for spinners, by continual changes in the varieties produced.” This view is very understandable until the facts are put forward, and spinners are entitled to an explanation: the trouble is the impact of applied science upon agriculture.

Taking both yield and quality into account, and assuming a constant basis for prices, the cotton crop from average Egyptian land has increased.
in Egyptian Cotton Varieties—Hancock

in value per acre by some 60 per cent. during the past twenty years. For much of the land the increased return is more than 60 per cent., but the general average of the country is brought down by the steady increase in marginal land from reclaimed areas formerly not under cultivation. Nearly a half of this remarkable improvement is attributed to factors with which this account is not concerned, and which cannot be assessed at all accurately; but on the most conservative estimate, at least 20 out of the 60 per cent. must be attributed to the improved seed supply.

Had the plant breeders been confined to research on established varieties only, the rate of advance could not have been so much as a quarter of that actually achieved. Progress became swift only when the breeders seized upon improvements in whatever new varieties they could be found. The Egyptian Government naturally wished to have these developments exploited to the utmost since costs of production were seen to be so much lower, but there was never any question of the new varieties being forced into cultivation. The Egyptian grower changed from old varieties to new according to his own free will, for the same reason that the English farmer changed from arable to dairy farming—he thought it would pay him better. Nor was it the growers alone who gained benefit from more efficient production; spinners' interests also were favourably affected.

Some easing of the growers' price probably followed, lowered costs of production, although it is not easy to say how much was passed on to the spinner. In respect of bigger crops, however, the spinner certainly gained some advantage. In the above calculation of improvement in value of the crop, prices were assumed to be the same for the increased crop as for the original; but any buyer knows that this cannot be true in general. Over and above the normal market fluctuation in demand, spinners can buy their cotton more cheaply when the supply increases, and it has increased by some three million kantars annually. Thus for their increased crops, growers did not actually receive value quite proportional to the increase; the cotton became cheaper and the difference represents the spinners' share of the profits on cotton-growing research. The inconvenience of new varieties must be balanced against greater efficiency in raw cotton production.

Changes in the varieties were formerly essential because of the growers' inability to control deterioration. When changes are made now, progress is real and permanent, not an illusion arising mainly from deterioration in the preceding varieties. Although varieties are introduced almost as frequently as ever, at least they deteriorate more slowly. The situation is better than it was, and there is promise of stability in the future. No end to the advances in plant breeding is yet in sight, but progress must eventually slow down; stability in varieties may then be reached to an extent that could never have been possible when deterioration was uncontrolled.

In the sense that they would not be developed without artificial selection on an extensive scale, varieties of the future will be more unnatural than they are already; and the higher they rise in the economic scale, the further they can fall. It yet remains to be shown what is the nature and extent of this deterioration, that it has occurred and is still occurring. These points, together with the general problem as the writer sees it, are discussed in Part III.

Summary

New Egyptian varieties were formerly developed from offtypes found in old-established commercial varieties. Nineteen types given Giza numbers (one of them was Giza 7) were picked out of commercial Ashmouni, and a dozen improved types were also selected from the pedigree lines of other contemporary varieties.
Much faster advances in plant breeding were made by changing to the hybridisation method, pedigree plants being mated, and not plants from the partly deteriorated varieties from field populations. Selections from the hybrid lines were then again mated, and so on for several cycles, the populations being carried to successively higher economic levels by a process analogous to evolution. Strains with some economic character at a value beyond the limit formerly considered extreme are frequently found; there are now half a dozen varieties with yield above that of the highest yielding variety ten years ago, and the former upper limit for yarn strength is similarly exceeded frequently. Stress is laid on the possibilities inherent in secondary selection, and response to selection is ascribed to recombination of plus and minus modifiers in polygenic systems, on the lines suggested by "Student" and by K. Mather.

A short account is given of the effect of botanical research on agricultural economics. Changes in the varieties grown were formerly frequent and essential because the growers were unable to control deterioration; but changes are now made chiefly to exploit the more efficient production possible with new varieties. Stability will be reached when progress in research slows down, but only if the new varieties can be maintained without deterioration; and their evolutionary background has an important bearing on this question.

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5 H. J. Denham, Shirley Institute Memoirs, 1922, p. 87.
9 "Student," Eugenics Review, 1933, 24, 293.
10 K. Mather, J. Genetics, 1941, 41, 159.
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13 Manchester Guardian, April 10th, 1944.
Part III—EXTENT, NATURE, AND CAUSES OF DETERIORATION

i. Preliminary Enquiries

When spinning-tests were first carried out at Giza on the Egyptian commercial crops of 1934 and 1935, it was noticed that lower yarn strengths were given by commercially grown varieties obtained from Alexandria, than were given by the same varieties grown in experiments by the Ministry of Agriculture. Ashmouni was only two or three per cent. low, but the strength deficiency reached some ten or fifteen per cent. with Sakel and Sakha 4, which were then the top quality varieties of the Egyptian range.

Alexandria merchants and classifiers, asked to give their opinion, offered several explanations for the result. Those chiefly mentioned were that (a) the commercial crop was badly ginned; (b) Ministry of Agriculture farms were on better than average land; (c) Ministry of Agriculture farms were given better cultivation, including the effects of fertilisers and the water supply; and (d) the experimental samples were of higher grade than the commercial. A further explanation was that commercial seed was mixed, although it was thought that any mixing into Ashmouni would raise the strength rather than lower it, all other varieties being of better quality. And still one more suggestion was made, naturally not at Alexandria, to the effect that Alexandria graders mixed the lint of commercially grown cottons, with inferior motives. This last explanation for the weak yarn was later proved to be very wide of the mark, but the writer proceeded to enquire first into the suggestions (a) to (d), which represented the majority of opinions.

Non-Genetic Factors.—Except for a trivial quantity of very low grade cotton, all the Egyptian crop is ginned on single action roller gins. Direct experiment showed them to be entirely free of guilt; the gins could not be made to affect the yarn strength by any mishandling whatever. Direct experiment also showed that the fertility of the land and its method of cultivation, the supply of water and of manures, taken singly or altogether in their effect on the crop, could not explain as much as one-tenth of the strength deficiency in question. An allowance had to be made for Ashmouni, according to whether it was grown in the north or the south of Upper Egypt, but nothing of this kind applied to the weakness of Sakel and Sakha 4.

Enquiry into grade differences, suggestion (d), showed these to be a minor factor in the yarn strength results. The experimental samples had been mostly first pickings, often with bollworm damaged cotton sorted out; hence they were of higher grade than the fully good commercial samples used in the comparison, and a correction needed to be made for this. Although in some circumstances the grade correction can be very large, it did not amount to much for the tests now in question. The enquiry did help to clear up most of the discrepancy, however, as regards the strengths of Ashmouni (Giza 19), Wafeer (Giza 12) and Giza 7. When compared at the same grade these cottons gave much the same spinning results on average, with signs of only slight deterioration in commerce. The discrepancy that remained was in Sakel and Sakha 4, of which commercially grown samples were too weak by 400 lea product units in 60s carded ring twist, or 13 per cent. on the average.

Contamination in the Seed.—With the elimination of the above factors as explanation for weak yarn, attention was directed again to the seed. The Giza plant breeders had given close attention to the seed question long before 1938, which was the time of the present writer's enquiry; they declined to
accept mixed seed as a likely explanation, and presented what appeared to be a strong case for their view.

They pointed out that the Giza maintenance system had an excellent theoretical and practical basis to support it against a charge of issuing deteriorated seed to growers, as was shown in Parts I and II of this paper. Moreover, several of the breeders were old enough to remember the crop as it had appeared 10, 20, or 30 years before; and they were quite positive that the modern crop of any variety was more uniform in the appearance of the plants, and also of the seed, than ever it had been before. They were supported in this view by the opinion of leading cultivators, who were most flattering in their appreciation. But above all, the breeders pointed to the analysis of results achieved by the Seed Control Law (Part I, Section v), which had been in operation since 1926.

Elimination of Hindi.—Certain small and black cotton seeds known as Hindi used to be very common in Egyptian seed, and the operators of the Seed Control Law used the Hindi content as the main basis for acceptance or refusal of seed for sowing. There are possibly different kinds of Hindi, but in general these seeds develop into an American type of plant and lint, quite a different species from Egyptian. The staple is very short by Egyptian standards; the yield of lint (but not of seed-cotton) is also low; and the plant is a hopeless economic failure, although very successful as a weed since it produces many seeds. Quite obviously there would be deterioration in crops harbouring many of these, which expand vigorously out of proportion whenever they have the opportunity to do so, and as they actually had done up to 1926. As a result of the steady refusal for sowing of lots containing such seeds, they had practically vanished from the Egyptian crop by 1938.
The improvement thus effected in commercial seed was in fact remark­able (Fig. 3), and was the explanation for the greater uniformity of field plants which the breeders and cultivators had noticed. The breeders had other means of knowing that they were issuing undeteriorated seed; and they insisted that improvements in seed production as well as in seed control were leading to greater uniformity of seed, rather than the opposite. Subsequent work has substantiated the first claim; the breeders were issuing better seed. But the greater uniformity of commercial plants and seeds was illusory; the crops were not nearly so homogeneous as they appeared to the eye; and the fault lay in commercial seed control.

### Table V

Commercial Seed Compared with Renewal Nucleus Seed

Commercial Seed was a composite of some scores of random lots sent by cultivators for examination under the Seed Control Law. Renewal Nucleus Seed was always the current renewal nucleus. For those entries marked "x" in the table, the commercial crop was derived in part from a former renewal nucleus having appreciably different values from the current nucleus; some part of the difference shown for these is therefore due to a change in the nucleus, as well as contamination in commercial seed. The tests were spread over the period from 1940 to 1943.

<table>
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<tr>
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<th>Malaki</th>
<th>Sakha 4</th>
<th>Sakel</th>
<th>Karnak</th>
<th>Giza 7</th>
<th>Wafeer</th>
<th>Ashmouni</th>
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<td><strong>Nucleus Yield, lb. per acre</strong></td>
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<td>518x</td>
<td>617</td>
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<td>(4)</td>
<td>(4)</td>
<td>(6)</td>
<td>(9)</td>
<td>(2)</td>
<td>(9)</td>
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</table>

### ii. Extent of Deterioration

Comparison of Commercial and Pedigree Seed.—In 1939, comparison was made between Ministry of Agriculture seed and commercial Sakel seed, sown in chequer plots. With the plants grown together, and the cottons picked and spun together, any yarn strength difference now found could only reflect a fault in the commercial seed. The latter sample was a composite from many lots picked out at random from those sent for examination and passed under the Seed Control Law; it was thus thoroughly representative of the seed in use by ordinary cultivators, no matter from where they obtained it. Such composites can be assumed to have been used for all tests on commercial seed mentioned in this account, unless the contrary is stated. The pedigree seed was always from Ministry of Agriculture stocks, usually from the current renewal nucleus.

Chequer comparisons have been repeated some 40 or 50 times since 1939, every Egyptian variety coming under test during the period. The results confirmed there to be only slight deterioration in the commercial seed of Ashmouni, Wafeer, and Giza 7; but the commercial seed of Sakel and Sakha 4 was found to be badly deteriorated, the 13 per cent. previously mentioned being fully accounted for. The results are shown in Table V; and as regards Sakel and Sakha 4, the Giza system was evidently failing badly at some point.

Point of Failure in the System.—The defect was found to be in the method of examination under the Seed Control Law. For many years it had been believed that visible offtypes such as Hindi were not the sole cause of deterioration. Even before the Law came into operation, Sakel lots with as many as five per cent. of Hindi seeds were rare, and the average lot contained only about one per cent. That much larger percentages were
necessary to explain the observed extent of deterioration, was shown by Dunkerley's work on the yarn strength of mixings; and by 1938 the Hindi content was absurdly inadequate to explain the observed deterioration. There was no escape from the conclusion that invisible offtypes were responsible for the major effect.

These hidden offtypes always existed in the seed, along with the visible Hindi which added its quota to the sum total of deterioration. For the period when the percentage of Hindi was a good guide to seed age, the Seed Control Law must have been effective in elimination of both the visible and invisible offtypes. The quantities of the two types were almost certainly correlated, and only the Hindi was necessary as a guide. The trouble came when the latter was so reduced that it was no longer an accurate guide, and by 1938 the proportion of Hindi to normal seeds had fallen below one per thousand. The situation had therefore been improved a good deal; but then in the main crop there was no longer enough Hindi by which to distinguish accurately between new seed and old. This was the point of failure; badly deteriorated seed carrying many invisible offtypes was being passed, and in consequence there was too small an inflow of new seed, of which plenty would have been available had there been a demand.

Table VI
Testings of Single Lots

Lea Products of 60s carded ring twist yarn, means of four spinnings, two on each of two repetitions. Single lots of seed received for examination under the provisions of the Seed Control Law, taken at random, with control lots of pedigree seed included; and sown separately in one big plot with two repetitions, variety by variety. The Sakel and Malaki were sown in 1942, the Ashmouni in 1944. First pick cotton in every case. (See Appendix X for analysis of these data.)

| 1705 | 2400 |
| 1710 | 2405 |
| 1710 | 2410 |
| 1710 | 2300 2425 |
| 1710 | 2305 2430 |
| 1710 | 2315 2430 |
| 1715 | 2325 2430 |
| 1725 | 2330 2460 2505 |
| 1730 | 2265 2330 2465 2520 |
| 1730 | 2275 2350 2475 2525 |
| 1735 | 2275 2365 2485 2535 |
| 1740 | 2280 2370 2490 2550 |
| 1740 | 2285 2370 2490 2570 |
| 1745 | 2285 2390 2495 2590 |
| 1745 | 2290 2395 2495 2595 ---- |
| 1750 | 2700 |
| 1755 | 2715 |
| 1755 | 2880 |
| 1760 | 2920d |

47 Lots of Sakel

| 1770 | 2010 |
| 1770 | 2910 |
| 1770 | 2925 |
| 1770 | 2835 |
| 1770 | 2935 |
| 1770 | 2840 |
| 1770 | 2940 3005 |
| 1770 | 2945 3010 |
| 1770 | 2955 3010 |
| 1770 | 2825 3015 |
| 1770 | 2840 3020 |
| 1770 | 2860 3025 |
| 1770 | 2870 3025 |
| 1770 | 2870 3030 |
| 1770 | 2880 3030 |
| 1770 | 2880 3045 |
| 1770 | 2880 3045d |
| 1770 | 2770 3110 |
| 1770 | 2775 3110 |
| 1770 | 2885 3110 |
| 1770 | 2885 3120N |
Comparison of Single Lots.—While the extent of deterioration in Sakel was already seen to be serious, worse was to come. Forty-seven single lots of seed, not composites this time, were taken at random from different gimmeries, with one control lot of pedigree seed included; they were sown separately in one big plot, and the 47 resulting crops were as 47 growers would find them.

All the seed lots were derived from the State Domains renewal nucleus; and as issued originally all must have given lint with the spinning quality of the control lot, which was Domains Sakel. But by 1942, by when they had circulated for some years as commercial seed, several of the lots had deteriorated by much more than the 13 per cent. previously mentioned. As shown in Table VIA, the worst case of deterioration was below the control by as much as 655 lea product units, or 22 per cent. in yarn strength. The unfortunate grower of this cotton would have to sell his crop at some 20 or 30 per cent. below the top price, and the fact illustrates the importance of the problem to growers, no less than to spinners. Such a result is the answer to those who hold that deterioration is overstated.

Fig. 4.—Staple Diagrams from the Balls Sorter. Deteriorated Sakel (lowest of 47 commercial lots), and Domains Sakel from pedigree seed, the two cottons being grown and picked together.

It would be natural to question the accuracy of the tests on which Table VIA is based. Each point is the mean of four spinnings, and it happens that these were the results used to demonstrate the accuracy of spinning-tests in a previous paper to this Journal, where the analysis of variance is to be found. (See also Appendix I). Practically the whole of the scatter shown in Table VIA was proved to arise from real differences between the seed lots, and not from variation in the growing or spinning conditions. The spinning evidence was only too sound.

Similar tests (Table VIB) were carried out on 51 single lots of the newer variety, Malaki; and although these showed deterioration on nothing like the grand scale found in Sakel and Sakha 4, yet it was enough to cause uneasiness. Karnak, the only long staple remaining to be discussed, and still newer, has also been tested extensively by a different method. Quality deterioration here was less than 0.5 per cent. up to 1944, and was commercially undetectable, but it could be measured by sensitive methods. Even Ashmouni (Table VIC) was not immune. If the methods of detection were sensitive enough, traces of deterioration could in fact be found in every variety, traces ready to expand into serious proportions given time and opportunity.
iii. Nature of Deterioration

There is no character in which deterioration is so marked as in the yarn strength. This is partly because of the ease with which differences in yarn quality are detected, and is perhaps at the root of the trouble with cotton; the quality of most other agricultural crops, even of wheat, is not so precisely measured in commercial use.

Related to the changes in yarn strength, changes can be seen in several lint characters when deterioration is extreme. Shortening of the staple is pronounced (Fig. 4), and the consequence is a very familiar feature to spinners—increased comber waste. This shortening of the staple leads to wastiness in blendings, and partly explains the "low strength anomaly" (Part II, Section iii), which is very marked in deteriorated lots. Also the staple is weak, as can be detected easily even by hand tests. Mean hair-weight tends to rise.

**Lint Colour.**—Deteriorated lots show very interesting changes in the lint appearance. Weak lots could be picked out of Sakha 4 with fair success, on the off-colour alone; and the staple felt dry and brittle. These characteristics were still more pronounced in Sakel; the grader described the worst lots as "burnt or scorched," and they were markedly browner than normal Sakel. No mixing of any Egyptian commercial varieties could simulate this result, or anything remotely like it; it cannot be explained by direct mixing of Sakel, with Pilion or Ashmouni for instance. Nor does a cross between Sakel and another variety normally give this result, for the brown and scorched types are never found in the hybrid lines.

The bolls of deteriorated Sakel were uniformly brown so far as could be seen; but there was formerly sporadic in this variety a plant type which had the characteristics of deteriorated Sakel in extreme degree. Two or three examples of this type, known as Enan's Brown*, have been seen by the writer. The seed was small and without fuzz, the ginning out-turn very low, and the lint was a deep brown, almost red; yet it was a typical Egyptian plant with no resemblance to other cotton species which have lint of a similar colour. To a spinner, the most significant feature of this cotton was wastiness coupled with extreme weakness and brittleness; as the lint came from the plant it looked and felt as though it had spent weeks in a hot oven. At a rough guess, one part of this cotton intimately mixed with two or three parts of good Sakel, would resemble deteriorated Sakel rather well—a result to be obtained from no other mixing known to the writer.

Sakel at no time contained sufficient Enan's Brown to account for the brown colour of deteriorated lots, and the Sakel of 1942 contained either none at all, or very little. The seeds were recognisable as something other than Sakel, and lots with such extreme contamination would certainly be eliminated by the Seed Control Law operations. The presumed relation of Enan's Brown to deterioration will be discussed in a later paragraph. These observations on scorch and colour are interesting, however, because other Egyptian varieties of long ago were similarly described as they were dying out.

**Lint Yield.**—No significant change in lint yield was found in average commercial Sakel, and the grower had no compensation for his crop of inferior quality, but there was an increase of yield in deteriorated Sakha 4. Giza 7 showed a small but significant drop in yield compared with the nucleus, although scarcely otherwise deteriorated at the time the yield tests were made. Some Egyptian varieties of the past are said to have deteriorated badly in seed-cotton yield, and also in ginning out-turn.

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*First described by Hussein Enan Bey, now Under-Secretary of State to the Ministry of Agriculture.
Plant and Seed Changes.—As shown by the target diagrams from commercial seed, plants appeared with low ginning out-turn and seeds of low weight. There was a general tendency for these characters to be coupled with short staple length, and all three characters gradually increased in range of deviation, with increasing deterioration. Both low ginning out-turn and small seeds would tend to increase the number of seed produced per plant, but not sufficiently to affect the mean of the bulk to a marked extent. The calculated number of seeds produced per acre usually differed little as between commercial and propagation lots compared in chequers; the difference in fact was rarely significant because of uncertainty in the yield figure. Commercial Sakha 4 was an exception, and showed increase in the seed number per acre. (Seed weight changes as extreme as those shown in Table I were rarely found in bulks; such lots were easily detected and soon eliminated. This continual elimination of bad lots by human agency must also be borne in mind when considering the yarn strength distributions shown in Table VI).

Late maturing plants with a bushy habit could be seen in most commercial lots, but only when sown wide-spaced, one plant per hole, as in the purity chequer. Thick monopodia sprang from the lower nodes, so that frequently there seemed to be two or three plants growing from one hole. Such plants are rarely or never seen in nucleus bulks, nor in the pedigree or hybrid lines; but they were common in commercial Sakel, Sakha 4, and Malaki, and reached a frequency of nearly 50 per cent. in a particularly bad lot of Giza 7. It was noticed that the yarn strength of deteriorated Malaki fell most in the second pickings, which may have indicated the presence of late maturing elements.

<table>
<thead>
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<tbody>
<tr>
<td><strong>Offtypes Selected out of Renewal Nucleus Families</strong></td>
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<td>(The examples are mostly single chequer comparisons)</td>
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<tr>
<th></th>
<th>Lea Product 60s Carded</th>
<th>Lint Yield lb. per acre</th>
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<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Offtype selection</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td></td>
<td>2515</td>
<td>627</td>
</tr>
<tr>
<td></td>
<td>2360</td>
<td>683</td>
</tr>
</tbody>
</table>

The bushy plants were of about normal height, and were not detected even by an expert eye when sown in the field, close spaced and with two plants per hole, as is usual. This applied even to the highest and lowest of the 47 Sakel lots previously mentioned (Table VIa); even when so grossly deteriorated, the offtype plants could not be eliminated by roguing in the field, as is attempted by the methods of mass selection. And as previously
mentioned in connection with the failure of the Seed Control examination, deteriorated Sakel seeds were also indistinguishable by eye from the normal seeds, and this applied generally to all varieties.

**Wilt Resistance.**—Sakel as a whole was susceptible to wilt (Fusarium), although even in the nucleus families some five per cent. of resistant types generally could be found; and such resistant types increased about five-fold in commercial Sakel. A much smaller increase in resistant types occurred in Malaki, another susceptible type which showed traces of the impurity in the nucleus. In Sakha 4 which was a highly resistant type, wilt susceptible plants were found in the deteriorated seed, but only to a small extent.

**iv The Cause of Deterioration**

At one time or another, several wilt immune types extracted from the Sakel renewal nucleus had been studied, in approximately pure state, in the pedigree lines. Several were indistinguishable from normal Sakel as regards the plant form; and both in Sakel and in other varieties these types had a very general tendency to be of lower spinning quality than the normal types (Table VII). None of the resistant types examined actually had characters as bad as deteriorated Sakel, although some approached towards it; but obviously there was a possibility that such offtype was present at low frequency in the renewal nucleus, and that its subsequent expansion would fit in with the observed nature of deterioration in Sakel.

**The Time Factor.**—An attempt was made to place this explanation on a quantitative basis, in terms of the possible initial frequency of the offtype and its rate of expansion, so as to cover the extent of deterioration as well as its nature. This was too simple an approach, the expansion of a single offtype not actually being the general cause of deterioration; but a numerical example worked out for a hypothetical case is given here, because it illustrates rather vividly how a minute trace of impurity can expand to become a multitude of plants in the time estimated to be available.

**Table VIII**

The Time Factor in Differential Expansion

The calculated increase of Ashmouni impurity within a Sakel population, in successive years of propagation, assuming a differential expansion rate of 5:3. In calculating the yarn strength of the mixings, unmixed Sakel is taken to have a lea product of 3,000; and Ashmouni, 1,800. The starting point is one Ashmouni plant in a population of 999 Sakel plants.

<table>
<thead>
<tr>
<th>Year of Propagation</th>
<th>Plants per Thousand Sakel</th>
<th>Ashmouni</th>
<th>Lea Product of Mixture</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st</td>
<td>999.0</td>
<td>1.0</td>
<td>2990</td>
</tr>
<tr>
<td>2nd</td>
<td>998.3</td>
<td>1.7</td>
<td>2988</td>
</tr>
<tr>
<td>3rd</td>
<td>997</td>
<td>3.0</td>
<td>2996</td>
</tr>
<tr>
<td>4th</td>
<td>995</td>
<td>5.0</td>
<td>2994</td>
</tr>
<tr>
<td>5th</td>
<td>992</td>
<td>8.0</td>
<td>2990</td>
</tr>
<tr>
<td>6th</td>
<td>987</td>
<td>13.0</td>
<td>2984</td>
</tr>
<tr>
<td>7th</td>
<td>980</td>
<td>20.0</td>
<td>2976</td>
</tr>
<tr>
<td>8th</td>
<td>965</td>
<td>35.0</td>
<td>2958</td>
</tr>
<tr>
<td>9th</td>
<td>945</td>
<td>55.0</td>
<td>2934</td>
</tr>
<tr>
<td>10th</td>
<td>910</td>
<td>90.0</td>
<td>2892</td>
</tr>
<tr>
<td>11th</td>
<td>855</td>
<td>145.0</td>
<td>2826</td>
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<tr>
<td>12th</td>
<td>785</td>
<td>215.0</td>
<td>2742</td>
</tr>
<tr>
<td>13th</td>
<td>685</td>
<td>315.0</td>
<td>2622</td>
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<tr>
<td>14th</td>
<td>565</td>
<td>435.0</td>
<td>2478</td>
</tr>
<tr>
<td>15th</td>
<td>435</td>
<td>565.0</td>
<td>2322</td>
</tr>
<tr>
<td>16th</td>
<td>315</td>
<td>685.0</td>
<td>2178</td>
</tr>
</tbody>
</table>
The hypothetical example chosen is the case of one Ashmouni plant in a population of 999 Sakel plants, expanding for some years at a differential expansion rate as 5:3. So as to simplify the problem, the relative expansion of Ashmouni is assumed to arise solely from its higher seed yield, which actually is about in the ratio of 5:3 compared with Sakel. It is assumed that no natural crossing takes place, and that no other selection factors operate. The Ashmouni then expands at compound interest with yearly rests, is harvested along with the Sakel as one crop every year, and the mixed seed is sown as one bulk each following year. The course of this expansion is shown in Table VIII, the expected lea products of the mixtures being given in the right-hand column.

Out of every 1,000 plants in the bulk, i.e. Sakel and Ashmouni together, there is only 1 Ashmouni plant the first year, which expands to become 5 Ashmouni plants in the fourth year, 35 in the eighth year, 215 in the twelfth year, and 685 out of every 1,000 in the sixteenth year. (Evidence of such snowball growth has been seen in experiments). The lea product, which was 3,000 for the original Sakel, is calculated to fall to 2,742 for the mixture at the twelfth year, and to be as low as 2,178 at the sixteenth year, when a spinner would no longer recognise the mixture as Sakel. The fall is rapid after about the tenth year.

Most populations in the present commercial crop have circulated probably for 8 or 12 years from the date of the original single plant selection; but special circumstances applied for Sakel at is was dying out in 1942, and most of the seed had circulated probably for 16 years—a critical extra four years according to the conditions of the hypothetical example. Treating the problem on the above simple lines, one offtype plant present at an early stage of propagation therefore had the time required to expand and swamp the Sakel bulks.

Selective Advantage of Minor Genes.—The case of Sakel was considered to be appropriate for study on such simple lines, since Fahmy's work on wilt resistance had indicated major genes to be playing an important part in the expression. Resistance to wilt is a valuable character under Egyptian conditions; and these major genes were conceived to be increasing in commercial Sakel not simply because they affected the seed yield per plant, but by reason of the obvious selective advantage conferred by wilt resistance. The present writer set off in his enquiry holding that point of view; but eventually it was realised that if the selective advantage of these major genes were to be allowed as a factor in deterioration, the selective advantage of minor genes for wilt must be allowed as a factor also; for Fahmy's work showed minor as well as major genes to be affecting the expression. And once the selective advantage of minor genes was taken into consideration, along with the magnitude of the time factor, an immense vista was opened up. Many other characters besides wilt resistance were known to be controlled by minor genes; they were present by the score, possibly by the hundred, and the extent of their selective advantage became a question of prime importance.

The main point at issue was whether minus modifiers were at a selective advantage compared with plus modifiers, the latter being defined as the minor genes favoured by human selection; but a direct approach was out of the question. Even for major genes whose expression is well marked, proving a selective advantage is apt to be difficult. Expansion of resistant types in commercial Sakel, for instance, was not necessarily a result of natural selection for wilt resistance; instead, there might have been selection for some other character which happened to be linked with wilt resistance. For the minor genes, proving a selective advantage is doubly difficult; their individual effect is small, perhaps often within the limits of uncertainty in measurement; also their number is large, there may be many of a like kind, and their effects accumulate. Hence there did not seem to be much hope of
Measures to Check Deterioration

proving a case in detail for these genes; but a general argument of considerable weight is available, by which to show that minus modifiers must be at a selective advantage in commercial crops.

As concluded by Hutchinson and by Mather, selective forces tend to establish balanced mixtures of types; and polygenic systems provide the reservoir of genes which is the source of material for natural and artificial selection (Part II, Section v). In nature, the balance of plus and minus modifiers changes until the environment is best exploited. If the objectives in artificial selection are opposed to those of natural selection, the polygenic balance will be disturbed. Minus modifiers assiduously discarded by the plant breeder will be then at a selective advantage if they have the opportunity to re-enter his populations; pressure of natural selection will favour their expansion until a natural balance is restored. This argument may be applied to Egyptian cotton if it can be shown that there is a contrast between the course evolution would take in nature, and the course along which the varieties are persuaded by the breeders.

That there is such a contrast seems to be beyond doubt. High spinning quality, in particular, of itself is a character without value to the plant; general improvement of spinning quality by natural selection could arise only by coincidence—a coincidence which occurs either not at all, or else very rarely, in Egypt. In any bulk a few plants with variations in a desirable direction are likely to be found, as is revealed by the target diagrams; but variations in the opposite direction are more frequent and of greater deviation; the change for the bulk as a whole is always for the worse. Thousands of commercial lots have been examined for spinning quality by the writer; and whenever a significant change in a variety is found—as it is found very frequently—it is always in the direction of lower spinning quality.

Consideration of the evolutionary background of modern varieties leads to the same conclusion. Giza 45, for example, a super-strong type reaching well into the Sea Island range of quality, was derived from controlled matings between lines selected out of commercial Sakel and Ashmouni. These two varieties often must have crossed into each other naturally, so that all the genes required for Giza 45 types were present in commercial Sakel populations; but although such types had time in which to expand, they did not expand under our conditions of cultivation. If types such as Giza 45 were present at all, they diminished rather than increased in frequency; the types which did expand in Sakel were of a very different nature, as has been seen. The development of brown linted types in deteriorated Sakel was also very significant. According to Silow, all the wild species of the genus Gossypium bear coloured hairs on their seeds, and most wild representatives of the cultivated species also have coloured lint. White lint is essentially a product of human selection.

Hence as regards both strength and colour the result achieved by natural selection is quite contrary to the breeder’s objectives, and similar arguments apply to several other characters. If artificial selection results in the accumulation of plus modifiers, natural selection results in the accumulation of minus modifiers; the minus modifiers in question can be regarded as the “wild-type” appropriate to the environment concerned, and to the polygenic system operating. In the writer’s view, the expansion of these wild-type genes is the main cause of deterioration.

The propagation of pure strains, long regarded as the ultimate objective in Egypt, is an ideal with a sound basis. No truly pure strain has ever been obtained at Giza, where the term is not actually used; but the conception is useful so long as it is realised that no more than approximate purity is attained in practice. It is important to notice that although a pure strain carries both plus and minus modifiers, neither kind of modifier is at a selective advantage over the other while the strain remains pure; the restor-
The mechanism of polygenic systems cannot operate in homozygous and homogeneous populations. As the plant breeder puts it, the strains are "fixed." The situation is changed, however, when impurity is present—whether it was never eliminated from the beginning, or whether it is introduced by new mutations or by one pure strain crossing with another. Variability is released by heterozygosity, and the selective advantage of minus modifiers leads to their rapid dispersal, with the development of new and undesirable recombinations.

If two pure strains crossing are denoted thus:

\[
\begin{array}{cccccc}
- & + & + & + & + & + \\
- & + & + & + & + & + \\
\end{array} 
\times 
\begin{array}{cccccc}
+ & + & + & - & - \\
+ & + & + & - & - \\
\end{array} 
\]

then among the ultimate offspring will be types to be denoted thus:

\[
\begin{array}{cccccc}
- & - & + & - & - \\
- & - & + & - & - \\
\end{array} 
\]

and of course heterozygous and other combinations of various kinds. Such types carrying an accumulation of minus modifiers, even though they are derived from pure strains, are presumed to be the typical deterioration products. Extreme accumulation is presumed to result in Enan's Brown, which in addition possibly carries undesirable major genes, such as certain of the wilt resistance genes.

Following a study of Enan's Brown, Harland attributed the occurrence of the ordinary barbadense type with white or near-white lint, to the disintegration by human agency of an original brown-linted complex. Human processes, unfortunately, left too many of the disintegration products lying around; for deterioration seems to be the product of their re-integration by natural selection.

Expansion from a Trace. —The raw material for this re-integration inside a variety is probably any kind of impurity, although some kinds are worse than others; but no more than minute traces need be present initially. Contrary to a rather popular belief, bulk mixing of seed of different varieties is not the reason for deterioration under modern Egyptian conditions. Whether the mixing is supposed to occur by accident in ginneries, by farmers taking the wrong bags, by deliberate mixing of seed-cotton with intent to defraud, or even by wholesale natural crossing between different varieties in the fields—the expected consequences are rarely found although they certainly would be found by the methods of analysis now available.

In the first place, commercial varieties give target diagrams with distributions and correlations quite different from those to be expected from seed mixtures of the known varieties; and in a good many cases, gross mixtures of that kind would be detected at once by the Seed Control Law examination. But especially, the detailed search for deterioration in Karnak revealed how little such contamination amounts to nowadays, all causes being taken into consideration. The high quality Karnak was expanded from a small crop on a thousand acres in 1939, up to a crop more than a hundred times greater in 1942; and this occurred during a period when there was more low quality Zagora grown in the Delta than ever before. Yet in the four years' exposure to risk of crossing in the fields, or mixing in ginneries, etc., the total contamination in Karnak was equivalent to less than one per cent. of Zagora admixture, as was proved by tests on thousands of lots. In recent varieties, at least, the cause of deterioration was not in the bulk of impurity initially introduced, but in the length of time allowed for impurities and their by-products to expand, and in the virulent nature of those by-products.
Gene Interactions.—The tendency of useless structures to disintegrate or degenerate in the absence of further selection in their favour is well known in evolutionary biology; the gradual loss of eyes in cave-dwelling animals is a familiar example. Deterioration differs from ordinary degeneration in the rapid pace at which changes take place; Egyptian cotton varieties commonly changed character within ten or twenty years of their introduction. In Sakha 4, offtypes began to increase rapidly, less than ten years from the date of the single plant parent of the renewal nucleus; and the lint from these offtypes was of a quality that could be viewed by spinners only with dismay. This haste to revert towards non-cultivated types is a measure of the contrast in objectives between natural and artificial selection; but the rapid change in lint quality calls for comment, if—as seems to be likely—high quality lint of itself is an “indifferent” character, with neither selective advantage nor disadvantage under the conditions of cultivation. There is a strong implication that natural selection actually operates on non-lint characters, and that the marked changes observed in the lint are secondary consequences.

That the expression of each gene or factor in an organism is dependent on all or most of the other factors present, is an opinion held by many biologists; Rasmusson referred to it as the inter-action theory. Discussing Wright’s studies on the subject, Huxley remarks: “Most genes have multiple effects. Organs under direct selection will be modified by a system of genes; but the genes of such a polygenic system will also have secondary effects on ‘indifferent’ organs, and most of these secondary effects will tend to promote degeneration in size or function. Further, when two linked polygenic systems are lodged in the same chromosome or chromosomes, and selection is acting to alter the main character controlled by one system, while that controlled by the other is useless, the resultant recombination will ‘break up’ the useless character. In virtue of the tendency of random change to be towards decreased efficiency, this also will promote degeneration.” On this view, when a cotton variety begins to accumulate modifiers affecting e.g. the number of seeds produced, the vigour of the seedlings, the strength of the root system, the potency of the pollen and so on, disintegration of the lint characters occurs by accident. The disastrous consequences recorded on our lea testers when a variety deteriorates are then merely the subsidiary effects of natural selection.

v. Review of Developments

Impurity as it expands sometimes raises the yield (as with Sakha 4 in Table V), but such increase is never sufficient to compensate for the fall in quality always associated with it; in every variety studied at Giza, the effect of deterioration is to lower the net return per acre. Egyptian mixtures, whether accidental or deliberate, are not likely to meet with success in propagation; genetic variability must be avoided, for the crops are always apt to seize on it for the promotion of their own ends.

One way of evading the steady fall in quality which is the feature of deterioration, might be to let the cotton populations settle down to their natural level without interference. There is reason to think that stability would be reached, although seed actually is always withdrawn from circulation before arriving at that stage. So far as the result can be forecasted, the crops would end up as dark brown cottons of weak and wasty staple, with lint yield and spinning quality both below that of Ashmouni. At this hypothetical natural level, the mixture would be the fittest population; but such fitness does not refer to economics, by the standards of which the crops would be failures.

Even partial success in control of deterioration therefore reaps a handsome reward; but the higher a variety is carried above this natural level, the greater are the difficulties likely to be, because the greater is the pressure
of natural selection tending to bring the variety down. The assembly of plus modifiers continues apace in the breeding stocks from which future varieties will be derived, to aid in the fuller exploitation of the different kinds of Egyptian land. Yet if it be suggested that artificial selection is already carried too far, and that it would be wiser to rest content with varieties nearer to the natural level, the reply is that present evidence points clearly to the contrary.

Higher initial purity and better protection in the early stages of propagation, have led to greater uniformity in the seed now issued, as can be demonstrated by several lines of evidence. But in particular, better methods are available, and still better are projected, for the elimination of seed lots in which the wild-type genes have begun to disperse. No seed can be kept pure in bulk for long; even a one-variety community for all Egypt would help little in the control of deterioration unless all impurity could be eliminated from the beginning. The essential difference between present and former techniques is in the stress laid upon seed elimination; future crops will be given far less opportunity to follow their own line of development than was formerly the case.

Up to about 1912, every new variety was contaminated from the earliest stages by the other varieties grown in adjacent fields. Every crop began as a small bulk covering only a few ridges; it was subject to serious natural crossing from the beginning, since the risks were not appreciated. Types such as Enan's Brown, once they entered the populations, were liable to persist indefinitely from old variety to new, speeding up the deterioration process by the rapid dispersion of their genes. From these degenerate populations, new varieties were selected from time to time. Natural crosses occurred in abundance, but there were strong forces operating against success in selection; the advantage of controlled matings between pedigree plants as in the present Giza system, was not to be realised for many years to come. Expansion of offtypes could be kept in check by mass selection methods only for a variety covering a small acreage, or for one such as Ashmouni which deteriorated fairly slowly. Complaints were made even of Ashmouni, and extreme deterioration was only a matter of time in all the other big crops.

Dating from the formation of the Cotton Research Board in 1920, increasing attention was paid to seed purity. By 1928, the general ruling was to propagate from single plants which had been selfed and reselected for about six generations, Giza 7 being the first Egyptian variety to be so derived. Yet although renewal nucleus families showed a gratifying improvement in seed purity at the time of testing, offtypes invariably developed before the nucleus had run its course some six years later. As we now know, homozygosity is seldom or never reached by F4; in those populations, plus and minus modifiers were freely available, and were able to accumulate gradually in some plants by successive recombination. Such plants would possess characters at values both higher and lower than those of the original plants; and impurity getting in from outside, in spite of the precautions taken, would add to the effects.

Examples of offtypes found in renewal nucleus families, mostly selections for wilt resistance, were shown in Table VII; these were not considered to be successes and were promptly discarded by the breeders. It will be noticed, however, that all were of lower quality than the parents; and also that each would expand out of proportion in commercial crops grown on wilty land, so giving rise to deterioration. Examples of another kind of selection are shown in Table IX; these are successes, and can be used to illustrate the possibilities in secondary selection. But they are used here to illustrate another point; for if plus modifiers were assembled to such extent in the plants selected, so could the corresponding minus modifiers be assembled in plants which were not selected. This is presumed to be the
explanation for the plants with short staple and low ginning out-turn occasionally found in the nucleus families, and disclosed by the target diagrams.

Table IX
Examples of Improvement by Secondary Selection

The latest improved family is shown first, the comparison usually being between parent and daughter or grand-daughter, but some near or distant cousins also occur.

Yarn strengths are expressed as the Lea Strength x Counts Product of 60s carded ring twist; yields are in lb. of lint per acre. All comparisons are based on yield or miniature chequer results, the number of chequers averaged being shown in brackets.

<table>
<thead>
<tr>
<th>Variety</th>
<th>Lea Product</th>
<th>Lint Yield</th>
<th>No. of Cheqs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ashmouni/44</td>
<td>1813</td>
<td>707</td>
<td>(12)</td>
</tr>
<tr>
<td>Ashmouni/43</td>
<td>1744</td>
<td>712</td>
<td></td>
</tr>
<tr>
<td>Sakha 4/34</td>
<td>2920</td>
<td>562</td>
<td>(2)</td>
</tr>
<tr>
<td>Sakha 4/32</td>
<td>2780</td>
<td>566</td>
<td></td>
</tr>
<tr>
<td>Sakha 4/27</td>
<td>2600</td>
<td>552</td>
<td></td>
</tr>
<tr>
<td>Giza 7/42</td>
<td>2406</td>
<td>610</td>
<td>(11)</td>
</tr>
<tr>
<td>Giza 7/39</td>
<td>2374</td>
<td>625</td>
<td></td>
</tr>
<tr>
<td>Giza 23 (118-9)</td>
<td>2224</td>
<td>643</td>
<td>(5)</td>
</tr>
<tr>
<td>Giza 23 (145)</td>
<td>2238</td>
<td>530</td>
<td></td>
</tr>
<tr>
<td>Malaki/44</td>
<td>3145</td>
<td>365</td>
<td>(4)</td>
</tr>
<tr>
<td>Malaki/43</td>
<td>3065</td>
<td>366</td>
<td></td>
</tr>
<tr>
<td>Karnak/44</td>
<td>2800</td>
<td>574</td>
<td>(4)</td>
</tr>
<tr>
<td>Karnak/41</td>
<td>2770</td>
<td>535</td>
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<tr>
<td>Karnak/41</td>
<td>2850</td>
<td>648</td>
<td>(9)</td>
</tr>
<tr>
<td>Karnak/49</td>
<td>2845</td>
<td>632</td>
<td></td>
</tr>
<tr>
<td>Giza 30C</td>
<td>2155</td>
<td>653</td>
<td>(3)</td>
</tr>
<tr>
<td>Giza 30B</td>
<td>2205</td>
<td>628</td>
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</tr>
<tr>
<td>Giza 30A</td>
<td>2190</td>
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</tr>
<tr>
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<td>2249</td>
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</tr>
<tr>
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<td>2272</td>
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<td>(7)</td>
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<tr>
<td>Giza 31E</td>
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</tr>
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<td>Amoun/42</td>
<td>3060</td>
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<tr>
<td>Giza 42 (200)</td>
<td>2940</td>
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<td>(4)</td>
</tr>
<tr>
<td>Giza 42 (196)</td>
<td>2920</td>
<td>486</td>
<td></td>
</tr>
</tbody>
</table>

Hence although the propagation seed issued was very pure by commercial standards, for every variety managed by the Government after 1928, it has to be admitted that the raw material for deterioration was present. Yet the fact would have been of little importance had the Seed Control Law been effective; there is every reason to believe that good seed could have moved into the commercial supply at a rate fast enough to overtake the rate of deterioration, with something to spare. Failure to eliminate bad seed was the defect that led to a slow intake of good seed, especially as regards Sakel, in which the situation was aggravated by a special factor
after 1936. Propagation seed for Sakel, as for any other variety, entered the commercial supply almost entirely in response to demand from the big growers; and from them it passed to the medium and smaller growers within a few years. The bigger growers also were always the leaders in changing over to new varieties, and when they changed over to Giza 7, after 1936, Sakel was left mainly with the smaller growers alone, among whom it lingered on until 1942. These smaller growers however, were not in the habit of buying propagation seed; they continued to use their old commercial seed, and since it could not be detected by the method of examination then in force, the consequences followed as recorded in this paper. History was repeated when the bigger growers changed over to Karnak, and Giza 7 in its turn was abandoned mainly to the smaller growers; the demand for Giza 7 propagation seed rapidly diminished in far greater proportion than the reduction in acreage; a strain heavier than it was able to bear was again placed upon the seed elimination system.

In 1942-43, the Giza technique was greatly strengthened by a series of measures concerned with seed purity and selection, with the time allowed for expansion, and particularly with the method of elimination. As regards purity, it was ruled that a new variety could not leave the hybrid lines before the F₅ generation, after which it is allowed to begin expansion into a renewal nucleus and into a commercial crop. And maintenance within the renewal nucleus area came into operation, leading to the faster introduction of newer and purer seed for the established varieties. (The present Karnak nucleus, the F₁₃ family, is believed to be the purest nucleus ever available for an Egyptian variety, and begins to circulate in the commercial crop at the fourth or fifth year of expansion from a single plant). Opportunities for selection remain even after many generations of in-breeding; and so far as the operation of the system is concerned, it is largely immaterial whether the source of variation is initial impurity not yet removed, or new mutations within the variety, or contamination introduced by accident from outside; the methods of selection are equally appropriate for all the possibilities. As regards seed elimination, the spinning-test method was adopted for all varieties of higher quality than Menoufi, all commercial seed submitted for examination under the Seed Control Law being allowed for sowing only if its lint passed the spinning standards, lot by lot. This is the direct test for deterioration, independent of the presence of hidden off-types in plants or seeds.

As a result of all the forces operating, the commercial crop of Malaki in 1944 was restored in yarn strength to the level of the nucleus family, below which it had fallen for some years; and Karnak in the same year, the fifth after its introduction at the stage of 1,000 acres, showed no measurable deterioration by commercial standards. The case of Malaki was interesting rather than important, for it was only a small crop; but Karnak in 1944 covered over half a million acres. Control of deterioration, if it remains successful in a crop of this size, will represent the saving of immense sums. Unfortunately it was not possible to confirm if the commercial crops of Sakel and Sakha 4 could have been restored to the strength level of their nucleus families; both varieties died out the year after the new method of elimination was introduced.

It will be noticed that the method of seed elimination based on spinning-tests is applied to the long-stapled varieties only, in which deterioration is apt to be the most marked. Application of the method to all varieties is not yet feasible because of various technical difficulties, of which perhaps the chief is that environmental factors increase in relative importance in the shorter staples; and elimination is therefore less efficient. These difficulties may be overcome in the projected Dated Seed System, which will provide a means to identify seed after it has circulated for a certain number
of years, whether it shows measurable deterioration or not. The first steps have been taken to put this system into operation, by dating the seed of all varieties issued. The virtues of such a system are very apparent; thus it is hoped that a pedigree system carried right through the commercial crop, as well as inside the plant breeding system, will soon come to be accepted as a matter of course.

**Clearing Away Suspicion.**—One final observation remains to be made; it concerns the spinning quality of cotton grown from ordinary commercial seed, the average of hundreds of seed samples sent up for examination from ordinary commercial sources. Representative samples of Malaki, Karnak, Sakel, Sakha 4, and others, have been sown over the course of years on Ministry of Agriculture farms. The cotton thus obtained was found to give yarn of the same quality, within the limits of significance, as samples of similar grade drawn from exporters’ deliveries.

Those aspersions on the fair dealing of Alexandria merchants, mentioned earlier in this account, were thus shown to be quite unfounded. If there had been fraudulent mixing of lint on any considerable scale, the fact would have been disclosed by these Ministry of Agriculture growings of commercial seed. And by the same test, all others in the line of transit from grower to exporter were given a clean sheet; they passed on the cotton as they received it from the grower. The whole onus of responsibility for deterioration was thus thrown upon the seed.

One of the most unfortunate aspects of deterioration was the suspicion of bad faith it aroused throughout the industry. Such doubts were perhaps inevitable when deterioration was widespread, and its origin so mysterious. That the whole responsibility had to be thrown upon the seed, was particularly difficult for growers to believe, when they could see the crop improving in (apparent) uniformity before their eyes. Correspondingly, exporters doubted the good faith of growers, of gimmers, and of interior merchants; and spinners probably mistrusted all concerned. Nor did the spinners wholly escape; there was a general suspicion that they overstated their case. The unwanted genes thus have much to answer for, over and above the enormous losses they caused; and doubt and suspicion will probably remain so long as there is deterioration. Fortunately there is clear evidence that the insidious forces at work are being rapidly overcome, and we may not be troubled with the problem much longer in Egypt.

Even though the commercial crop has suffered serious deterioration in the recent past, plant breeders had already found how to maintain a renewal nucleus intact, and how to keep it intact indefinitely. There has been no measurable deterioration in the nucleus families, and the plant breeders are in a position to supply good seed so long as there is a demand for it. It was very significant that the writer could obtain Sakel seed fully up to standard at least as 1942, when the crop as a whole had utterly fallen. No such pure seed was available for Yoannovitch, Mit Afifi, or Gallini as they died out, those varieties then being entirely lost and dispersed.

Considerable advances have thus been made in knowledge, and in application of that knowledge to the devising of better technical methods. The work of the past five or ten years is only just beginning to take effect on the crop, and it will not be until about the year 1950 that we can know for certain if the problems have been satisfactorily solved. When that time arrives, spinners’ opinions on the subject of deterioration will be awaited in Egypt with no little interest.

**Summary**

In extreme cases, deterioration in a variety led to a fall in yarn strength amounting to about 20 per cent. With Sakel, which was badly deteriorated at the end of its life, the yield and ginning out-turn did not change appreci-
ably, but the staple became shorter, weaker and browner—a total result that could not be simulated by direct mixing of any combination of ordinary Egyptian cottons. Deterioration in general is ascribed to the dispersal of minor genes which can be regarded as the ‘‘wild-type’’ most suited to the environment and to the polygenic system operating. These minor genes, and certain major genes, have a strong selective advantage in varieties carried to a high economic level by human selection, in which the objectives are quite different from the objectives in natural selection. Any kind of impurity is apt to be seized upon by the crops for the promotion of their own ends.

Deterioration reached serious proportions in Sakel and Sakha 4 owing to defects in the method of examination under the Seed Control Law. The offtypes chiefly responsible for deterioration were indistinguishable from normal plants and seeds, but only those lots containing visible offtypes were eliminated by operations, under the Law. The result demonstrated the extreme importance of methods for the detection and elimination of bad seed, because ample good seed was available although not in demand. Continuous attention has been paid at Giza to the initial purity of seed, and to its further protection; but seed cannot be kept pure in bulk, and increased attention is being paid to methods of elimination. Elimination of seed for the long staples is now based on spinning quality, and a Dated Seed System to be applied to all varieties, is projected.

References

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Cotton Research Board,
Orman, Giza, Egypt.

Received 26/9/44

Appendix I

Analysis of Variance, Data of Table VI

In the calculation of variance, deviations normally are measured from the mean of all values; and when the present data were tested for significance in an earlier paper (Uses and Accuracy of Spinning-Tests on 60-gram Samples) the standard procedure was followed. An unusual point arises in regard to the distribution of these strength values, however, when the origin of the seed is considered: all the commercial lots have deteriorated, so that their strength values deviate from the renewal nucleus value in the minus direction only.
Another analysis of variance was therefore carried out, deviations being measured from the renewal nucleus value, and not from the mean. As in Table III of the earlier paper, genetic variance is assumed to be the residual, after spinning and sampling variances are subtracted from the total variance. On halving the sampling variance shown in that Table, and quartering the spinning variance, we obtain the components of variance for the 4-point means of Table VI now under discussion, these being the means of two spinnings on each of two repetitions. Results by this method of calculation, and also by the standard method based on deviations from the mean, are shown in Table X. Results for Ashmouni are also included, deviations for this variety being measured from the value for propagation seed, since none of the commercial lots was derived from a renewal nucleus with so high a strength value as the 1944 nucleus used as control.

Significance can be determined only by the standard method; but a much better estimate of the genetic factor is given by the second method, although the reference point has a greatly reduced number of degrees of freedom. Spinning and sampling variances are the same by either method. I am indebted to Dr. W. L. Balls for drawing my attention to this unusual point.

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>Malaki Variance</th>
<th>S.D.</th>
<th>Sakel Variance</th>
<th>S.D.</th>
<th>Ashmouni Variance</th>
<th>S.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Based on Deviations from the Mean</td>
<td>Genetic 5,050</td>
<td>71</td>
<td>19,250</td>
<td>139</td>
<td>107</td>
<td>10</td>
</tr>
<tr>
<td>Spinning 825</td>
<td>29</td>
<td>675</td>
<td>20</td>
<td>742</td>
<td>27</td>
<td></td>
</tr>
<tr>
<td>Sampling 1,175</td>
<td>34</td>
<td>1,525</td>
<td>30</td>
<td>688</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>Total 7,030</td>
<td>84</td>
<td>21,450</td>
<td>146</td>
<td>1,537</td>
<td>39</td>
<td></td>
</tr>
<tr>
<td>Based on Deviations from the Renewal Nucleus Value</td>
<td>Genetic 181</td>
<td>29</td>
<td>500</td>
<td>26</td>
<td>132</td>
<td>27</td>
</tr>
<tr>
<td>Spinning 34</td>
<td>39</td>
<td>26</td>
<td>26</td>
<td>26</td>
<td></td>
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<tr>
<td>Total 187</td>
<td>503</td>
<td>138</td>
<td>138</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Acknowledgments.—The writer owes a considerable debt to Dr. W. L. Balls for encouragement and advice; to the Director of the Botanical Section and to the Giza plant breeders for their courtesy in supplying data; to Mr. J. B. Hutchinson both for criticism, and for the stimulus of the questions in his paper to the 3rd E.C.G.C. Conference on Cotton Growing Problems; and to Dr. James Philp for his valued criticism of the first manuscript.
THE JOURNAL OF THE
TEXTILE INSTITUTE

ABSTRACTS

1—FIBRES AND THEIR PRODUCTION

(B)—ANIMAL

Mulberry Leaves: Chemical Composition. S. J. Demianovski and N. G. Doman. Biochimia, 1944, 9, 360-364 (through Brit. Abstracts, 1945, A III, 412). Protein, carbohydrate, and cellulose were determined on different parts of leaves of the mulberry (Morus alba). The food value of the leaves for silkworms is determined mainly by the nature and amount of proteins and carbohydrates and, in less degree, by the nature and level of the mineral content.

Silk: Production in India. Mysore Board of Sericulture. Indian Text. J., 1945, 55, 649. A list is given of proposals involving an expenditure of nearly £100,000 for improving sericulture in Mysore. A research institute is to be opened at Channapatna, at a cost of about £20,000.

Maltese Mulberry Silk Cocoons: Quality. Bull. Imperial Institute, 1945, 43, 86-87. Silk cocoon raising trials have been carried out by the Department of Agriculture in Malta with eggs from Cyprus. The sample submitted to the Imperial Institute comprised good, promising cocoons. The absence of diseased, insect attacked and dead cocoons indicated good sericultural methods. The Maltese cocoons were on the average larger and bolder but less regular in size and much less uniform in colour than Cyprus cocoons. They were also less firm and somewhat coarser in surface texture.

(C)—VEGETABLE

Internal Boll Rot Disease: Control in Peru through Selection. T. B. Barducci, G. G. Rada and J. Wille. Nature, 1945, 156, 235-236. Great damage to the cotton crop in Northern Peru is caused by the cotton stainer (Dysdercus sp.). Known methods, such as observation of the time of planting and picking, destruction of host plants, trapping of insects or use of insecticides were of little success. Isolations from internal diseased bolls and cultures were made from four micro-organisms and a series of inoculation tests carried out. A few plants from four strains showed resistance to infection. On comparing results with those of Steyaert in the Belgian Congo it seems that Peruvian cotton varieties are genetically more resistant to infection by fungi producing internal rot of the cotton bolls, transmitted by the “arrebiatado” punctures than American varieties.

Punjab-American Cotton Plant: Manuring and Tirak Disease. R. H. Dastur and S. Singh. Indian J. Agric. Res., 1944, 14, 325-332. A concise account is given of the practical aspects of cotton manuring, with special reference to the effect of nitrogen application as sulphate of ammonia, in combination with varied levels of other factors, in order to avoid tirak symptoms in the Punjab-American cottons on light sandy soils. The different strains of cotton were found to respond to nitrogen in the order of their yielding capacity.

DDT Insecticide: Application against Cotton Insects. U. C. Loftin. U.S. Dept. Agr., Bur. Entomol. Plant Quarantine, 1945, E-657, 6 pp. (through Chem. Abstr., 1945, 39, 3109). DDT was not so effective as Ca arsenate against the boll weevil. It was ineffective against the cotton leafworm and the cotton aphid. There were indications that red spiders were increased somewhat by DDT dusting. DDT was effective against plant bugs and stink bugs, cotton flea hopper, cotton bollworm, and especially the pink bollworm. One application of a 3 per cent. DDT dust gave a very good kill of a heavy infestation of Thrips tabaci Lind. and Frankliniella fuscus Hinds on cotton.
Indian Cotton Contract: Operation. K. R. Marfatia. *Indian Text. J.*, 1945, 55, 611-616. Experience of futures trading under the new Indian Cotton Contract of July, 1942, is reviewed and modifications necessitated by the buying policy of the Government of India are discussed. The main features of the amended contract now operating are set out under 18 headings, dealing with the basis, grades, staples, premiums and so forth.

Cotton Plant: Selection in Nigeria. *Ann. Report Agric. Dept., Nigeria*, 1943, 34 pages. The following references to cotton production are noted (pp. 22 and 23). Two bulk strains of Ishan cotton were tested for yield, half arising from self-pollination, the rest from open pollination. On the average, self-pollination did not appear to depress yields. In the northern provinces a very successful strain 26C (a derivative from D3) has been developed which yielded 100 per cent. more than the standard B.C.G.A. Allen from Zaria, and was slightly stronger than ordinary Allen.

Long Staple Cotton: Production in India (Sind). R. Sankaran. *Indian Farming*, 1945, 6, 257-259. A survey is given of the attempts made in Sind to evolve healthy long-staple cotton. The range of variability present in the material at hand offers wide possibilities for judicious selection work.

Queensland Cotton Soils: Significance of Carbon-Nitrogen Ratio. F. Hardy. *Tropical Agriculture*, 1945, 22, 119-127. Results are presented of the analysis of representative samples of Queensland soils supporting cotton plants prone to "bolting," i.e. the development of unfruitful rank growths susceptible to insect attack. These soils are characterised by relatively low C:N ratios. They are the "Red Earth" soils. Alluvial soils are satisfactory and "Black Earth" soils intermediate. Bolting of cotton has been shown to be a physiological phenomenon associated with high rates of nitrate production in the soil which is a feature of low C/N ratio soils under certain moisture conditions. Fresh soils can bear early satisfactory crops, whereas during successive cropings the bolting increases ("new land" effect). Several factors which decide the suitability of the soil and the site for successful cotton-growing in Queensland are discussed.

Sea Island Cotton: Production in the West Indies. West Indian Sea Island Cotton Association. *Reports of 8th, 9th and Extraordinary General Meetings, 1943 and 1944* (1944, 14 pages). The following particulars are noted: (1) The crop of Sea Island cotton in the British West Indies amounted to 3,365,400 lb. of lint in 1940-41, nearly 2,600,000 lb. in 1941-42, and nearly 1,600,000 lb. in 1942-43. (2) The work of cotton breeders is reported. (3) The competitive power of Montserrat Sea Island cotton against newer Egyptian strains is emphasised. (4) Agricultural problems in the various cotton islands are reviewed.

Root-rot Disease of Cotton: Relation to Root-rot in other Crops. N. Prasad. *Indian J. Agric. Sci.*, 1944, 14, 388-391. As it has been observed that crops such as sesameum, guar, etc., suffer from root-rot, an investigation was undertaken to find out whether the disease in different crops is the same as in cotton in Sind. Isolations were made and infection tests carried out. *Fusaria* and *Rhizoctonia* were isolated and it has been established that they belong to the species *Fusarium cavernulum* (Lib) Sace, and *Rhizoctonia bataticola* (Taub.) Butl., respectively, which are also associated with root-rot of cotton in Sind.

Root-rot Diseased Cotton Plants: Leaf Temperatures. R. Sakai Vasudeva. *Indian J. Agric. Sci.*, 1944, 14, 385-388. The leaf temperatures were recorded by a thermo-electrical method during a number of days on healthy and diseased cotton plants. Determinations of the leaf surface and inner tissue temperatures were made simultaneously and the data are tabulated. It was observed that leaves on diseased plants had a higher temperature and lower rate of transpiration.

Pink Bollworm: Occurrence in Nigeria. F. D. Golding. *Empire Cotton Growing Rev.*, 1945, 22, 1-2. The presence of pink bollworm, *Platyedra*, has been recorded in Nigeria, and two adults were bred from resting larvae in cottonseed stored near Zaria. Pink bollworm is at present rare in the Nigerian American cotton belt, but has recently been found to be widely distributed.
in native cotton areas. Some information has been obtained of the larval resting stage. Reference is made to surveys by other authors; the pink bollworm seems to have been found in French West Africa.

**Milkwed: Utilisation in the Paper Industry.** L. V. Forman and D. Niemeyer. Paper Trade J., 1945, 121, TAPPI, 95-100. The pulping characteristics of the principal fibrous components of the milkwed stem were investigated from the standpoint of their potential use as a raw material in the paper and paperboard industry. These components were the whole stalk, the bast fibre and the woody material of the stalk. Bleached pulp made from whole milkwed stalk is not likely to be able to compete on an economical basis with the common bleached pulps. The bast fibre separated from milkwed stalk gives a pulp similar to flax pulp and might be used in the manufacture of cigarette paper. In view of its low yield, however, it would be necessary to find a use for the woody fraction. The use of kraft cuttings and kraft waste with the milkwed rejects seems feasible as the latter would add stiffness to the kraft board and might improve its strength. Whole milkwed stems might be used as a substitute for straw and certain repulped waste papers.

**Cellulose Acetate Fibres: Improvement of Extensibility.** L. Vinel. Ind. textile, 1944, 61, 9-10 (through Chem. Abstr., 1945, 39, 31637). Stretched acetate-rayon threads have an extensibility in the dry state of not more than 5-2 per cent. Treatment of the fibres with a mixture of swelling reagents is only moderately successful. More efficient is a process developed by the Rhodiaeta firm in which a mixture of chloroform and ethyl acetate is used at —25° to +5° C.; 5 per cent. of acetone, etc., may be added. This treatment increases the extensibility up to 12-3 per cent., but decreases slightly the tear resistance. The thread thus treated can be saponified with but slight loss in strength.

**High-molecular Wood Celluloses: Isolation and Properties.** N. Gralen and B. Rænby. "The Svedberg" Commemoration Vol., 1944, 274-287. By a mild sulphite cooking, which is broken off before the complete disintegration of the wood structure, it is possible to obtain wood celluloses of very high molecular weights. The authors describe studies of the usual type on the molecular magnitude of such products. Viscosity measurements were performed in cuprammonium and sedimentation and diffusion measurements were made on the nitration products dissolved in acetone. The highest degrees of polymerisation obtained are about 9,000; the molecules are of the same order of size as those of native fibre cellulose. By polydispersity measurements it has been found that the sulphite process possibly has a homogenising effect on the cellulose, when most of the lignin has been removed from the wood.

**Sulphite Pulp: Production; Chemistry.** S. Ulfsparre. "The Svedberg" Commemoration Vol., 1944, 379-399. A bibliographical review of the chemical reactions taking place when wood is digested with sulphite cooking acid is given under the headings: Sulphonation of lignin, Dissolution of lignin sulphonic acid, Properties of dissolved lignin sulphonic acid, Dissolution of wood polyoses, Wood cellulose (characterisation), and Significance of the final tem-
perature and the lime content in the cooking of pulp for rayon. There are 72 references. C.

Wood Cellulose: Applications in Rayon Manufacture. A. Waller. “The Svedberg” Commemoration Vol., 1944, 400-412. Industrial processes using pulp as raw material are reviewed, and the possibilities for using wood instead of cotton linters as a cellulose source are discussed. Analytical figures are presented for viscose cellulose from cotton linters, spruce, deciduous wood, reeds and pine, and some European high-a celluloses are compared. C.

Nylon: Development. H. L. Maxwell. Iowa State College J. Sci., 1945, 19, 263-268. In the course of a paper on “Chemistry at Work” reference is made to nylon. The problem of the selection of construction materials for nylon plants is briefly discussed, and a short review is given of the rapid development of nylon production. C.

**PATENTS**

**Linear Fibre-forming Polyamides from Poly-functional Acids: Production.** E. I. Du Pont de Nemours & Co. B.P.570,858 of 25/7/1945 (Conv. 27/8/1942). The claim is for the condensation of diprim ary diamines (e.g. hexa- or deca-m ethylenediamine) with a tricarboxylic acid (e.g. tricarballylic acid) or a tetracarboxylic acid (e.g. pyromellitic acid) to fibre-forming polyamides. C.

**Peanut Protein: Preparation.** Sarah N. McGeoch and Imperial Chemical Industries Ltd. B.P.570,908 of 6/12/1943:27/7/1945. A difficulty encountered in the spinning of filaments from alkaline solutions of peanut globulin is a tendency to surface gelation that begins at the liquid/air interface and spreads into the body of the solution. It is now reported that this is aggravated by the presence of seed testa in the peanut meal and that there is a minimum alkalinity of the solution used for extracting the globulin above which gelation of the extract does not occur if the testa is absent. Accordingly, peanuts are crushed and the fragments of testa are removed by means of air currents, the oil is then extracted by means of petrol, and the extracted meal is ground to a fine grist, moistened with water and extracted with alkali the quantity and concentration, allowing for the water, being 10 parts of 0-2 per cent. alkali to one part of meal. The pH of the extract, about 11-0-11-2, is then brought to about 5 by reaction with sulphur dioxide and the precipitated globulin fraction is collected. C.

**Vinylidene Chlorofluoride Polymers: Production and Application.** American Viscose Corporation and F. G. Pearson. B.P.570,941 of 30/7/1945 (Conv. 31/3/1943). Vinylidene chlorofluoride is obtained from trichloroethylene or methylchloroform by suitable stages [e.g. CHCl:CCI + (HCl + ACI)l→ CH2Cl:CCI + (HF + SiCl4)→CH2Cl:CCI,F + (Zn + EtOH)→CH2:F] . The monomer, b.p. –10° C., suffers polymerisation under the influence of a catalyst and light. Preferably, 79 parts by weight in 20 parts of acetone are mixed with 1 part of benzoyl peroxide, 1 part of lead tetraethyl and a trace of uranium acetate, and exposed in a sealed tube to ultraviolet light for 2 to 3 days. The higher polymers, m.p. above 60° C., are useful for extrusion into filaments, for films, and for use as rubbery coatings or adhesives. Filaments have rubbery elasticity and recover from extensions up to about 500 per cent. C.

**Spinneret Cleaning Machine.** American Viscose Corporation. B.P.570,959 of 31/7/1945 (Conv. 6/6/1942). Apparatus for cleaning spinnerets and other objects having indentations or perforations, comprises means for holding the object, spraying it with cleaning liquid and oscillating it back and forth past the spray. C.

**Cellulose Acetate: Preparation.** British Celanese Ltd. B.P.571,010 of 1/8/1945 (Conv. 29/10/1942). Cellulose is acetylated in the presence of sulphuric acid (e.g. 170 parts of cotton +358 of Ac.O +2050 of AcOH +25 of H2SO4, for 6 hours at room temp. to 36° C.), water is added (50 parts) and ripened is conducted (35° C., 30 hours) until the acetic acid yield of the product is 50 per cent., and the ester is precipitated by an excess of water, dissolved in acetic acid (1500 parts +255 parts of water) and ripened further in the presence of an aliphatic poly-carboxylic acid (e.g. 0-85 part of oxalic or tartaric acid at 80° C. for 22-32 hours). C.
Pigmented Linear Polyamides: Production. E. I. Du Pont de Nemours & Co. B.P.571,018 of 2/8/1945 (Conv. 13/5/1942). Pigmented linear polyamides are formed by beating an aqueous dispersion containing the reagents required to give the linear polyamide, a finely divided pigment, and a protective colloid.

Casein Solution: Dry Spinning. Rudolf Signer (Berne). B.P.571,468 of 27/8/1945 (Conv. 15/1/1942). The temperature over which an alkaline casein mass can be successfully spun by the dry method can be extended by adding oleic acid or an oleic acid soap to the mass. For example, a mass containing casein (245 gm.), caustic soda (103 gm. of 3-561*), oleic acid (3 gm.), and water (64.9 gm.) can be spun over the range 31-45° C. That is, the thread would break if the nozzle is colder, or drip if hotter. At 37° C. the mass can be delivered at a rate of 0-06 gm. per minute, and the withdrawal may be varied from 6 to 25 metres per minute, giving filaments of 25-6 denier. Five other examples are recorded.

Baobab Tree Wood: Collection for Pulping. B. E. D. Kilburn (for L. P. W. Keys, Johannesburg). B.P.571,469 of 1/4/1943:27/8/1945. It is reported that trees of the species Adansonia digitata (baobab, cream-of-tartar tree or monkey tree) yield a fibre that is rich in high-grade cellulose. The invention is a method by which the outer wood is peeled off in strips about 1 in. thick and 5 ft. or more long and baled for export. The stripping may be done on the standing or fallen tree and the tree may first be pounded to loosen the fibre.

2—CONVERSION OF FIBRES INTO FINISHED YARNS

(A)—Preparatory Processes

Rayon Fibres: Blending. B. McComb. Rayon Textile Monthly, 1945, 26, 225-226. The writer enumerates the principles to be observed in the blending of rayon fibres, thus: (1) Coarse fibres limit the yarn count; (2) fine fibres should be used if strength is required in the cloth; (3) a range of lustre can be secured by blending lustrous and matt fibres; (4) twist is important for the control of light reflection; (5) for men’s wear blend lustrous rayon staple with wool top; (6) for a crisp finish use coarse fibre; (7) for soft, sheer fabrics for fine dress goods, use fine fibre; (8) for novelty effects, blend viscose and acetate fibre; (9) for hosiery, Aralac in 7, 5 or 3 den., if in. staple, gives useful combinations with viscose and/or acetate fibre, or wool top.


Post-war Woollen Carding Machines. “McHine.” Text. Merc., 1945, 112, 667-669, 693-694. Improvements suggested are the use of outside drives, a more positive driving action for workers and strippers, quickly-detachable grids fitted beneath each swift, and wider use of the garnett clothed breast. Other subjects discussed are:—types of bearings; the number of workers per swift; the best position for the Peralta device; mechanisms for transferring the raw material from the scribbler to the carder, the advantages of the parallel fibre feed being stated; the width of the machine. The merits of wood and iron for rollers are compared, attention being drawn to the possible use of alloys and plastics. The Continental practice of fitting covers over the fancy is justified, as higher speeds are accompanied by increased air currents which tend to move the material upon the rollers.

(B)—Spinning and Doubling

“Cedar” Mule Wiping-down Motion. Philipson & Co. Ltd. Textile Weekly, 1945, 36, 492-6. Particulars and diagrams are given of a motion that consists of (a) a small polished, leather-backed plate for wiping the roller beam and (b) a carriage wiper that moves from the headstock to the end of the mule while (a) moves in the reverse direction, both (a) and (b) moving the full length of the mule stretch at each draw. Attached to a mule spinning 14s on paste cop bottoms it wipes down the machine roughly every two minutes.

frame capable of spinning yarns finer than 200s. The system of top rollers is: front, loose boss fitted with roller bearings, leather covered, \( \frac{1}{4} \) in. diam.; 2nd, aluminium, \( \frac{1}{8} \) in.; 3rd, \( \frac{1}{6} \) in.; back, 2 in. (II) A brief, illustrated description is given of an inclined mule spindle ring frame, and its advantages are enumerated with special reference to the fact that the yarn produced resembles mule yarn in softness.

**Spinning Mule: Lubrication and Prevention of Mule Spinners' Cancer.** Sub-Committee D, Ministry of Labour. *Textile Weekly*, 1945, 36, 398, 400, 450. Particulars are given of a specification for relatively non-carcinogenic oils on the basis of density and refractive index. It is recommended that a copy of a certificate from the suppliers of the oil to the effect that the oil conforms to the specification should be exhibited (in the mule room), together with a certificate of an annual test by the Shirley Institute. The need for radical reform in the oiling of spindles is stressed. It is also recommended that wiping-down motions shall be provided on all mules.


**Rayon Staple: Spinning.** F. S. Culpepper. *Textile Manufacturer*, 1945, 71, 329-330 (from *Textile Age*, Feb., March, 1945). Practical advice is given on the processing of rayon staple on cotton machinery. It is reported that the output of rayon staple in the United States reached 162 million lb. in 1943, of which 15 per cent. was acetate fibre. Particulars are given of the available deniers and staple lengths. Rayon staple should definitely be carded and not merely passed through the machine as fast as possible.

**Plexon Yarns: Qualities.** Freydberg Bros.-Strauss Inc. *Rayon Textile Monthly*, 1945, 26, 276. It is reported that the plastic-coated yarns known as "Plexon," which are resistant to moisture, perspiration, grease, mild acids, etc., are now available in 120 shades and finished with a range of 17 plastics.

**Converting Fibres into Finished Yarns (Patents)**

- Speed-frame Bobbin Driving Wheel Support. F. Blomley and Tweedales and Smalley Ltd. B.P. 571,194 of 11/12/1943:10/8/1945. The claim is for a tubular support for a bobbin driving wheel for use in slubbing, intermediate and roving frames in which the flat surface on which the base or bottom flange of the wheel rests is formed with a recess or upstanding flange that constitutes the wall of an oil well.

- Cotton Yarns and Cords: Strengthening by Treatment with Abietic Acid Derivatives. T. A. Clayton (for United States Rubber Co.). B.P. 571,358 of 14/10/1943:21/8/1945. Cotton yarns and cords are treated with an aqueous solution of an abietic acid derivative (Na abietate, hydrogenated Na abietate, or abietene sodium sulphate), stretched (preferably after removing excess solution) and washed with hot water (preferably of zero hardness). Increases of strength result, the amount depending on the temperature of the washing water. Thus at 160° F. an increase of 36.7 per cent. was obtained and boiling water gave an increase of 42 per cent.

- Condenser Card Rubbing Motion Variable-speed Driving Mechanism. Platt Bros. & Co. Ltd. and I. Marsden. B.P. 571,386 of 4/1/1944:22/8/1945. The claim is for the application of variable speed gear to the driving mechanism for the rubbing motion of the tape condensers of cards for wool or waste. Improved rovings are secured.

- Spindle Bearing. T. S. Whittle, T. S. Turner and E. S. Alexander. B.P. 571,427 of 17/2/1944:23/8/1945. The claim is for reduced friction and absence of vibration in the spindles of spinning, doubling and like frames by...
combining a roller bearing for the top journal with a supporting ball thrust bearing. Alternative or additional support may be provided by a narrow blade spring that bears against the bearing sleeve.

3—CONVERSION OF YARNS INTO FABRICS

(A)—PREPARATORY PROCESSES

Swiss Textile Machinery: Developments. Textile Recorder, 1945, 63, August, 48-49. Brief particulars are given of the specialities marketed by the "Four of Horgen," viz., Messrs. Schweiter Ltd. (winding machines), Staubli Bros. & Co. (dobbies and looms), Sam Vollenweider (cloth cropping, clipping and shearing machines) and Grob & Co. (healds and accessories). A table compares the maximum number of Grob flat steel healds and steel wire healds per shaft and per centimetre.

Winding and Warping Machinery. Dixon, Hawkesworth Ltd. (Middleton). Silk J. Rayon World, 1945, 21, August, 38, 42; Textile Recorder, 1945, 63, August, 52, 54. Brief, illustrated descriptions are given of the following: (1) a cone and cheese winding machine of the spindleless type having self-aligning cone centres to dispense with mandrels, and capable of winding at 200 to 800 yards per minute, (2) a magazine creel in which the parts are clamped in place and can be adjusted easily in any direction, and (3) a beam-lifting machine, the drum of which can be expanded from 54 to 63 ins. wide by turning hand-wheels, and is provided with mechanism for lifting the beam onto a truck.

Bobbins: Winding. H. E. Wenrich. Rayon Textile Monthly, 1945, 26, 230-232. Practical advice is given on the winding of bobbins to weave with a minimum number of defects. Illustrations are given of finger and disc tensioning devices, bunch-building motions and various systems of re-winding large packages of yarn into bobbins.

(B)—SIZING


Rayon Warp Sizing Materials: Evaluation. G. B. Frankenberg, A. M. Sookne and M. Harris. Rayon Textile Monthly, 1945, 26, 165-8, 227-8, 285-6. The authors report on an exhaustive study of the sizing of rayon staple warps made with the view to finding simple tests for assessing the value of sizing agents. Starches, gelatin, soluble synthetic plastics, and several blends of these materials, were applied and the warps were woven into cloth. Records were kept of warp breaks and fibre shedding and the warp and cloth were tested for strength and other properties. Films of the sizes were cast on chromium-plated ferrotype plates bonded to plate glass and the films were tested for strength, hardness, and deformability. The results establish, in general, fairly consistent relationships between sizing efficiency and deformability and hardness of the films and stiffness of the cloth, but not between weaving quality and warp strength. Softeners of the type of oils and tallow appear to contribute a lubricating effect that is not given by glycerin. The data recorded are: (1) Particulars of the adhesives; (2) Size compositions and temperatures of application; (3) Weaving efficiencies (loom stops per 1,000 picks and amount of fibre shedding), amounts of size on the yarn and cloth, and viscosities of the sizes; (4) Yarn and cloth breaking loads, extensions, resistances to abrasion, cloth stiffness and loom stops; (5) Film strengths, folding endurances and hardness; (6) Elongation/time curves of films under various loads; (7) Plots of loom stops against stiffness, ratings of the fabrics and hardnesses of the films.

(C)—WEAVING

Saurer 100 W Loom. Crowther Ltd. Silk J. Rayon World, 1945, 21, August, 40-42; Textile Recorder, 1945, 63, August, 50-51. A broad description is given of the special features of this loom, which differs from others in that the frame ends are boxes that house all the gearing to which access is not generally required, the boxes being joined by tubular ties.
Picking Tappet: Design. S. S. Ahluwalia. Indian Textile J., 1945, 55, 717-720. The importance of the picking motion for the smooth working of a loom is discussed. The desired motion of the shuttle is described and the time-velocity curve for picking is determined for a particular case. The design of a correct picking tappet is demonstrated and the effect on it of picks per minute, weight of the shuttle, length of the shuttle, and reed space of the loom are discussed.

Automatic Loom Bobbin Magazine: Replenishing. H. E. Wenrich. Rayon Textile Monthly, 1945, 26, 281-283. Advice is given on the training of learners to become proficient in the systematic replenishment of bobbin magazines.

Split Selvedges: Weaving. Textile Mercury & Argus, 1945, 113, 295-297. For weaving narrow fabrics side by side in a wide loom, it is customary to weave the inside selvedges as ' 'splits' ' with two or more threads half crossing around each other as in gauze and leno weaves. The writer explains the ' 'top doup' ' and ' 'bottom doup' ' methods for weaving these special, well-locked threads. The crossing end is usually 60s/4 Egyptian cotton and the best two-fold yarn is used for the standing end. With cloths that have to be finished under high pressure there is a risk of the 60s/4 yarn cutting the cloth. This may be overcome by using two standing threads.

(G)—Fabrics

Parachute Cloth: Manufacture in India. K. N. Tiku. Indian Text. J., 1945, 55, 625-626. Practical advice is given on the soaking, warping, weaving and degumming of silk yarn and cloth for parachutes, weaving particulars being provided for four sorts. Suitable Indian silk yarn is derived from Kashmir and Irani cocoons.


Cellulose Acetate Lint-free Lens Cleaning Cloth. Superfine Lens Cleaner Co., New York. Rev. Sci. Instruments, 1945, 16, 226. A lint-free cloth, made of a special Celanese fabric, has been developed for cleaning and polishing lenses and precision optical surfaces. It is soft, non-abrasive, absorbent and washable, and retains its full effectiveness after laundering.

Cotton Textiles: Development for War. H. Y. Robinson. M/cr. Chamber of Commerce Monthly Record, 1945, 56, 144. A short review is given of the contribution of cotton textiles to the British war effort. Reference is made to flying suits for the Arctic made of special material developed by the Shirley Institute.

Patents

Embroidered Striped Interlock Fabric and Knitting Machine for Producing it. Edwin Wildt, H. H. Holmes, J. C. H. Hurd and Wildt and Co. Ltd. B.P. 570,930 of 6/9/1943:30/7/1945. A knitted fabric is claimed that has an interlock structure and embroidery plating consisting of lap or wrap stitch and/or loop effects combined with plain stitch portions of one or each web, producing horizontal stripes. Circular knitting machine mechanism of the multi-feeder type is modified for producing the fabric.

Straight Bar Knitting Machine. William Cotton Ltd. and W. A. Cooper. B.P.570,933 of 7/10/1943:30/7/1945. In straight-bar machines of Cotton's type, especially those equipped with automatic welt-turning mechanism, there is a tendency for the linear rate at which the take-up straps are wound on to the beam roller to differ from the rate at which the cords, by which the straps are unwound, are unwound from a second roller. To obviate this a spring coupling is used to connect the two rollers.

Winding Machine Cop Skewer Holder. C. B. Cummins. B.P.570,980 of 28/7/1944:31/7/1945. When coarse yarn on paste bottom cops is being wound, there is a bad tendency for the cop skewers to be pulled out of their holding brackets or ' 'jiggers.' ' This is overcome by securing to the jigger a length of spring steel wire that passes along the top of the jigger, then round the upper arm of the fork in which are the two holes into which the skewer is placed, and then to the underside of the arm where its end passes to one side of the upper (or lower) hole slightly in the path of the skewer. When
the skewer is placed in the jigger the spring wire is thus made to exert a grip.

C. Reinforced Textile Fabric Hot-air Duct. Thomas French and Sons Ltd. B.P. 571,237 of 8/3/1944: 13/8/1945. Tubes for conveying hot air (e.g. about 7 in. diameter for clearing ice from aeroplanes) are woven with suitable warp and weft for the main fabric and at the same time reinforcing warps (usually five) are woven in lengthwise except at intervals (3 or 4 inches) where gaps are left between these warps and the weft for the insertion of metal rings or coils that keep the tubes from collapsing. The reinforcing warps may be stout yarns, tapes or braids of bootlace type and may be arranged in pairs.

C. Loom Weft End Cutting Device. Sulzer Frères Soc. Anon. B.P. 571,341 of 21/8/1945 (Conv. 11/6/1942). The claim is for a device by which the ends of the weft threads that project from the selvedges (e.g. at cop changes on automatic looms, as loops in multiple-box looms and as loose ends in gripper looms) are bound by two sets of continuously twisted binding threads between which the cutting edge works to sever the ends while they are under tension. Each set of binding threads consists of two ends which are made to change position at each pick by the shedding mechanism. The severed set with its weft fragments is wound up on a bobbin device.

C. Flat Single Bed Beret Knitting Machine. Kangol Wear Ltd. and J. T. Saunders. B.P. 571,346 of 30/11/1943: 21/8/1945. In knitting articles like berets formed of roughly triangular sections it is usual for the machine to stop automatically after the pre-determined number of sections have been knitted so that the operative can insert a separation thread to indicate where the fabric must be severed. The invention now claimed is for means to do this automatically without stopping the machine. The extra mechanism is actuated by cams carried by a secondary shaft which is driven from the main shaft by two spring pawls to make one revolution for the pre-determined number of sections and brings its cams into play to hold down the needle selector mechanism, insert the separating thread and release the needle selector mechanism again.

C. Cellulose Ester Yarn Lubricant. British Celanese Ltd. B.P. 571,490 of 27/8/1945 (Conv. 3/10/1942). The claim is for compounded lubricants for yarns composed of or containing cellulose derivatives in which the ingredients are a mineral oil, a softening agent (an oxidised or sulphonated oil or sulphated alcohol, especially oxidised peanut oil), an alkylated phenol, a higher fatty acid and an alkylolaminate. These ingredients are defined in more specific terms and seven examples of the mixtures are given.

4—CHEMICAL AND FINISHING PROCESSES

(E)—Drying and Conditioning

Radiant Heat Sources: Applications in Finishing. H. Miedendorp. Rayon Textile Monthly, 1945, 26, 239-240. Brief notes are given on the use of “infra-red” gas burners and batteries of electric lamps for singeing, and drying textiles, with illustrations of some American appliances. Gold-plated copper or nickel reflectors are used by some makers.

(G)—Bleaching

Continuous Peroxide Bleaching Range: Application. Buffalo Electro-Chemical Co., Inc. Amer. Dyes. Rept., 1944, 33, 345-6; 365-8, 380; 385-8, 401; 405-7. A detailed account is given of a patented system of continuous peroxide bleaching, in which use is made of J-boxes for steaming the cloth in rope form or open width. The headings are: (1) Development (from 1931 onwards), (2) Operation, (3) Equipment, and (4) Adaptability (including economies of space, costs and service demands).

(I)—Dyeing

Artificial Fibres: Dyeing. H. G. Scull and H. De Witt Smith. Amer. Dyes. Rept., 1945, 37, 303-306 and 315-318. A report of a lecture. Characteristics important for the dyer, such as chemical reactivity, swelling behaviour and thermoplasticity of viscose rayon, cellulose acetate rayon, nylon and casein fibre are outlined and the methods in use for cloth dyeing are discussed.
Colour Technologists: Presbyopia. D. P. Knowland. *Amer. Dyes. Rept.*, 1945, 34, 308-310. Changes of colour vision due to age have been studied on a group of technicians, aged from 17 to 60 years. Older persons were found to see most dyeings yellower than young persons. C.

Dyed Cotton Union Cloths: Stripping. A. Ellis. *Textile Weekly*, 1945, 36, 412-420. Practical hints are given on the stripping of dyed cloths that may contain acetate or viscose rayon or jute. C.

Kier Waste Liquor: Application as Dye-bath Levelling Agent. A. M. Patel. *Indian Text. J.*, 1945, 55, 622-624. The author claims that spent kier liquor can effectively replace Dekol, Dispersol and other levelling agents in dyeing. The liquor is allowed to settle and 10-15 gallons of the clear liquor, of 1-5-2° Tw., are used for 100 gallons of dye bath. C.

Nylon Yarn and Fabrics: Processing. British Nylon Spinners Ltd. *Silk J. Rayon World*, 1945, 21, August, 24-27, 33. A concise account is given of the preparation, sizing, weaving and knitting of nylon yarn, setting nylon fabrics, and scouring and dyeing, with particular reference to the influence of the extensibility of the yarn under small loads. C.

Rayolanda and Wool Blends: Dyeing. Courtaulds Ltd. *Silk J. Rayon World*, 1945, 21, August, 28-29. Typical recipes and lists of suitable dyes are given for the dyeing of blends of Rayolanda and wool with the fast-to-milling ("aggregated") acid and Neolan d dyes. C.

Direct Cotton Dyes: History. C. M. Whittaker. *J. Soc. Dyers & Col.*, 1945, 61, 201-203. On the occasion of the diamond jubilee of the discovery of the first direct cotton dye, Congo Red, the author recalls the introduction of different dyes which marked definite progressive steps in the expansion of this group. C.

Sulphur Dyes: Review. W. Norton Jones, Jr. *Chem. Reviews*, 1945, 36, 291-313. A review collecting and presenting as much pertinent information as possible concerning sulphur dyes, giving a brief historical survey and discussing methods of preparation, general properties and the constitution of the dyes. There are 84 references. C.

Acid Dyes: Absorption by Wool, Silk, Casein Fibre and Nylon. B. G. Skinner and T. Vickerstaff. *J. Soc. Dyers & Col.*, 1945, 61, 193-201. Absorption experiments, covering a wide range of dye concentration up to saturation of the wool yarn have been carried out to fill some gaps in the authors' theory of the dyeing mechanism. The investigation is also extended to silk, casein and nylon yarns. Absorption isotherms are tabulated and graphed. It is assumed that dyeing takes place by attachment of dye molecules to active centres in the wool. The mode of attachment must be reversible in order to account for the phenomena of levelling. If the values of $C_B/C_F$ ($C_B$ and $C_F$ = concentrations of dye in the dyebath and on the fibre, respectively) are plotted against $C_B$ a straight line should result. This was confirmed experimentally at higher concentrations. At low concentrations a deviation is observed in the form of a second straight line representing a constant value of the ratio $C_B/C_F$. The existence of this constant value is confirmed by an investigation of the effects of competing inorganic anions on the dyeing system. Saturation values of Solway Blue B on the four different fibres have been determined. The values for wool and silk are in agreement with those found by other investigators. The absorption isotherms of casein fibre and wool at pH 1-6 are almost identical. This seems to indicate that the main difference between casein fibre and wool lies in their physical properties rather than in chemical structure. The dyeing mechanism of nylon seems to be similar to that of the other fibres. The effect of pH and other dyes on the saturation value of wool and the damage to wool by high concentration of dye has also been studied. C.


modern practice in the dyeing of viscose, cellulose acetate, casein and nylon materials.

**Narrow Fabrics: Package Dyeing.** H. A. Thomas. *J. Soc. Dyers & Col.*, 1945, 61, 185-193. Various methods for dyeing narrow fabrics are considered. The different ways of dyeing webbing and ribbons in hank form are outlined, but, technically and commercially, dyeing in roll form seems to offer the greatest advantages. Shrinkage in length is only 0.3-1 per cent. for roll dyeing, compared with 5-8 per cent. for hank processing, and shrinkage in width is absent. Webbing dyed in roll form is maintained in a flat condition whereas when dyed in hank form it often contains kinks and other distortions. Preparing and finishing operations conducted with rolls of narrow and wide fabrics are also satisfactory. Viscose rayon is better dyed in cake form. These conclusions are supported by details of a large number of experimental dyeings.

**Printing**

**Cellulose Acetate Rayon Fabrics: Hand Block Printing.** Silk J. Rayon World, 1945, 21, August, 22-23. A broad description is given of the process of hand block printing with particular reference to the production of white and colour discharge effects on acetate rayon fabrics.

**Glucose: Application in Printing.** A. M. Patel. *Indian Text. J.*, 1945, 55, 548-554. Because of the present cost of vat dye reducing agents of the hydrosulphite type, the author recommends a return to the earlier use of glucose and alkali. The old Schleper and Baum method (1882-83) is mentioned and experimental work is described to show that successful reduction of vat colours can be achieved with much less glucose and alkali than formerly employed. Several recipes are given.


**Azoic Screen Prints: Production.** Rayon Textile Monthly, 1945, 26, 246-7, 295-6. Practical hints are given on the development of azoic colours in screen printing on rayon, including airing, steaming and wet methods, development on drying cylinders, and the Rapidogen Developer N process. Recipes are provided.

**Finishing**

**Melamine Resins: Application in "Wet Strength" Paper.** C. G. Landes and C. S. Maxwell. *Paper Trade J.*, 1945, 121, TAPPI, 51-60. The introduction of a new process, involving addition to slush stock in the paper machine of small amounts of a melamine resin colloid, was followed by an immediate increase in the production and use of "wet strength" paper. The paper treated by this process was also found to have improved dry tensile and bursting strengths and folding endurance. Laboratory studies relating to the application of melamine resin colloid to paper have been carried out and the peculiar changes that occur when the resin is dissolved in acid and aged are discussed. Certain operating variables, such as point of resin addition, pulp hydration, age of resin resolution, pH and alum have been investigated. Certain special precautions must be taken in laboratory hand-sheet evaluations to insure reproducible results. A short discussion is given of studies relating to the fundamental mechanism of the new "wet strength" process.

**Phenol-Formaldehyde Resin Treated Cloth: Sublimation of Hydroxybenzyl Alcohols from —.** I. W. Ruderman. *J. Soc. Chem. Ind.*, 1945, 64, 204. A considerable quantity of white crystalline material was found to deposit in the exhaust stacks of tunnel dryers when paper or cloth impregnated with a commercial phenol-formaldehyde ammonia-catalysed resin was dried. On fractional crystallisation both o- and p-hydroxybenzyl alcohol were isolated and identified. The relative amounts of these two alcohols were found to vary, but the p-isomeride was generally in large excess.

**Army Tent Cloth: Coating with Plastics.** Resinous Products and Chemical Co. *Rayon Textile Monthly*, 1945, 26, 229. A brief account is given of the application of protective coatings to Army tent cloth in which "Paraplex" alkyd resins of a rubbery type provide a flexible finish and part of the resistance to water and act as a binding medium for flame-proofing and rot-proofing.
agents, and the Amberol resins are used as a grinding vehicle for the pigments and other agents.

**Vinyl-butyral Plastics: Applications in Finishing.** Monsanto Chemical Co. *Rayon Textile Monthly*, 1945, 26, 221. Mention is made of the post-war development of a range of fabrics and draperies (e.g. "unstainable tablecloths") that can be wiped clean with a damp cloth, in which the finish is secured by the application of very thin layers of "vinyl butyral."

**Wool Hose: Wet Chlorination.** W. M. Rush. *Text. World*, 1945, 95, No. 6, 115. To control felting shrinkage, lightweight and cushion-sole hose containing 50-70 per cent. wool are wet chlorinated in a rotary drum machine of monel metal, stainless steel or wood. The goods are first wet-out for 5 min. in a 1 per cent. borax solution at 65-75° F.; then sufficient of a separately-mixed solution containing 1 lb. calcium hypochlorite (70 per cent. available chlorine) and 2 gal. water is added during 10-15 min. to the bath to give a concentration of 41/2 per cent.; 1 per cent. sodium bisulphite is added and the bath run for 10-15 min. at the same temperature. The goods are then given 2 rinses in water at 110-120° F., each lasting 5 min. They are then dyed, using reduced amounts of dye.

**Calva Process for Treating Woolled Sheepskins and Loose Wool.** Plastics (Chicago), 1945, April, 3, 36-37, 39-40, 114 (through *Text. Res. J.*, 1945, 15, 265). [The process is covered by U.S.P.2,211,645, 2,240,388 and 2,348,602]. Sheepskin and similar materials are used to simulate expensive furs; the products are claimed to retain their lustre after repeated wear, dry-cleaning and exposure to rain. Shorn and unshorn sheepskins are treated to imitate short- and long-haired furs respectively. Two methods are used. (1) The tanned shearing is placed in a solution of cresol, alcohol, benzol and water maintained at 38° C. for 120 min., an acid being introduced for activating the keratin. It is then submerged in formaldehyde at 45° C. for 20 min. (2) The fur side of the pelt is brushed by hand with the same substances. In both methods the skin is then washed, dried, heated, clipped for uniform length, polished and dyed. It is assumed that the acid breaks the salt linkages between neighbouring polypeptide chains and also causes some hydrolysis; the free amino and imino groups then react with formaldehyde to form methylene links between the chains, a cresol-formaldehyde resin being formed within the fibre at the same time. Wool fibres which were kinky, permeable to water, and prone to mat, are straightened and rendered resistant to water, chemicals, and abrasive action. It is claimed that a felt indistinguishable from felt fur can be produced from shorn wool, and that bristle, cordage, carpeting and clothing can be converted into materials possessing new appearance and properties.


Insoluble Cellulose Derivatives: Production. Imperial Chemical Industries Ltd. B.P.570,853 of 25/7/1945 (Conv. 5/8/1942). Cellulose derivatives that do not dissolve in organic solvents or readily fuse are obtained by dissolving a cellulose derivative containing free OH groups (e.g. 15 parts of cellulose acetate having 54-5 per cent. of combined acetic acid) and a crystalline, monomeric polyalkoxymethyl-melamine (e.g. 11.5 parts of N:N'-tri-(ethoxy-methyl)-melamine) in a common solvent (e.g. 83 parts of acetone), evaporating the solvent and heating the mass (e.g. for 90 minutes at 160° C.). The “safe ironing point” of acetate rayon is increased thereby.

Two-toned Cellulose Ester Fabric: Production. Arthur Mellor and R. J. Mann (British Celanese Ltd.). B.P.570,880 of 24/9/1943:26/7/1945. The claim is for the production of cellulose ester fabric showing different tones on the two faces after dyeing, by the application to one face of an alkaline saponifying agent suitably thickened to prevent penetration.

Vinylidene Vapours: Application in Stiffening Cellulosic Fabrics. J. B. Speakman, T. Barr and Imperial Chemical Industries Ltd. B.P.570,883 of 29/9/1943:26/7/1945. Increased stiffness or firmness in handle, and reduced affinity for water vapour are secured by heating cellulosic materials in steam containing the vapour of styrene, an ester of acrylic or methacrylic acid, or a vinyl ester, so that a polymer is formed within the fibre. Increases in fabric weight of from 6 to 70 per cent. are mentioned in the examples.

Disazo Dyes for Wool and Silk. A. H. Knight, W. E. Stephen and Imperial Chemical Industries Ltd. B.P.570,972 of 2/12/1943:31/7/1945 (Addition to B.P.557,842). A range of disazo dyes that dye wool and silk from an acid bath in various fast shades of blue and black is prepared by diazotising an amine A and coupling it in an acid medium with 1-amin0-8-naphthol-3:6- or-4:6-disulphonic acid to form a monoazo compound Z, and coupling Z in an alkaline medium with a diazotised amine (B) of the general formula X-CO-NY-R-NH₂. The base A is defined as a primary aniline or naphthylamine that carries at least one sulphonic acid or aminosulphonyl group wherein the OH of the acid or the H of the aminosulphonyl group may be replaced by hydrocarbon residues that may be further substituted by groups other than nitro or acylamino groups. In (B) the group R is a m- or p-phenylene residue (possibly with Me, MeO or -SO₂H substituents), X is a mono-chloro or mono-bromo-alkyl radical of not more than 3 C atoms, and Y is H, alkyl (C₁—C₆), cycloalkyl, aralkyl, alkoxyalkyl or aryl. Lists of the appropriate intermediates are given.

Cellulose Acetate Rayon: Dyeing Fast Shades. Henry Dreyfus. B.P.571,056 of 26/8/1943:3/8/1945. The fastness (especially to gas fumes) of acetate rayon dyed with aminoanthraquinone dyes is increased by impregnating the dyed material with cyanamide solution, drying and baking at 110-150° C.

Vat Dye Printing Paste. American Cyanamid Co. B.P.571,274 of 17/8/1945 (Conv. 24/2/1942). The vat dye printing paste comprises a dispersed vat dye and an effective amount of soluble salt of an ester of a C₃ — C₁₀ alcohol with an acyclic aliphatic sulpho-di- or -polycarboxylic acid (e.g. a diamyl, diocetyl, dihexyl or di-isobutyl sulphosuccinate, or a tributyl sulphotricarballylate), with appropriate thickeners. The claim is illustrated by 27 examples.

Vat Dyes: Application by Pigment Padding. Join Welch & Sons Ltd. and C. Newton. B.P.571,325 of 17/12/1943:20/8/1945. Vat dyes are applied by pigment padding (dye + sulphonated castor oil + locust bean gum), reduced while sandwiched between two impermeable surfaces (e.g. a rubber blanket and the surface of a wide cylinder), and oxidised again by the usual system of rinsing, oxidising, rinsing and soaping. The reducing agent (alkali + hydr sulphite) is picked up by the travelling blanket so that economy of reducing agent is secured and there is a minimum loss of reduced dye.

Vetch and Corn Cockle Seed Adhesives: Preparation and Application. J. G. Fife (for Messrs. Bubeck and Dolder, Basle). B.P.571,335 of 25/2/1943:21/8/1945. Vetch seed is not widely accepted as fodder because certain kinds contain cyanogetic glucosides. Corn cockle seed is also unsuitable because of the saponin content. The patentees now propose to use vetch and/or cockle seed meal for sizes, adhesives and thickeners. Thus, a size for cotton yarn is
prepared by stirring 10 kg. of the meal into a paste with cold water, adding water to 100 l., and heating under a pressure of 2-3 atm. for 15-20 min., or under atmospheric pressure for about 1 hour. There may also be added to the liquor 1 per cent. of the Na salt of p-toluenesulphochloramide. Thickeners and finishing pastes are prepared with other ratios of meal to water. Caustic soda may be used in the cooking to give alkaline pastes.

C. Acrylonitrile: Application in Finishing. Rohm and Haas Co. B.P.571,478 of 27/8/1945 (Conv. 11/12/1942). Claims are made for the effects produced by the application of acrylonitrile to cellulosic fibres, yarns or fabrics, followed by treatment with caustic alkali (Na, K or organic quaternary ammonium hydroxides). They include increased strength, increased absorptivity for and swelling in water, and a linen finish. Examples given demonstrate by data the strengthening of cotton yarns under different conditions in the mercerising step, claim an improved surgical cotton wadding, claim an improved linen finish, and show that the process is applicable to regenerated cellulose rayon.


C. 5—ANALYSIS, TESTING, GRADING, AND DEFECTS

(A)—FIBRES

Equilibrium Humidity Measurement Apparatus. J. F. Vincent and K. E. Bristol. **Ind. Eng. Chem., Anal Edn., 1945, 17, 465-466.** A simple manometric apparatus is described for rapid measurement of equilibrium humidity (in dried foodstuffs, etc.). The difference between the equilibrium pressure and the pressure obtained after freezing out moisture vapour is the vapour pressure of the moisture in the material. This figure may be converted to per cent. relative humidity.

Indian Cotton Fibre: Maturity. A. N. Gulati and Nazir Ahmad. **Indian Farming, 1945, 6, 9-11.** A description is given of the development of the cotton fibre, its appearance under the microscope and the influence of certain agronomic factors, such as season, soil character and irrigation, upon its development. The maturity of common Indian cottons is discussed in relation to spinning quality.

Regenerated Cellulose Fibres: Physical and Chemical Measurements. N. Gralen and O. Samuelson. **Svensk Papperstidn.**, 1945, 48, 1-5 (through Chem. Abstr., 1945, 39, 3157*). Measurements of the degree of polymerisation and of the polydispersity of cellulose have proved of value for the determination of the quality of regenerated cellulose fibres. Two samples of staple fibre of different grades were studied by several physical and chemical testing procedures. The molecular weights calculated from viscosity determinations according to Staudinger gave lower values than those obtained from sedimentation in the ultracentrifuge and diffusion. The fibres were examined by X-rays and the pentosan content, the Cu number, and alkali solubility were determined. Tensile strength and elongation to rupture were found to depend to a large extent on the experimental conditions employed. The resistance of the fibres to washing was studied by boiling in soap solution. A high polymerisation and low polydispersity were found to correspond with high strength, low Cu number, and slight alkali solubility.


Standard Regain of Textiles. P. Larose. **Canadian Text. J., 1945, 62, No. 14, 42, 51.** After reviewing various unsuccessful attempts to standardise regain, published work is summarised to show the variables which affect the moisture content of fibres. The conditions to which the various textile products are subjected in a normal course of manufacture and finishing preclude the establishment of a moisture equilibrium at a fixed and constant figure. A plea is made for the use of dry weights in commercial transactions involving raw materials, tops, yarns, cloths, etc.

Fibre Regain Data. C. H. Reumann. *Text. World*, 1945, 95, No. 6, 101-103. A table is given showing standard regains for various fibres, yarns and fabrics at 70° F. and 65 per cent. relative humidity. Charts showing (1) air temperatures from 20° to 220° F. plotted against relative humidity, (2) dry-bulb temperatures plotted against relative humidity, lines of constant wet-bulb depression being indicated (3) moisture regain (adsorption), and (4) moisture equilibrium (desorption) for wool, cotton, silk, viscose, acetate and nylon at different relative humidities are given.

Wool Fibres: Measuring Frictional Properties. M. Lipson. *Nature*, 1945, 156, 268-269. A copper hook (0.1 gm.) is fixed to each end of a clean fibre by means of molten shellac; the fibre is suspended over a cylindrical rod of polished keratin (rhinoceros hide, diameter 7 mm.), and a solution allowed to drop rapidly on to the fibre-rod junction; a bent glass rod in contact with the underside of the cylinder carries the used solution; weights made from calibrated pieces of wire are gradually added to one of the hooks until the fibre just commences to slide; the experiment is then repeated using the other hook, causing the fibre to move in the opposite direction. The forces required to slide the fibre with and against the scales can be determined to the nearest 0.01 gm. The coefficient of friction in either direction is then calculated from the formula $W_1/W_2 = \mu$, $W_1$ being the total load in the direction of motion and $W_2$ the weight of the hook plus shellac on the other end of the fibre. The formula is dependent upon continuous contact between the fibre and the fixed surface. The gradual motion of the fibre is usually of the order of 0.5-3.0 cm. per min. Variations within the range used (0.25-0.70 gm.) do not seriously alter values for the coefficient of friction. The method is inapplicable to dry surfaces. Frictional measurements are given for 64s merino fibres, untreated and treated by three commercial unshrinkable processes. The results for sulphuryl chloride and aqueous bromine agree in general with those of previous workers using other techniques (these *Abs.*, 1945, A346 and A112), and show that these reagents markedly reduce the coefficient of friction. Treatment with alcoholic potash causes no major reduction in the directional coefficient.

Influence of Age, Body Type and Fertility in Rambouillet Ewes on Fibre Fineness, Staple Length and Fleece and Body Weights. J. M. Jones and Ors. *Texas Agric. Exper. Sta., Bull.*, 657, 1944, 30 pp. Heaviest scoured fleeces were produced during the 3rd year of age; fleece weight declined gradually after the 4th year; Staple length was greatest during the 1st year; it did not change significantly during the 2nd, 3rd and 4th years, but decreased approxi-
mately 12 per cent. by the 6th year and 18 per cent. by the 8th. Fertile ewes produced 0.27 lb. less scoured wool than ewes that did not lamb during the year; the wool was also 0.08 in. shorter. The fibre was slightly finer during the 1st year, but in later age years there was no important change. Relatively smooth-bodied ewes (C type) produced fleeces of a higher commercial value, with greater staple length and finer and more uniform fibres, than the wrinkly ewes (B type). There were no significant differences in body weight for the C and B types, or in scoured fleece weight; the B type fleeces averaged 1 lb. heavier than the C type; the shrinkage was 62.9 per cent. (B type) and 59.4 per cent. (C type).

Vegetable Matter in Scoured Wool: Estimation. M. Lipson. *Amer. Dyes. Rep.*, 1945, 34, 250, 259. Reference is made to the author’s peroxide-carbonate method for estimating vegetable matter in scoured wool (these *Abs.*, 1943, A598). The present paper replies to criticisms by Wollner and others, who prefer their visual comparison method (these *Abs.*, 1945, A27) as being more accurate for rapid routine estimations. In the peroxide-carbonate method, variations in the recovery figures for different types of vegetable material are without serious influence on the final result. Objections to the visual comparison method are that it is inaccurate with Australian wools which may contain much more vegetable matter than American wools, and that it takes no account of the variations in the weights of different samples of the same burr type showing no outstanding difference in size.

Wool Classing and the Resolving Power of the Eye. W. R. Lang. *J. Australian Inst. Agric. Sci.*, 1944, 10, 175. The generally-assumed correlation between crimp and mean diameter is not supported by research (this *J.*, 1937, 28, P273 and P326, and these *Abs.*, 1944, A426). Ten clean fibres mounted on a black background, with the crimp just removed by tension, were placed in order of fibre diameter by 13 observers (woolclassers, textile technologists and laymen). Fibres differing in diameter by 40 microns were distinguished readily by all observers, the lower limit for the majority of observers being 15-20 microns. It is suggested (a) that claims that wool experts can detect without difficulty small differences in quality number by reference to fibre diameter alone are ill-founded, and (b) that the Helmholtz figure of a resolving power of one min. of arc for the human eye (Houston, "Treatise on Light") is high when applied to single wool fibres on a black background.

Shrinkage, Length, Fineness and Price of Wool: Estimating from Lock Samples. P. E. Neale. *New Mexico Coll. Agric., Agric. Exper. Sta., Bull.*, 315, 1944, 19 pp. This method enables the wool grower to estimate closely in 2-3 hr., the wool shrinkage (loss of weight in scouring) from 10,000 sheep. Its applicability to locks other than that of the New Mexico College of Agriculture is not known. It attempts to combine the visual method of the wool buyer and the laboratory method of the College, and can be used by totally inexperienced persons with a good degree of accuracy. For 1,000 sheep or more, one lock about twice the size of a finger, taken at random from every fifth fleece, is representative of the entire clip; for 500-1,000 sheep, one lock from every fifth fleece is necessary, for 100-500, from every second fleece, and for 100 or less, from every fleece. The locks are divided into groups according to the degree of dirt penetration (light, medium or heavy, each of these categories having three sub-divisions), by comparing each lock with illustrations of dirt penetration groups (shown on inserted sheet). The number of locks in each group is multiplied by the average percentage of shrinkage for the group, also shown on the sheet. The sum of these results divided by the total number of locks in all groups, gives the average shrinkage. Measuring the length of the locks and estimating the fineness are also necessary for price determination. The method is described by which the average percentage of shrinkage for each dirt penetration group was calculated.

Cotton and Rayon Tyre Cords: Elastic Properties. H. Wakeham, Edith Honold and E. L. Skau. *J. Applied Physics*, 1945, 16, 388-401. The elastic properties have been compared on nylon, cellulosic rayon, and ordinary and mercerized cotton tyre cords, and five experimental stretched and unstretched cotton tyre cords. Additional information concerning these should help to obtain a more useful set of requirements for good cord, since present criteria
do not yet permit prediction of tyre cord performance. All cords were compared under identical sets of load, temperature and humidity conditions. “Tensigrams” (load/extension curves) are given from which the change of rate of elongation with load were plotted. Effects of temperatures from 25°-200° C. on elongation curves with static loads were determined, and it is shown that the greatest changes in elongation occur just below 100° C. where the cord undergoes its maximum change in moisture content. Growth and partial recovery of cotton and nylon tyre cords subjected to cyclic loads are compared. An apparatus for measuring hysteresis of tyre cords is described which permits the calculation of energy loss per cycle of loading and unloading.


Telephone Cord Yarn: Abrasion Testing. A. C. Walker and P. S. Olmstead. Textile Research J., 1945, 15, 201-222. Tests have been made on the resistance to abrasion of the various single and folded cotton yarns used in the braided covering of telephone cords. A new yarn abrasion test is described in which the yarn is made to rub itself at a sharp loop. Suitable planning of experiments and statistical quality control analysis demonstrate the reliability of the test and show that it is capable of discovering clues to causes of yarn variability. Control, run, and lag correlation charts are shown to be applicable to process control and to the discovery and identification of changes in uniformity, of trends and of periodicities in the yarn. Tables are given of abrasion resistance data for 24s/3 brown mercerised, 10s/3 bleached, 24s/3 red plain, and 24s/3 red glazed cotton yarns, arranged for statistical treatment. C.


Yarns and Fibres: Load-Elongation Recording Apparatus. H. C. Brown. Bull. Lowell Text. Inst., Series 48, No. 2 (through Text. World, 1945, 95, No. 6, 123-125). Apparatus which operates in conjunction with a chain-loading device permits the electronic plotting of a load-elongation curve. A photograph and diagram of the apparatus are given, and curves reproduced for tests made on 35s cotton, 150-den. rayon, 50s worsted, and a cotton yarn removed from a woven fabric. It is hoped to improve the sensitivity of the apparatus and to increase its capacity to 20 lb. or more. W.

(C)—FABRICS

Carbon Arc Fading Test Lamps: Calibration. C. A. Seibert. Amer. Dyes. Rept., 1945, 34, 272-280. A method is designed to compensate differences in fading rates so that exposures in all lamps, varying in fading rates only, would give similar results. Nylon, coloured with 0.3 per cent. of Pontacryl Fast Red AS, was exposed in about twenty different lamps, one of which was found to be 28 times as fast as any other lamp. This led to the theory that a lamp could conceivably be abnormal in some range of the visible spectrum and normal in other ranges, and directed attention to the possible superior
usefulness of a control that would absorb in photometer measurements over a wider range of the visible spectrum than the red. Paper coloured reddish grey and greenish grey, and a greenish grey cotton sample were selected for experiments and tested by 56 persons. Results are tabulated and calculated by means of the K/s formula of Kubelka and Munk, which makes it possible to determine from reflectance measurements the per cent. of actual colour destruction resulting from exposure to light. The grey cotton sample was preferred, as it was much more easily coloured than the paper and showed greater percentage changes in identical hours of exposure. Methods for the establishment of standards are described and two methods are suggested for more precise grading of the colour changes.

**Standard Fading Test Lamp.** H. F. Launer. *Amer. Dyes. Rept.*, 1945, 34, 264. A "standard lamp", a carbon arc housed in a special room, has been developed by the U.S. National Bureau of Standards. Temperature, relative humidity, line voltage and arc current are automatically controlled and recorded. The radiant output of the arc is recorded by a special instrument. A Calibration Paper A has been developed in order to calibrate other arcs in terms of the reference standard arc.

**Standard Inflammability Test Apparatus.** H. E. Hager. *Amer. Dyes. Rept.*, 1945, 34, 291-292. A test procedure and a completely automatic "Flammability Tester" are described for the measurement of the rate of burning of textiles. Butane gas is the fuel and the gas jet is a hypodermic needle protected by a copper shield. The fabric is laid on a plane at 45° to the flame and the "end-point" is taken as the time when the flames from the burning fabric reach and burn through a stretched cord of 50s mercerised sewing thread. Full details are given.

**Cotton Fabrics: Effect on the Rate of Evaporation of Water.** W. H. Rees. *J. Textile Inst.*, 1945, 36, T165-T168. An apparatus is described for investigating the effect of fabrics on the rate of evaporation of water from a moist surface with which they are in contact. Three cellular (leno-weave) cotton fabrics and two plain-weave cotton cloths, one of close and the other of fairly open weave, were tested. Samples were either scoured, bleached or waterproofed. In general the scoured and bleached samples produced only a small change in the evaporation from that of the bare plate, whereas the water-proofed materials greatly arrested the evaporation from a moist surface. When two layers of scoured fabric were used, the rate of evaporation was greater than when one layer only was used, but when a water-repellent fabric was placed over a scoured fabric, the rate of evaporation was slightly greater than with the water-repellent fabric alone, though still much less than with the scoured fabric alone.


**Textile Fabrics: Weathering Tests.** S. Bacher and R. Harwood. *Amer. Dyes. Rept.*, 1945, 34, 265-271. Weathering tests were carried out on ten different samples of olive drab serges by outdoor exposures in 19 different localities throughout the United States for 10, 20 and 30 days during the months June to September, and also by exposures in three conventional types of accelerated fading units. Fading was most satisfactorily measured by the Hunter Multipurpose Reflectometer. Fading variations in different localities from month to month and from one locality to another, and the influence of length of exposure and sun hours are discussed and average fading values established. Machine exposures are compared with actual weather exposures and average ratios tabulated. Loss of reflectance in materials due to deposited dirt was also studied. Most of the results are expressed graphically.


**Asbestos Clothing: Standardisation.** E. L. Wheeler. *Industrial Standardisation*, 1945, 16, 53-55. A review is given of workers' asbestos clothing for which new American War Standards have been developed. As a result of fire-resistance tests of various grades of asbestos cloth it was decided to specify asbestos of Underwriters' grade, which requires 80 to 85 per cent. asbestos by weight. This grade appeared to provide adequate protection and was available. A complete list of American War Standards for safety clothing is given.
Knitted Cotton Fabrics: Physical Properties. Hazel M. Fletcher, Rayon Textile Monthly, 1945, 26, 233-236. The author reports on comparisons of the properties of fabrics knitted from the following yarns: (1) Carded 40s short-staple Peeler cotton, (2) combed 40s medium-staple Peeler, (3) ditto in 80s/2, (4) combed 120s/2 Sea Island, (5) ditto mercerised, (6) carded 36s Peeler, (7) ditto mercerised, (8) combed 36s Peeler, and (9) ditto mercerised. The main conclusions are: (a) Combed yarns are stronger and give higher bursting strength in the fabrics than corresponding carded yarns, but do not otherwise show much difference. (b) Mercerised yarns are as strong as or stronger than natural yarns but are less extensible and lead to less extensible fabrics. (c) Mercerised yarns give fabrics that have lower bursting strengths than corresponding natural fabrics. (d) The mercerised fabrics have the greater air permeabilities. (e) In other respects the mercerised fabrics did not differ much. The tabulated data are (i) yarn counts and twists, numbers of wales and courses, and weights of the fabrics; (ii) breaking loads and elongations of the yarns and fabrics (wet and dry); (iii) thickness, compressibility and resilience of the fabrics; (iv) water uptake, resistance to abrasion, thermal transmission, thermal insulating value, air permeability and moisture vapour permeability; and (v) statistical correlations (t values) for different comparisons.

Textiles: Informative Labelling. "B. J. M." Text. Rec., 1945, No. 747, 39, 58. The question is discussed of the labelling of British textiles (statement of minimum performance) for home and foreign markets, stressing the advantages both to consumer and manufacturer. It is suggested that the different sections of the industry should combine to finance and appoint an independent "Bureau of Textile Standards," of which the Textile Institute and the British Colour Council might form the nucleus. It would be necessary to establish a clear relation between field and laboratory tests; the field tests being fundamental and the laboratory tests being designed to give the required data in terms of field performance. The exploitation of speciality trade marks would not be prevented, but an agreed system of informative labelling would prevent present and future confusion.

Australian Textile Labelling Laws: Lack of Uniformity. S. N. Houston. Text. J. Australia, 1945, 20, 148-150. The States' Acts have been passed in the following sequence:—Victoria (Goods (Textile Products) Act 1944), South Australia (Textile Products Description Act 1944), Queensland (The Trade Descriptions (Textile Products) Act 1944), Western Australia (Trade Descriptions and False Advertisements Act Amendment Act 1944), New South Wales (Textile Products Labelling Act 1945), Tasmania (Textile Products (Description) Act 1945). The Acts agree that labelling shall be compulsory by law; they are uniform in the definition of textile products and of wool, and in stating the conditions with which trade descriptions must comply. The non-uniform features are as follows:—The Western Australian Act provides that the compulsory trade description shall contain the full name and address of the manufacturer, and that every manufacturer and distributor shall keep all records and specifications for at least three years, and shall furnish numbered invoices containing details of the constituent fibres; the Act also defines "manufacturer," "distributor," "wholesaler" and "retailer." The South Australian Act states that "a person shall not sell . . . any textile product to which is applied . . . the word "Wool" . . . unless at least 50 per cent. by weight of the materials of which that product is made is wool." The South Australia, Western Australia and Tasmania Acts incorporate the necessity of imported wood products to carry a "trade description showing all particulars required by or pursuant to the Commerce (Trade Descriptions) Act 1905-1933 of the Commonwealth, and the regulations thereunder." Each State Act includes provision for the Governor to make regulations not inconsistent with each Act, but the New South Wales Act is the only measure which makes definite reference to "standards and methods of testing, analysing textile products." Breaches of the States' Acts carry penalties in each instance, but the text and limit of such penalties are not uniform. The Australian Wool Board are proposing a conference to deal with this lack of uniformity.

(D)—Other Materials

two types of phenolic-laminated material and on vulcanized fibre are briefly described. All tests were carried out at the same conditions of temperature and relative humidity. Data were obtained at span/depth ratios of 8, 12, 16 and 24 to 1, using samples of $\frac{3}{4}$ and 1-in. depths and $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$ and 1-in. widths. The rate of crosshead motion was maintained as close as possible to the calculated value. Nearly all tests were remarkably consistent, calculated values of flexural strength and modulus exhibiting average deviations within $\pm 3$ per cent. of the mean of 5 to 10 determinations. With every material tested there was, in general, a decrease in ultimate flexural strength with increasing span/depth ratio. The effect of the width of specimen appeared anomalous, particularly for the phenolic materials, since samples cut lengthwise showed increasing strength, whilst those cut crosswise gave decreasing values, as the sample width increased. The anomalous variation in values computed for the modulus of elasticity with increasing span/depth ratio could not be satisfactorily explained. Several correlations of the observed data were made which show that the formula currently used to calculate ultimate flexural stress and modulus of elasticity are not rigorous for the materials studied. In a plot of breaking load against sample dimensions, however, the former was found to be a power function of the latter.

Plastics Automatic Heat Distortion Recorder. G. A. Heirholzer and R. F. Boyer. A.S.T.M. Bull., 1945, No. 134, 37-41. An automatic apparatus is fully described which plots the deformation-temperature behaviour of a plastic in approximately the same time now required for a heat-distortion measurement. The ease of operation of these heat-distortion units allows them to be used for control purposes on standard plastic materials. Their main advantage, however, lies in the routine evaluation of new laboratory materials and some typical curves which have been obtained on Bakelite, silicone/Fibreglas laminates, etc., are shown.

Plastics: Dimensional Stability. R. Burns. A.S.T.M. Bull., 1945, No. 134, 27-30. The various types of dimensional change are reviewed. Data illustrating the separate effects of humidity, drying, and repetitive ("cycling") procedures are submitted for cellulose ester and ether, vinyl, methacrylate, nylon and other plastics. The influence of fabrication processes such as compression or injection moulding, and sheeting, is included, and the results obtained are discussed.

Plastics: Flexural Properties. W. A. Zinziro. A.S.T.M. Bull., 1945, No. 134, 31-37. A summary of test results obtained on typical plastics in five different laboratories is submitted. The effects of the loading edge radii, the rate of crosshead motion and the span/depth ratio on the flexural properties of plastics were determined. The radius of the loading edges had very little effect on the results obtained. The ultimate modulus of rupture or the value of the maximum fibre stress for the more flexible materials seemed to be considerably affected by the speed of the crosshead motion. The modulus of rupture obtained seemed to vary somewhat with the span/depth ratio, and the modulus of elasticity increased slightly for the longer span/depth ratios. It is suggested that a span/depth ratio of 16 be used in making modulus of rupture and modulus of elasticity measurements. A definite radius of loading and a rate of loading such that a constant rate of straining is used are also recommended.

Rubber Specimens: Comparison of Tensile Test Results. (1) B. D. Porrit and J. R. Scott. (2) R. G. Newton. J. Rubber Research, 1945, 14, 93-112. (1) With a view to obtaining information on the closeness of agreement normally to be expected between tensile tests carried out in different laboratories, questionnaires relating to particulars of the test machines and methods used were answered by 36 laboratories. The results are summarized and discussed. Sixteen laboratories were selected to test a set of 20 rubber specimens. The full individual results are given in tables. (2) A detailed examination is made of the variation among the tensile test results as obtained by the 16 different laboratories. Statistical methods are used and the results are expressed graphically. Different types of tests, such as load at break, dumb-bell thickness, stress at break, elongation at break, load at 400 per cent. elongation and rigidity at 400 per cent. elongation, are fully discussed. Some sources of lack of agreement between results have been discovered and recommendations are advanced for reducing the discrepancies.
Varnish Films: Modulus of Elasticity. H. G. Steffens. *Ind. Eng. Chem.*, Anal. Edn., 1945, 17, 417-418. A method is described for determining the change in modulus of elasticity of detached insulating varnish films during immersion in water. A simple tensiometer was improvised for this purpose. The change in modulus curve is not a linear function of the immersion time. Tests of the elastic properties of the film after immersion are best made at times when the modulus of elasticity is changing least rapidly with respect to time.

Groundwood Paper Sheets: Discolouration in Light. H. F. Lewis, E. A. Reineck and D. Frommuller. *Paper Trade J.*, 1945, 121, TAPPI, 76-80. Prior to a fundamental investigation of the causes and mechanism of the "fading" of groundwood, i.e. its discolouration on exposure to light, an investigation of the relation between colour change and variables in sheet formation has been carried out. The effect of variation in time of exposure, in the source and quality of the groundwood, the relative influence of heat and light, variations in the technique of handsheet formation, the effect of the addition of sulphite pulp and the relation between the pH of the groundwood sheet and its rate of colour change have been studied. The Atlas carbon-arc Fade-Ometer was used as the standard fading instrument.

Wood-Cloth and Wood-Paper Laminates: Physical Tests. J. Delmonte. *British Plastics*, 1945, 17, 341-348. Developments in resin-impregnated plywood are discussed to show the advantages of increasing the ratio of synthetic resin to wood in order to stabilise the wood. Resin-impregnated wood-cloth and wood-paper laminates make possible more complicated assemblies and constructions. Test samples of cloth-wood and paper-wood laminates, impregnated in different ways and comprising increasing numbers of paper or cloth layers were prepared for physical dimensional stability tests under extremes of moisture condition. Wood-paper laminates showed improved values of the tensile strength, modulus of elasticity, and specific tensile strength. Though the plywood faced with resin-impregnated canvas did not show these gains, the stretchability of the cloth permitted bending at small radii of curvature and a certain amount of drawing, impractical in wood alone. Plywood-paper laminates showed a small but definite decrease in shear strength with increase in paper content, occasioned by the appearance of paper failure. Tests on dimensional stability were also carried out and the distortion of plywood as a function of time is illustrated. Resin-treated papers and cloths greatly improved the dimensional stability by retarding the effects of moisture.

7—LAUNDERING AND DRY-CLEANING

Modified Soda-Soap-Water System: Detergent Action. T. H. Vaughan, A. Vittone, Jun., and L. R. Bacon. *Ind. Eng. Chem.*, 1941, 33, 1011-1019. Three types of washing tests made with an artificially soiled cloth at 60° C., using 0.1 per cent. soap solutions "built" with modified soda, show that at a constant pH soil removal in this system first increases to a maximum and then decreases as the amount of modified soda is increased. Over the range of soap/builder ratios used in commercial laundry practice, soil removal is approximately proportional to the acid titration value, which is in turn proportional to the concentration. For this system titration is therefore a much better means of controlling the suds bath in laundry practice than pH measurements. The optimum ratio of soap to modified soda with the type of standard soil used is approximately 1 to 2 at a soap concentration of 0.1 per cent. Results obtained with soiled cloths of the same type but with different residual removable soil contents are correlated. Reflectivity values of standard soiled cloth are only an indirect measurement of soil content. Under the conditions used in this study and other things being equal, the rate of soil removal is directly proportional to the residual removable soil content of the cloth. With the type of standard soil used, soil removal can best be determined by turbidity measurements. Two types of Launder-Ometer studies have been made, and one type is correlated with commercial washer tests. The relative merits of all three types of experimental washing procedures are discussed.

sentative tertiary amine salts. Reaction of the ethers with methyl iodide, benzyl chloride and benzyl bromide gave corresponding quarternary morpholinium salts, soluble in warm water.

Soap Products: New Trends in Manufacture. J. Davidsohn and A. Davidsohn. Industrial Chemist, 1945, 21, 414-418, 461-465. Some patented saponification processes are described and the uses of soap builders in continuous saponification are outlined. Important developments in soap machinery are recorded and the use of synthetic fats, phosphates and starch are discussed. The addition of solvents of the "Cellosolve" type, "super-fattening" agents, and preservatives is reviewed and detergents of the sulphonated fatty alcohol and sulphonate types are also considered.

Rayon Fabrics: Laundering. F. Bonnet. Rayon Textile Monthly, 1945, 26, 219-221. A report of an address to laundry engineers. The speaker reviewed recent developments in the processing of rayon fabrics by which the range of rayon has been extended and emphasises the need for better control of laundry operations.

Patent

Higher Fatty Acid Amides: Application in Detergents. Procter and Gamble Co. (Cincinnati). B.P. 570,841 of 28/7/1945 (Conv. 20/2/1942). The detergent power of sulphonated detergents is greatly enhanced by the addition of a higher fatty amide. Examples speak of the addition of 3 or 4 parts of the amides of coconut oil fatty acids to 97 or 96 parts of the sodium salt of the sulphuric esters of coconut oil fatty acid monoglyceride.

8—BUILDING AND ENGINEERING

(A)—CONSTRUCTION AND MAINTENANCE OF BUILDINGS AND PLANT

Pulp Plastics: Production. S. L. Schwartz, J. C. Pew and H. R. Meyer. Paper Trade J., 1945, 121, TAPPI, 61-64. Experiments have demonstrated that moulded plastics can be made from high-yield wood pulps, in which little or no phenolic resin has been incorporated. The properties of the pulps and the corresponding plastics are tabulated. A comparison between the phenolic plastics containing about 40 per cent. resin and the corresponding resin-free pulp plastics showed that the latter products have decidedly lower ultimate tensile and compressive strengths and lowered resistance to water absorption, but improved toughness. The most promising of the resin-free plastics appeared to be those produced from pulps obtained by milling water-cooked chips. The water resistance of all the resin-free pulp plastics may be greatly improved by surfacing them with small amounts of resin before moulding. Plastics of moderate strength and good water resistance were also produced by the addition of small amounts of water-soluble phenolic or non-phenolic resins. The experiments described indicate that high-yield pulps may be used as plastic bases, particularly for low-cost products.

Floors and Roofs: Construction; Byelaws. J. Fairweather. Archt. Build., 1943, 174, No. 3882 (through Building Sci. Abstr., 1944, 17, 154). The English and the Scottish Model Byelaws, and the London County Council Byelaws regulating the design, construction and fire resistance of floors and roofs are reviewed and various differences are noted. The L.C.C. byelaws appear to be more definite than the others on questions of loading and wind pressure.

Roof Coverings: Wind Damage and Repairs. Associated Factory Mutual Fire Insurance Companies. Factory Mutual Bull. of Loss Prevention, 1943, No. 7 (through Building Sci. Abstr., 1944, 17, 155). Some ways in which roof coverings are damaged by wind are briefly described. Methods of recognising typical defects in roof coverings and of correcting them are also described with illustrations (in the original). Suitable roof coverings are suggested, the tar and gravel or slag coverings being particularly recommended, and attention is drawn to the fire danger when applying such coverings.

Wind Loads on Buildings. H. Ferrington. Struct. Eng., 1943, 21, 497-526; 1944, 22, 15-40. (Through Building Sci. Abstr., 1944, 17, 153-154). The design wind loads specified by various authorities for modern framed buildings are not considered entirely satisfactory, as they are based on the assumption of a maximum wind velocity of 80 m.p.h. In order to elucidate the problem of wind loadings, numerous data on wind velocities throughout the British Isles have been collected and meteorological conditions under which maximum
winds occur were extensively studied. The results are presented under various headings and a map is provided (in the original) to show the equivalent static wind pressure in lb. per sq. ft. at each anemometer station in the British Isles, averaged over the years 1909-1935.

Magnesium and its Alloys: Considerations and Applications. J. C. Mathers. *Mech. World*, 1945, 118, 305-9. The data given are taken from a paper presented to the American Society of Mechanical Engineers, and reported in *Mechanical Engineering*, 1945 (July). The mechanical properties of magnesium in relation to those of steel and aluminium are discussed, and tabulated with particular reference to aircraft construction. Magnesium alloy sand castings compare favourably with other metals and maximum saving in weight is obtained. They have been used successfully for making cooling fans and hubs for air conditioning plant, gear cases, portable tool housings and movable parts for textile, printing, packaging and other high speed or reciprocating machinery.


Converting Plant for Works Services. T. H. Carr. *Mech. World*, 1945, 118, 319-320. Installation costs for a 750 kW. motor converter, a rotary converter and a rectifier are compared. The rectifier is very much more economical to install and to operate than either of the other machines.

Centrifugal Coal Cleaning. M. G. Driessen. *Mech. World*, 1945, 118, 379-383. The data provided are abstracted from a paper presented to the Institute of Fuel and illustrate the considerable advantages of the cyclone thickener over the Dorr thickener when dealing with fine coal particles. The capacity of the cyclone washer is 15 tons per hour of fine coal per square foot nett area. Coal particles down to 0.150 mm., together with small coal and nuts can be handled.

Supercharged Diesel Engines. R. L. Boyer. *Mech. World*, 1945, 118, 419-422. The data presented are taken from a paper presented to the American Society of Mechanical Engineers, and recorded in *Mechanical Engineering*, 1945 (June). The four-valve engine lends itself to supercharging and a 42 per cent. increase in B.H.P. can be obtained from a given engine. Fuel consumption per B.H.P. is reduced slightly by supercharging. While an existing engine can be converted, better results are obtained when the engine is completely redesigned to allow for increased bearing pressures and higher loading generally.


Change Gears: Calculation. *Practical Engineering*, 1945, 11, 656-7; 12, 8-9. The author explains the calculations involved in the problem of determining what number of teeth shall be used in a 4-gear train that is required to have a velocity ratio lying within closely specified limits. The method of continued fractions is the basis of the procedure described and Brocot's Fractions are also recommended for quick calculations.

Lubrication Colour Code. C. B. Veal. *Industrial Standardization*, 1945, 16, 81-82. The American Standards Association has published a colour code for lubricating machinery. The principle is that the containers of a given lubricant and the points where this lubricant should be applied are marked in the same colour as an easy guide for the man in charge of lubrication. The code covers eight general classes of lubricants, each of which is designated by an identification colour. If more than one kind of lubricant is used in the same class, the code recommends that distinction between these lubricants be made by the use of different numbers marked on the identification colour for the class. The identification colour is merely intended to designate a general class of lubricant, but not any specific grade, quality or brand.

(F)—Lighting


(G)—Heating, Ventilation and Humidification


Air: Bactericidal Irradiation. W. F. Wells. *J. Franklin Inst.*, 1944, 238, 185-193. The efficiency of radiation for sterilising air in a ventilating system is discussed. The amount of irradiation realised from a radiant source within an enclosed space depends directly upon the mean ray length. The uniformity of irradiation of the space and the uniformity of exposure depending upon air circulation both increase with the length of rays. The efficiency of radiant disinfection of air was raised from 4 to 13 per cent. by good design.

High-frequency Heating Equipment. Rediffusion Ltd. *Electrical Review*, 1945, 137, 437-438. Some equipment manufactured specifically for industrial processing by high-frequency AC heating is described. The apparatus includes a bulk dryer for baled wool, or refractory bricks, fitted with air-cooled electrodes, a continuous conveyor dryer for thick fabrics or paper, with subsidiary air heaters, and two machines for welding plastics of the polyvinyl chloride group for packaging and making clothing and footwear.


Textiles and other Manufactures: Humidifying and Cooling. S. Smith. *Ind. Heating Engr.*, 1945, 7, 145-149. A discussion in general terms of the subject of artificial humidification and cooling. The systems described are (1) the spray system, (2) the conditioned air system, these two systems having their use in the textile industries and in the manufacture of tobacco, cigarettes and certain food products. The treatment is elementary.

9—Pure Science

Fast Grating Spectrograph. R. F. Stamm. *Ind. Eng. Chem., Anal. Edn.*, 1945, 17, 318-331. Apparatus and techniques for studying the Raman effect are described, including a suitable light source, filters and sample tubes, a fast grating spectrograph, and various accessories, such as plates, darkroom equipment, contrivances for depolarization measurements, etc. The spectrograph consists essentially of a Gaertner bilateral slit, an off-axis paraboloidal collimating mirror, a plane echelette grating, and a fast objective lens. The grating has 15,000 lines per inch and a total of about 90,000 lines. The use
of the Raman effect for the elucidation of molecular structure is explained. Applications of Raman spectra for qualitative and quantitative analysis are discussed, and results are given of analyses of various organic binary solutions, mixtures of inorganic salts in aqueous solution, and mixtures of o-, m- and p-xylene.

C. 

N-Phenyl-p:p'-diaminotriphenylmethane Dyes: Absorption Spectra. B. M. Tolbert, G. E. K. Branch and B. E. Berlenbach. *J. Amer. Chem. Soc.*, 1945, 67, 887-893. Six phenyl diamino triphenylmethane dyes were prepared and their absorption spectra compared with the spectra of malachite green and Dobner's violet. Diamino triphenylmethane dyes have a special type of spectrum between 900 and 240 m\(\mu\), which consists of three principal bands, termed the \(x\)-, \(y\)- and \(x'\)-bands. The \(x\)- and \(y\)-bands are in the visible region and \(x'\)-band has a maximum not far from 300 m\(\mu\). The phenyl group was found to increase the wave length of both \(x\)- and \(y\)-bands. In the phenylated dyes the substitution of a hydrogen atom for a N\(^+_m\)methyl group increased instead of decreased the wave lengths of both \(x\)- and \(y\)-bands. The asymmetry produced by a double phenylation of one nitrogen atom decreased the wave length of both \(x\)- and \(y\)-bands. These effects were shown to be independent of the solvent.

C. 

Photometer for Luminescent Materials. R. P. Teele. *J. Optical Soc. America*, 1945, 35, 373-378. Diagrams and a detailed description are given of a photometer which makes possible the determination of scotopic and mesopic luminance such as that of fluorescent and phosphorescent materials. A comparison field of colour temperature 2360° K. is used. The photometer has been used for routine measurements of the luminance-time (brightness decay) curve of phosphorescent materials and for determinations of the luminance and chromaticity of the fluorescent light from papers impregnated and coated with phosphorescent materials.

C. 

Trichromatic Data: Analytical Representation. P. Moon and Domina E. Spencer. *J. Optical Soc. America*, 1945, 35, 399-427. The Commission Internationale de l'Eclairage method of colour specification is hampered by the fact that the basic weighting functions are at present specified by tabulated values instead of by analytic expressions. Thus any theoretical investigation of colour has been limited to laborious numerical manipulation, and no analytic differentiation or integration has been possible. In the present paper it is shown how the C.I.E. tabulated values can be approximated by analytic expressions, all of the same form and yielding simple integrations. The use of the proposed analytic specification either as an approximation to the C.I.E. system or to supersede the C.I.E. system is explained, and its advantages are pointed out.

C. 

Gas Temperatures: Measurement. D. A. Richardson. *British Coal Utilisation Res. Assoc. Bull.*, 1945, 9, 165-171. Sources of errors in the measurement of the temperature of a gas are discussed, examples of errors are quoted, and precision methods are critically reviewed.

C. 


C. 

Ion-migration Phenomena: Electron Microscopic Observation. H. Thielisch. *J. Chem. Phys.*, 1945, 13, 249-250. A droplet of water containing dissolved potassium chloride (5 g. per litre) was placed on a collodion film and then included in a vacuum system which was pumped down to 10⁻³ mm. of mercury within 30 secs. In the electron microscope a regular cubic crystal structure, a regular linear dendritic system, and an irregular branch structure were observed. The differences are attributed to differences in the rate of nucleus formation and growth, the cubes resulting from the slowest, and the irregular dendritic branch structure from the fastest growth. The two dendritic structures are unstable in atmospheric conditions, since standing for 6 hours in the atmosphere or merely breathing upon the sample will cause migration. The streaks or schlieren which appear in regularly grown crystals
may be identical with the linear dendrites or may be due to electric surface charges.

**Pigments: Dispersion for Electron Microscopy.** H. C. O'Brien, Jr. *J. Applied Physics*, 1945, 16, 370-372. A method of preparing a pigment dispersion for electron microscopy is described, wherein the pigment, such as zinc oxide, is first wet with water and is then dispersed in a solution of cellulose acetate in methyl ethyl ketone. When a drop of the solution is then cast upon water there is obtained a continuous film of cellulose acetate, including particles of pigment, which are actually dispersed in water. Mechanical or chemical damage of particles is avoided in another method which uses the principle of electrostatic dusting. Details of this method and apparatus are given. Electron micrographs of pigment particles dispersed by both methods are presented.


**Pancreatic Amylase: Influence of the Sulphydryl Group.** M. L. Caldwell, C. E. Weill and Ruth S. Weil. *J. Amer. Chem. Soc.*, 1945, 67, 1079-1080. A number of specific reagents for free sulphydryl groups were examined for their influence upon the activity of pancreatic amylase, but it was found that they are not essential to the activity of this amylase. These findings were in marked contrast to the results, obtained under similar conditions, with these reagents and \( \beta \)-amylase from barley and malted barley, when the sulphydryl reagents caused complete inactivation of the amylase. Hydrogen sulphide or cysteine can restore the amylase activity. Furthermore, highly active solutions of pancreatic amylase show no qualitative indication of the presence of free sulphydryl groups, whereas with \( \beta \)-amylase the activities of the solutions were found to be directly proportional to the concentration of sulphydryl.

**Glass Electrode Assembly.** G. E. Coates. *J. Chem. Soc.*, 1945, 489-490. An apparatus is described for the measurement of pH to \( \pm 0.01 \) unit, which involves a cylindrically symmetrical liquid junction and can be cleaned and refilled rapidly without being taken out of the thermostat.

**Spectro-comparator: Application in Analysis.** K. B. Mather. *J. Sci. Instruments*, 1945, 22, 151-153. The instrument described has a similar layout to the Judd-Lewis Comparator, but mechanically it is improved by the use of adjustable plate tables for 10-in. negatives and a screw traverse with finger release for free movement. The optical system employs front surface aluminized mirrors instead of the more expensive totally internally reflecting prisms. The 90° edge of an aluminized prism divides the field. The microscope objectives are provided with deep conical lens shields to exclude scattered light. The eye-piece is contained in a brass cell with a milled head, providing smooth spiral focusing. The instrument is suitable for qualitative analysis by comparison or quantitative analysis by visual density matching.

**Fischer Moisture Determination Reagent: Application; Electrometric End Point.** (1) R. P. Rennie and J. L. Monkman. (2) G. G. Warren. *Canadian Chem. Process Inds.*, 1945, 29, 366-8, 370 (through Chem. Abstr., 1945, 39, 3221s). (1) A general rapid method has been developed for determining moisture in various materials with the Karl Fischer reagent. Values obtained are given for moisture in grain powder, in glacial acetic acid, in sawdust, and in shellac solutions. Ammonium oxalate is used for standardisation. An electric unit combining endpoint indicator, cell, and electrode system has been designed. The method is applicable to high or low ranges of moisture content, and to opaque and coloured solutions such as shellac. (2) Sodium acetate (\( \text{NaOAc}, 3\text{H}_2\text{O} \)) is recommended as moisture standard.

**Pigments and Fillers: Sieving and Bulk Density Tests.** D. M. Wilson. *J. Oil & Colour Chem. Assoc.*, 1945, 28, 104-107. A simple form of sieve is described for determining the percentage of pigment residue, so coarse as to be retained on a 300-mesh B.S. sieve. For determining the bulk volumes of fine powders, the bulk density test by Mitchell and Lee is recommended, which
can be applied to fillers, pigments and extenders. Gradings are given for some typical fillers.

Potassium: Colorimetric Determination. M. F. Adams and J. L. St. John. *Ind. Eng. Chem., Anal. Edn.*, 1945, 17, 435-436. The colorimetric determinations of K ion by means of K chloroplatinate is reliable and convenient. The colour develops immediately and is stable over a period of two months. The iodoplatinate method is about one hundred times more sensitive, but slow changes of colour have been observed.

Arginine: Colorimetric Determination. A. A. Albanese and Jane E. Frankston. *J. Biol. Chem.*, 1945, 159, 185-194. It has been found that the substitution of \(0.06\) Na hypochlorite for \(0.03\) Na hypobromite in the Weber modification of the Sakaguchi reaction (development of a red colour on the addition of \(\alpha\)-naphthol and hypohalite to an alkaline solution of the amino acid) affords greater convenience of operation and accuracy of the determination of arginine in protein hydrolysates. Arginine values for protein hydrolysates obtained by this method are given and compared with those secured by other techniques.

DDT Insecticide: Colorimetric Determination. E. L. Bailes and M. G. Payne. *Ind. Eng. Chem., Anal. Edn.*, 1945, 17, 438-440. A rapid colorimetric method for the determination of 1-trichloro-2:2-bis(\(\beta\)-chlorophenyl)ethane, the principal ingredient of technical DDT, has been developed, using the Friedel-Crafts reaction in benzene. The reaction produces a compound with a stable colour, orange by transmitted light and greenish orange by reflected light. A suitable wave-length for reading colour and time colour development was selected and a plot of the per cent. transmission values obtained at 420 m\(\mu\) against the concentration results in a smooth curve which is substantially a straight line in conformity with Beer's law. The best working range for the method is between 0.001 and 0.01 per cent. of DDT.

Glycerol: Determination in Presence of Gelatin. C. J. Wessel, St. W. Drigot and G. W. Beach. *Ind. Eng. Chem., Anal. Edn.*, 1945, 17, 440-442. A method for the determination of glycerol in the presence of large quantities of gelatin has been developed. After removal of the gelatin by precipitation with sodium tungstate in acid medium, the glycerol content is determined by the official method of the Association of Official Agricultural Chemists. An arithmetic mean of 99.62 per cent. recovery and a standard deviation of ±0.43 were found for representative determinations.

Oils and Fats: Acid and Saponification Value Determinations; Co-operative Research. N. Stafford. *J. Oil & Colour Chem. Assoc.*, 1945, 28, 97-100. No obvious reason was discovered for the deviations (coefficient of variation 5 per cent.) in the results of co-operative tests on acid values by broadly the same methods. A possible cause may be lack of precision in defining the end-point. Operators used approximately the same techniques for the saponification value determination. The coefficient of variation was 2 per cent. The conditions for the tests are not very critical. It is suggested to increase the amounts of sample and reagent to 4.5 gm. and 50 c.c. of N/2 KOH, respectively, so as to halve the error.

Synthetic Rubbers; Determination of Peroxides in. R. F. Robey and H. K. Wiese. *Ind. Eng. Chem., Anal. Edn.*, 1945, 17, 425-426. A colorimetric method is described for the determination of active oxygen (10 parts per million) in commercial synthetic rubbers. It uses the ferrous thiocyanate reagent made up in a solvent comprising essentially 20 per cent. alcohol in chloroform. Oxidation inhibitors as used in commercial synthetic rubbers do not affect the results.

Chlorine Peroxide and Sodium Chlorite Solutions: Oxidation Potentials. G. Holst. *Svensk Papperstid.*, 1945, 48, 23-30 (through Chem. Abstr., 1945, 39, 31947). The bleaching of pulp with chlorine peroxide and sodium chlorite in weakly acid solutions of pH 4.5 offers several advantages as compared with an alkaline hypochlorite bleach. The weakly acid solution of pH about 2 shows an oxidation potential of approximately 0.75 v., whereas a weakly alkaline hypochlorite solution of pH about 9 corresponds to a value of approximately 1.05 v. Chlorine peroxide in aqueous solution is a stronger and more rapidly reacting oxidising agent than sodium chlorite and would theoretically...
be preferable; practically, however, certain difficulties arise that are not encountered when the chloride is used.

**Metals: Recovery by Anion Exchange.** Sidney Sussman, F. C. Nachod and William Wood. *Ind. Eng. Chem.*, 1945, 37, 618-624. An exploratory study has been made to evaluate the use of anion exchangers for the recovery of Cr, Au, Fe, Mo, Pd, Pt and V from dilute solutions, chromium recovery being discussed more particularly. The tube or column technique was used in most of the experiments. The process is independent of the valency of the complex anion and of the nature of the non-metallic elements included in the complex anion. Adsorbed anions were recovered most effectively by alkaline solutions. The metal may generally be recovered in the form of a salt directly usable in the process producing the waste.

**Cellulose Acetate-butyrate: Molecular Weight Distribution.** D. R. Morey and J. W. Tamblyn. *J. Applied Physics*, 1945, 16, 419-424. The effect of concentration on the saturation limit has been studied by precipitating homogeneous polymer fractions of known molecular weight and at known concentrations, dissolved in solutions of known composition. Curves are plotted and the law governing concentrations as a variable is established. By precipitating a polymer of unknown molecular weight distribution by the gradual addition of precipitant, it is possible to calculate from the light-scattering data the mass precipitated as a function of the per cent. of precipitant. Distribution ratios and corresponding molecular weights are tabulated. The distribution curves obtained optically and gravimetrically for the same sample of cellulose acetate-butyrate showed very good agreement.

**Starch: Fractionation by Nitroparaffins.** R. L. Whistler and G. E. Hilbert. *J. Amer. Chem. Soc.*, 1945, 67, 1161-1165. In addition to butyl and iso-amyl alcohols (Schoch), other compounds possessing nitro, ester, ketone, mercapto, carboxyl and cyclic nitrogen groups are excellent agents for separating starch by forming hydrogen bonds with amylose. The nitropropanes have now been investigated. The quantity of amylose separated varies with the type of nitro-compound and of starch used, approximately the same yield of amylose being obtained through precipitation with nitroparaffins as with butanol. The nitroparaffin-amylose complexes precipitate in the form of "crystals." Their X-ray diagrams are identical. The amylose fractions have been characterized by iodine adsorption. The amylose retrogrades quickly from 1 per cent. aqueous solutions at 3°C. and films prepared from its triacetate derivative are clear, tough and pliable. The properties of the fraction remaining after removal of the nitroparaffin-amylose complex are typical of amylpectin. Retrogradation is extremely slow and films from its triacetate are too brittle to allow of the determination of tensile strength.


1. Native yeast glycogen is considered as identical with glycogen of animal origin, though it is admitted that coloration with iodine, opalescence, or rotatory power are not sufficient criteria for the establishment of the identity or similarity of two polysaccharides. The native yeast glycogen was separated by electrodialysis yielding about 27 per cent. of soluble and 73 per cent. of insoluble material. The properties of the soluble fraction are recorded. (2) The "terminal group" method of Haworth permits the calculation of the number of branches in branched-chain polysaccharides by determining the amount of 2:3:4:6-tetramethylglucose obtained by cleavage of the completely methylated polysaccharide. To determine the position of the branches, the
polysaccharide must be completely cleaved, and if all the branches originate in position 6, an amount of 2:3-dimethylglucose corresponding to the amount of tetramethylglucose obtained in the determination of the terminal groups should be found. To verify this, the determination of 2:3-dimethylglucose was investigated and the estimation carried out by an adaptation of the method of Reeves. All derivatives of glucose with primary alcohol group and a free neighbouring OH group, such as 2:3-dimethylglucose, gluconic acid, etc., yield a molecule of formaldehyde, whereas 6-ethers and glucosides with C atom 5 blocked by an O bridge, such as 2:3:4:6-tetramethylglucose, etc., do not give formaldehyde. Mannose gave two mols. formaldehyde, but fructose gave only 1.78 mols. Since the methylpentoses produce acetaldehyde on oxidation with periodic acid, it was not possible to estimate rhamnose directly by this method. Oxidation with K periodate is not successful with non-reducing disaccharides, such as trehalose and saccharose, or with 1:6-linked trisaccharides such as melibiose or melezitose, whereas sugars with 1:4-linkage, maltose and cellobiose, react normally, giving the second mol. of formaldehyde slowly. Thus the periodate method is a gentle procedure for determining the method of linkage between the CO groups of a disaccharide.

C. Starch Dispersions: Optical Rotation; Effect of Stannic Chloride. C. L. Hoffpauer and J. D. Guthrie. "J. Amer. Chem. Soc., 1945, 67, 1225-1226. The optical rotation of a dispersion of starch in calcium chloride solution was appreciably reduced by the addition of stannic chloride. The original rotation may, however, be restored by the addition of sodium acetate or uranyl acetate. Glycogen dispersed in calcium chloride solution gave a lower rotation on addition of stannic chloride, whereas the laevo-rotation of inulin was increased, and restored to the original by sodium acetate. Dextrose was unaffected. C.

Cis-Indigo: Reactions. G. Heller. Ber. deut. chem. Ges., 1944, 77 B, 163-167 (through Chem. Abstr., 1945, 39, 29942). Solutions of indigo white treated with air at low temperatures do not give trans-indigo but a dye which is a little darker blue and may be cis-indigo. This changes into the trans-indigo on long standing or on heating. It reacts with excess of hydroxylamine in strongly alkaline solution at low temperatures. This reaction apparently reached a maximum in 6 days and yielded a crystalline cis-oxime. Pure cis-indigo and its oxime were finally obtained through the acyl derivatives of the dye. Pure oxalylindigo was also prepared. It is stable towards hot acids and hot dilute ammonia solution, but dilute caustic soda decomposes it in ice, giving cis-indigo. It separates from chloroform in micro-leaflets, whilst trans-indigo crystallises in fine needles. N:N'-Diacetylindigo, which belongs to the trans-series, decomposes in the same way, and as oxalylindigo can be prepared from it, this must also belong to the trans-series. Therefore, both these compounds rearrange under the influence of the alkali.

Methyl Oleate Oxidation Products: Isolation. Daniel Swern, H. B. Knight, J. T. Scanlan and W. C. Ault. J. Amer. Chem. Soc., 1945, 67, 1132-1135. The effect of catalytic air oxidation upon pure methyl oleate has been determined and the high-boiling substances thus produced have been characterized. The biggest boiling fraction of the volatile material produced has been isolated and by oxidative splitting shown to consist of methyl esters of several isomeric monohydroxy derivatives of one or more mono-unsaturated acids in which the double bond has been shifted from the 9:10-position.


Low Temperature Thermostatic Bath. E. L. Ruh, G. E. Conklin and J. E. Curran. Ind. Eng. Chem., Anal. Edn., 1945, 17, 451-452. A three-bath thermostat with automatic temperature control has been designed for viscosity determinations at temperatures ranging from +40° to -70° F. One bath contains the cooling mixture which is 99 per cent. isopropyl alcohol and solid carbon dioxide, the second bath is filled with acetone and contains in addition to the cooling coil a bimetallic thermoregulator and an immersion heater, and the third bath is a Dewar-type evacuated jar filled with acetone and containing a thermoregulator and a knife-blade immersion heater (tem-
perature control within $+0.1^\circ$ F.). The installation is mounted in a special cabinet which augments its operating efficiency.

Condensible Vapours: Heats of Sorption. A. G. Foster. *J. Chem. Soc.*, 1945, 360-366. A new method for calibrating the Pirani gauge, based on the reciprocal relation between thermal conductivity and pressure, is described for measuring the pressure of condensible vapours up to 0.5 mm. Sorption isothermals of water, toluene, ethyl alcohol, dioxan, n-octane and carbon tetrachloride have been determined on silica and ferric oxide gels. All give the linear plot of $p/c$ against $p$, which conforms to the Langmuir isotherm. The saturation values calculated for the amounts held in the completed unimolecular layer show good agreement with previous estimates made from data at higher pressures. Heats of sorption have been calculated by means of the Clapeyron equation and compared with the values calculated by the statistical theory from the constant of Langmuir's equation. Entropy changes accompanying the sorption process have been calculated and support the view that the occluded molecules lose most of their translational mobility, which is replaced by vibrational motions in three degrees of freedom (three-dimensional oscillator). The motions of the adsorbed molecules approximate to those in the liquid or solid state.

Condensible Vapours: Sorption by Silica Gel. D. N. Broad and A. G. Foster. *J. Chem. Soc.*, 1945, 366-371. The isothermals on silica gel fall into two classes (i) "normal" showing gradual increase of pressure with concentration, comprising acetic acid, acetone, carbon tetrachloride, n-hexane and toluene, and (ii) curves falling almost vertically from abnormally low saturation values to very low pressures, comprising n-octane, di-isopropyl ether, morpholine and triethylamine, in order of decreasing extent of adsorption, the pores of silica gel acting as a molecular sieve. It has to be assumed that the gel contains tapering capillaries. The generalisation (Gurwitsch rule) that volumes of different liquids adsorbed at saturation were approximately constant for a given adsorbent does not apply in this case where it is clear that the lowest saturation values are associated with the largest molecules. The fact that part of the pore volume is inaccessible to large molecules implies that part of the total surface is also inaccessible, and the amounts of various substances held in the unimolecular layer should also decrease as the molecular size increases.

Gas Adsorbents: Measurements of Surface Area. P. H. Emmett. *Ind. Eng. Chem.*, 1945, 37, 639-644. A critical review is given of published methods involving the measurement of the adsorption of gases by the solid adsorbents at temperatures close to the boiling points of the gases. The conclusion is drawn that low-temperature adsorption isotherms of some gas, such as nitrogen, afford the simplest basis for measuring the surface area of finely divided porous adsorbents or even of materials having small surface areas.

Silica Gel: Adsorption of Water Vapour. R. K. Taylor. *Ind. Eng. Chem.*, 1945, 37, 649-652. Adsorption data for a given ratio of water to silica gel over the range 25°-250° C. were obtained by the static method in the absence of air. Pressure readings were taken up to 900 mm. Plotted on a Cox chart (1923) the pressure-temperature points lie on converging straight lines. Experiments were made with 1-30 per cent. water added. No evidence of hysteresis was found for changes of temperature or composition, neither in the absence of air nor for 10 mm. partial pressure. The same data are represented as isosteres on a graph of relative humidity/temperature and the relation appears to be linear over the range of measurements.

Water Vapour: Sorption on Porous Solids. D. N. Broad and A. G. Foster. *J. Chem. Soc.*, 1945, 372-375. The adsorption isothermals of water and deuterium oxide have been compared at 25° on silica and ferric oxide gels and on charcoal. On each adsorbent the relative pressure/volume curves of the two liquids are identical. With silica and ferric oxide gels the experimental points fall on the curve predicted by the capillary theory, but scarcely any adsorption takes place on charcoal at low pressures. The adsorptive force between the charcoal surface and the water molecules is abnormally small and probably does not suffice to overcome the cohesive forces between the water
molecules. In this case the critical pressure which must prevail before condensation begins is characteristic, not of the condensation process, but of the layer adsorption process.

Monolayers; Reactions in — E. K. Rideal. *J. Chem. Soc.*, 1945, 423-428. A "Liversidge" lecture. Although the quantity of substance involved in surface reactions is only of the order of 1 mg./sq. m. the methods used for following the chemical change are very sensitive (measurements of surface pressure in Langmuir trough or change in boundary potential). The monolayer is capable of being expanded or compressed and thus the molecular orientation and often also the physical state can be altered at will. Cases of ester hydrolysis and oxidation are cited as typical surface chemical reactions. In all these alteration of the path of approach of the diffusible reactant implies an alteration in the energy of activation as well as in the steric factor, and these alterations are directly reflected in a change in reaction velocity. The ester group can be shielded by a short hydrocarbon chain immersed below the surface, complete protection being afforded by the benzoate group. In the field of photochemical reactions a whole series of hydrolytic and oxidative changes, including indole ring closure, can be brought about by suitable radiation of natural proteins. It is possible, too, to incorporate alien chromophores into the protein and achieve similar reactions. If injected molecules possess non-polar portions they may penetrate into the monolayer and react with its non-polar portions. The injection of long-chain fatty acids beneath a protein monolayer leads to formation of a lipo-protein complex by penetration of the acid into the protein film. Addition of more of the soap displaces the film of complex from the surface. Similarly injected cholesterol leads to lipo-protein complex. On compression of the film the cholesterol is pushed up and the protein down into the aqueous phase. The fact that surface complexes can be displaced sets a limit to the biological activity of homologous series. Sensitisation is a different aspect of this complex penetration mechanism.

Colloidal Electrolytes: Equivalent Conductivity in the Minimum Region. Emanuel Gonick. *J. Amer. Chem. Soc.*, 1945, 67, 1191-1194. The equivalent conductivity of nearly all colloidal electrolytes (e.g. detergents) in the region of the conductivity minimum obey the equation: \( A = A_0 + B/c \), where \( A \) and \( B \) are constants, depending on anion and cation concentration, respectively, at a given temperature. The only exceptions so far found are long-chain substituted ammonium acetates. The position of the minimum in the conductivity/concentration curve is determined by the mobilities of the cation and anion, respectively, but in opposite sense: \( C_{\text{min}} = A/B \). The equivalent conductivity of these colloidal electrolytes may be represented as the superposition of two parts, \( A_0 + B/c \), which are equal when the conductivity is at its minimum.

Proteins: Interaction with Synthetic Detergents. F. W. Putnam and H. Neurath. *J. Biol. Chem.*, 1945, 159, 195-209. An electrophoretic investigation of the interaction between recrystallised horse serum albumin and purified sodium dodecyl sulphate is reported. In phosphate-NaCl buffer solution, pH 6.8, ionic strength 0.2, two discrete complexes have been identified at 1°C., whilst at 20°C. additional complexes of varying composition have been observed. The distribution among the complexes is a function only of detergent to protein ratio. The composition of complexes 1 and 2 was calculated to be 0.22 gm. and 0.45 gm. of detergent per gm. of albumin, respectively. These compositions correspond to the minimum ratio required for complete precipitation of the protein at pH 4.5. It is suggested that interaction must involve protein groups, presumably cationic, which remain fully ionised in the pH region from 4.5 to 6.8. The number of detergent anions bound in the two complexes is calculated to be equivalent to one-half and to all the cationic protein groups, respectively. This stoichiometric combination of detergent anions with basic protein groups explains the specific precipitation of proteins by anions of high affinity. The higher complexes of variable composition are electrophoretically monodisperse up to a detergent to protein ratio of unity, at which free detergent makes its first appearance. The nature of these relatively easily dissociable complexes is considered in relation to the precipitation and viscosity behaviour of the protein.
Liquids: Viscosity at High Rate of Shear. L. Grunberg and A.H. Nissan. *Nature*, 1945, 156, 241. Theoretical considerations are advanced to show that at high rates of shear the viscosity of Newtonian liquids may be expected to become a function of the rate of shear. The value of the rate of shear at which the effect becomes perceptible depends on the relative magnitude of the thermal agitation of the molecules and the "agitation of flow." C.

Polyamide Solutions: Viscosity. S. R. Rafikov and V. V. Korschak. *Bull. Acad. Sci. U.S.S.R., Cl. Sci. Chim.*, 1944, 432-439 (through Brit. Abstracts, 1945, A I, 198). Viscosities are recorded (in the original) for solutions in m-cresol of nylons of mean mol. wt. 5,100-148,000 derived from hexamethylene-diamine and adipic acid, and also for the diamine, its adipates and its diacyl, dibenzoyl and distearyl derivatives. The increment in the value of \eta for the CO-NH, group is less than for the NH, group. Increase of temperature causes a rapid fall in \eta, which is more marked for products of low mol. wt. and at high concentrations. The anomalously high \eta of the polyamides is due to free NH, groups. Divergence from the Hagen-Poiseuille rule is shown only by concentrated solutions of polyamides with high mol. wt. C.


Acridine Derivatives: Absorption Spectra. (1) D. P. Craig and L. N. Short. (2) N. H. Turnbull. *J. Chem. Soc.*, 1945, (1) 419-422, (2) 441-444. (1) The absorption spectra in the visible and ultra-violet are recorded and discussed for acridine, mono- and diamino-acridines and acridinium ions. (2) The absorption spectra in the ultra-violet of the five isomeric monoamino-acridines are reported. The absorption maxima of the bivalent ions of 1-, 3-, and 4-amino-acridines coincide with those of acridine hydrochloride, whereas those of the univalent ions of these bases are displaced to longer wave-lengths. The conclusion is reached that, in the shift from uni- to bi-valent ions, the amino-group in each substance accepts a proton and thereby ceases to affect the absorption spectrum. The 2- and 5-amino-acridines, which possess outstanding biological activity, exhibit great spectrographic individuality. C.

Basic Dyes: Metachromacy. L. Michaelis and S. Granick. *J. Amer. Chem. Soc.*, 1945, 67, 1212-1219. Many basic dyes are adsorbed in different normal and metachromatic colours. A 3 per cent. nucleic acid solution at pH 4.5-5 has been chosen as a model for a normally staining substrate and an aqueous agar gel at the same pH for a metachromatically staining one. Spectrophotometrical measurements have been taken of the absorption curves of these model substrates. The degree to which a dye exhibits metachromatic properties in agar goes parallel to the degree to which it deviates from Beer's law in aqueous solution, due to the fact that with increasing concentration dimeric molecular aggregates of the dye molecules are found. This metachromatic effect manifests itself by a strong displacement of the main absorption band towards shorter wave-lengths at the expense of the metachromatic band, a similar effect as that of a high concentration of the dye in aqueous solution when the main band is depressed, to a less extent, at the expense of the dimeric one. Metachromatic effects are diminished or even abolished, reversibly, on increasing the temperature. In contrast, in the presence of nucleic acid the molar absorption curve of all basic dyes is independent of the dye concentration and is similar to that of the dye in dilute solution. Instead of polymers, a stoichiometrically well-defined salt-like compound is formed from each cation of the dye with one acidic side-chain of nucleic acid. It is shown that the faculty of dyes for di- or poly-merization is always correlated with their metachromatic effect exhibited in certain staining processes. C.

Rabkin Colour-Blindness Test: Evaluation. L. H. Hardy, Gertrude Rand and M. Catherine Rittler. J. Optical Soc. America, 1945, 35, 481-491. A close examination of Rabkin's "Polychromatic Plates for Testing Colour Vision" shows this test to be more informative than the Ishihara test. Some of the twenty plates are described in detail and the individual plates were analysed. The test affords a good means for screening the colour defective from the normal performance by accepting a critical score of 75 as a dividing line. Scores alone cannot be used to indicate either the extent or the type of colour defect. The test, when evaluated in a revised manner, affords an excellent medium for the differential classification of type of red-green defect not only among dichromats, but also among anomalous trichromats. It is, however, not adequate to differentiate between anomalous trichromats and dichromats. Two improvements, in the pigments and in the chroma of pigments used, are suggested.

Portable Electrometer: Application in Measurement of Electrostatic Charges. D. Bulgin. J. Sci. Instruments, 1945, 22, 149-151. Diagrams and a detailed description are given of an apparatus, based on the electrometer valve, for measuring voltage by the induction, by capacity coupling on to the grid system of the valve, of a small voltage proportional to that of the source under examination. The sign, voltage and quantity of charge can be ascertained on stationary or moving objects by direct reading of a pointer instrument, whilst by the use of an auxiliary group of condensers resistance to earth can be measured from $10^7$ to $10^{12}$ ohms. By the design of suitable accessories the instrument may be used for the measurement of any function which can be reduced to a voltage or a voltage change.

Polythene: Texture. C. W. Bunn and T. C. Alcock. Trans. Faraday Soc., 1945, 41, 317-325. The relation between crystalline and amorphous constituents of polythene, displayed as fairly sharp reflections and as a diffuse band, respectively, on X-ray diffraction patterns—has been studied at temperatures up to the melting point (approximately 120°C.). Photographs show that an increase in the relative intensity of the "amorphous" band as compared with the "crystalline" reflections becomes obvious above 80°C. and quite marked at 101°C. At 123°C. only the "amorphous" band is visible. Density and heat capacity measurements are consistent with this picture of gradual melting. The lattice dimensions were determined from the positions of the 2 0 0 and 0 2 0 reflections. The length of the b axis of the orthorhombic cell remains approximately constant at 4.93-4.95 Å, whilst that of the a axis increases from 7.43 Å at 18°C. to 7.65 Å at 100°C. Optical evidence indicates a spherulitic structure in polythene. The orientation of the crystals in the spherulites is deduced by reference to the optical properties of cold-drawn fibres. The conclusion is drawn that the c axes of the crystals (the molecular axes) are perpendicular to the radii of the spherule. Films of polythene were melted on microscope slides and observation between crossed Nicols showed that the spherules do not completely disappear until a temperature of 115°-170°C. is reached. There is a general rise of melting point with average molecular weight up to about 20,000; the highest melting point observed was 126°C. The mechanism of cold drawing is discussed.


axis, with the molecules perpendicular to the zinc sulphide surface which the needles touch along their long axes. Since the lattices made by Zn and S and by -OH, >CO and =O...H-O... have closely similar dimensions, linkages are formed between them, by pole-dipole forces in the first two cases and by a H-bridge in the last two. Orientated deposits of alizarin can also be formed on Sb and Pb glances. The lattice measurements of these sulphides agree approximately with those of alizarin so that the latter is linked to Sb in the first case and to Pb or S in the second, by pole-dipole forces. Other anthracene derivatives that display the effects are listed.


Electron Microscope Diffraction Specimen Holder. G. L. Simard and C. R. Stryker. *Rev. Sci. Instruments*, 1945, 16, 146-148. A specimen holder is described for an adapter lens to the Model B, R.C.A. electron microscope. It is designed to accommodate a wide range of specimen sizes and shapes for diffraction investigations by both electron reflection and transmission methods. Three completely independent motions of the specimen are provided: (1) translation in a direction perpendicular to the electron beam, (2) rotation about the direction of translation, and (3) rotation about an axis perpendicular to both the electron beam and the direction of translation.


Inert Dust Insecticides: Activity. P. Alexander, J. A. Kitchener and H. V. A. Briscoe. *Ann. Appl. Biol.*, 1944, 31, 143-149, 150-156, 156-159. (1) The mode of action of inert dust insecticides on the grain weevil (*Calandra granaria* L.) has been investigated by determination of mortality curves. The action of inert dusts on weevils is not in any sense a chemical process. In no case was any dust detected in the respiratory systems of weevils but it was found that all kinds of dust are eaten indiscriminately. Further experiments confirmed the view of earlier workers that inert dusts kill insects by inducing death by dessication. (2) Investigations were carried out to find some physical or mechanical property of inert dusts responsible for killing weevils. Particles of carborundum larger than 15 µ are without action, probably because they do not adhere to insects, and effectiveness increases as the size is reduced from 10 µ to about 2 µ. A test method has been devised which eliminates the particle size as a variable, and a rough correlation of effectiveness with hardness is shown. Generally, materials softer than calcite are ineffective, but the method of preparation of dusts is also important. Some dry-ground powders are inferior to those wet-ground, a phenomenon which seems to be due to some kind of surface change. Insecticidal effect of a dust is enhanced if the surface of the particles is crystalline or angular in character, but it is diminished if the surface becomes amorphous or rounded. On the basis of experiments with an artificial membrane system it is suggested that clean crystalline surfaces of effective dusts can absorb, or in some way penetrate, the water-resistant epicuticle. (3) Inert dusts were found to be effective against a variety of insects infesting stored products, both larvae and adults. The results, while differing for different species, show in contrast with *Calandra* that the effect of hard mineral dusts on larvae is comparatively small, but the adsorbent powders, alumina and Neosyl, are extremely effective. The mechanism of action seems to be the same. The effect of dusts on the mealworm, which is particularly striking, has been investigated more fully. The greatest dusting effect occurs only with the living organism.

Animal Feeding-stuffs: Water Uptake at Controlled Humidities. D. Snow, M. H. G. Crichton and N. C. Wright. *Ann. Appl. Biol.*, 1944, 31, 111-116. Details are given of the water uptake of a wide variety of feeding-stuffs at a range of fixed humidities. The level and shape of the water uptake curves are closely related to the amounts of soluble carbohydrate and protein present. Fibre exerts a depressing effect on the water uptake, and the value is also lowered by the presence of inert fats and non-hygroscopic ash constituents. These conclusions were confirmed by direct experiments on the water uptake of samples of pure starch, protein and fibre. The results of the investigations have enabled safe limits of moisture content to be laid down for the storage of feeding-stuffs, representative figures being included in tabular form.

Cellulose: Fermentation by Thermophilic Bacteria. R. Enebo and H. Lundin. "The Svedberg" Commemoration Vol., 1944, 438-455. Some questions concerning thermophilic bacteria in general are discussed and their important properties and classification according to Enebo are reviewed. As the result of experiments on the possibilities of the technical exploitation of cellulose fermentation, it appears that the medium should not contain more than 3-4 per cent. cellulose, if the latter is to be entirely fermented. The accumulation of fermentation products seems to inhibit further fermentation. Methods for successive removal of products during the actual fermentation are not yet technically feasible, but the recovery of fermentation products from the mash, especially in alcohol production, is relatively cheap. Mashes with predominantly acid content can be worked up according to Oman by freezing out the water. Cellulose in the soft part of plants and in annual plants is more easily converted by cellulose-fermenting bacteria than lignified material. Further experiments have shown that bacteria whose cellulose-fermenting activity on artificial cellulose media is completely inhibited by sugars can tolerate the presence of sugar in a beet pulp medium and effect normal cellulose fermentation.

Chaetomium Moulds: Cellulose-decomposing Power. G. A. Greathouse and L. M. Ames. *Textile Research J.*, 1945, 15, 223-225. Evidence is presented of the comparative abilities under similar experimental conditions of sixteen species of Chaetomium to decompose cotton fabric. The different species and their activities are described, and the effect of the different species, grown on four nitrogen sources, on the breaking load of cotton duck, after 7 days incubation, is tabulated.

Moulds: Growth at Low Humidities. D. Snow, M. H. G. Crichton and N. C. Wright. *Ann. Appl. Biol.*, 1944, 31, 102-110. Observations were made on the development of mould growth on six widely different feeding-stuffs for storage periods extending over some 3½ years. The rate of mould development was found to depend on the relative humidity of the atmosphere rather than on the moisture content of the material stored. Moulds developed fairly rapidly on all samples stored at 100-75 per cent. R.H. At humidities below 75 per cent, mould growth only took place after a very prolonged latent period (over 2 years). The balance and type of nutrients provided by the various feeding-stuffs influenced the latent period as well as the extent of mould deterioration. This was confirmed by experiments on artificially dried grass fractions and by experiments on starch, protein and fibre mixtures, samples containing the fibre constituent taking the longest periods for moulds to develop. Samples stored at 22° C. developed mould mycelium sooner than those stored at 15-5° C. The literature relating to the growth of moulds at different humidities is surveyed.

Starch and Glycogen: Constitution and Enzymatic Degradation. K. Myrbäck. "The Svedberg" Commemoration Vol., 1944, 474-483. Structures proposed for the molecules of starch and glycogen by various authors are discussed and it is argued that most of them bear no relation to any conceivable
mechanism of the enzymic synthesis of polysaccharides. Myrbäck and Sillén (1943) have proposed a structure with multiple branching of the chains, similar to that proposed by K. H. Meyer, and this is held to be in good agreement with the known facts concerning the enzymic degradation of polysaccharides. The proposed structure, though irregular and in a sense complicated, may be found to give a quantitative interpretation of the facts.

Adsorption Analysis Recording Apparatus. S. Claesson. "The Svedberg" Commemoration Vol., 1944, 82-93. A recording apparatus designed for plotting the refractive index as a function of the weight of solution that has passed through it has been constructed for adsorption analyses and is fully described. The accuracy is about \(10^{-3}\) and 0.03 g., respectively, at maximum sensitivity.


Chemical Balance Knife Edges: Testing. A. Craig. Rev. Sci. Instruments, 1945, 16, 205-209. Methods are described for testing balance knife edges with very simple equipment. Sharpness and straightness are tested optically and mechanistically. Formulæ are given for arm length ratio and knife-edge parallax (vertical and horizontal). Suggested tolerances for macro-balances are:—Fatigue not more than 5 per cent. of the swing; Arm ratio not more than 1:1000001; Drop in sensitivity for 100 gms. not more than 0.02; Angles of parallax not more than \(5^\circ\) of arc, vertically, and \(1^\circ\) horizontally.

Oxygen Absorption Determination Apparatus. M. H. Menaker, M. L. Shaner and H. O. Triebold. Ing. Eng. Chem., Anal. Edn., 1945, 17, 518-519. An apparatus is described that consists of a group of units and makes a continuous automatic record of the oxygen absorbed by a sample. Constant pressure is maintained in the reaction chamber. The apparatus has been used in a study of the effect of temperature on the induction period of a sample of lard. The data obtained indicate that determinations can be made with a fairly high degree of accuracy.


Alumina Column: Separation of Inorganic Ions by Adsorption. P. W. M. Jacobs and F. C. Tompkins. Trans. Faraday Soc., 1945, 17, 388-405. I. Static Adsorption Measurements. The adsorption of cations and anions from aqueous solution of electrolytes by alumina has been measured. The causes for deactivation are discussed. The cation is more strongly adsorbed than the anion because of additional cation exchange adsorption. This is associated with the presence of sodium aluminate as an impurity and is not due to hydrolytic adsorption, nor an exchange process involving either the Al or H ion. The adsorbability is associated with the tendency to covalency and the adsorption is molecular. II. Position, Rate of Advance and Width of Adsorbate Zones. The relation of widths of bands of some cations on alumina columns, the rate of advance when developed with hydrochloric acid, and the relative positions have been studied. The rate of advance is directly proportional to the viscosity and varies inversely as the amount adsorbed. The possible extension to quantitative work has been examined, and various observations of previous authors are given alternative explanations. III. Elution Curves. Differential and integral concentration distribution curves of Cu ions in solution have been obtained in a chromatographic study of the formation and development of bands on alumina columns. Variations of length of column, initial concentration and volume of copper sulphate solution and of pH of elution solution have been investigated and the results confirm and extend the conclusions of parts I and II. Alumina was found to be unsuitable as an absorbent, as the irreversibility and other factors render measurements of width of bands very inaccurate and the separability of cations becomes almost impossible.
Calcium: Spectrophotometric Determination. R. E. Scott and C. R. Johnson. *Ind. Eng. Chem., Anal. Edn.*, 1945, 17, 504-506. Several simple and rapid methods are described for the determination of Ca by precipitation as oxalate and subsequent colorimetric determination with permanganate. Once a calibration curve is obtained by adapting one of the methods to a particular spectrophotometer or photometric colorimeter, only one or two easily prepared and very stable standard solutions and a few common reagents are required. A summary of calibration data shows that precision is satisfactory. The new methods are compared with standard and official methods as carried out by six different analysts and show good agreement.

Metallic Traces: Colorimetric Estimation. R. S. Essery. *J. Inst. Brewing*, 1945, 51, 185-188. The examination of wort for traces of metal, extracted from the alloy on boiling under various conditions, has been undertaken to describe some of the difficulties encountered. In the preparation of samples for analysis the main difficulty was the destruction of the carbohydrate; the author removed it by fermentation. The methods employed for the estimation of Ni, Fe, Cu and Cr in quantities up to 3 parts per million, are described. The importance of the following points is emphasized: methods should be selected which are free from interference by relatively large proportions of phosphate; the method should be applicable in acid solution; recovery should be checked by controls.

Oxygen: Quantitative Absorption. H. W. Stone and E. R. Skavinski. *Ind. Eng. Chem., Anal. Edn.*, 1945, 17, 495-498. A study has been undertaken to resolve doubts about the application of acetic acid solutions of chromous chloride for the quantitative absorption of oxygen. The effect of the concentration of acid hydrogen in the reagent on the evolution of hydrogen gas is shown, and this and other factors that create difficulty can be eliminated or avoided by applying the principles indicated. The reagent specified is excellent for determining oxygen in the atmosphere and an apparatus and directions for an accurate determination of this value are described.

Phosphorus: Colorimetric Determination. J. I. M. Jones. *Analyst*, 1945, 70, 298-301. An investigation of factors affecting the development of the blue colour by reduction of phosphomolybdate with stannous chloride has been carried out. Reliable and reproducible results are obtainable if conditions are strictly controlled. Standards must be prepared at the same time as the unknown samples. The method is applicable over a range of 0.01 to 0.05 mg P in 10 c.c. of solution.

Amino Acids: Chromatographic Adsorption on Organic Exchange Resins. C. S. Cleaver, R. A. Hardy, Jr. and H. G. Cassidy. *J. Amer. Chem. Soc.*, 1945, 67, 1343-1352. The responses toward several amino acids of a cation-exchange and an acid-binding synthetic organic resin have been examined. The influences of the following factors have been investigated: (1) Type of resin, weight of resin and particle size. (2) Height of adsorption column, flow rate, concentration of amino acid in solution and hydrogen ion concentration of the solution. The study has been extended to several binary and two ternary mixtures of amino acids, and evidence is given on their separability. An attempt is made to explain the effects observed. Some of the factors which need to be investigated before resins can be used in the analytical separation of amino acids are discussed.

Amino Acid and Peptide Mixtures: Adsorption Analysis. A. Tiselius. "*The Svedberg* Commemoration Vol.*, 1944, 376-378. Some experiments are described in which the adsorption method is applied to the separation of monoamino-monocarboxylic acids and some peptides of the same type, with an active carbon as adsorbent. Curves for the different types of experiment, front analysis, elution analysis, and displacement analysis, are shown. Quantitative separations are possible with the amino acids and with those peptides which show low adsorption affinity for carbon. With the higher peptides losses occur and some methods of eliminating this difficulty are discussed.

a "pre-burner" is recognised, and a universal Pregl combustion tube filling containing a 3-cm. section of platinum wire gauze is adopted. The elimination of lead peroxide from the combustion tube filling through the use of a permanganate absorber is not applicable to the micro-method. The effect of combustion time was also studied.

**Fats and Oils: Chromatographic Analysis.** N. D. Sylvester, A. N. Ainsworth and E. B. Hughes. *Analyst*, 1945, 70, 295-298. A method for the determination of fat in admixture with fatty acids is described whereby a solution containing fat and fatty acids is passed through a column of aluminium oxide. The fat is easily washed out by a suitable solvent, the fatty acids remaining strongly adsorbed on the column. Bromothymol blue is used as indicator for locating the position of fatty acids. Similarly, unsaponifiable matter can easily be washed through the absorption column. It is suggested to wash the ether solution, containing the unsaponifiable matter after extraction of the soap solution, with dilute acid, and to remove the resulting fatty acids by passing the ether solution through the aluminium oxide column. The results obtained by this method showed satisfactory agreement with results arrived at by standard methods. The adsorption method is considered to be easier and quicker.

**Fat and Oil Polyunsaturated Constituents: Determination by Ultraviolet Absorption.** B. A. Brice and Margaret R. Swain. *J. Optical Soc. America*, 1945, 35, 532-544. A method based on measurement of the ultraviolet absorption of a sample before and after isomerisation in an alkaline glycerol medium is described for application to materials having small proportions of polyunsaturated constituents, such as animal fats and their soaps, partially hydrogenated fats and purified fatty preparations. The method comprises correction of data for extraneous absorption, correction of data for conjugated constituents originally present and surviving the isomerisation treatment, and calculation of the proportions of conjugated and non-conjugated diene, triene and tetrane fatty acid constituents in the sample.

**High-molecular Fatty Acids: Potentiometric Titration.** P. Ekwall and G. Juup. "The Svedberg" Commemoration Vol., 1944, 104-112. It is shown that the sodium salts of long-chain fatty acids in aqueous solutions can be titrated potentiometrically with silver nitrate. The results are usually slightly too low, but never more than 5 per cent. The solubilities of the silver salts of various fatty acids show marked differences. The solubility products of the silver salts were determined approximately from the titration curves and the possibility of determining two different fatty acids in a mixture is discussed. It is shown that such a determination is possible if the hydrocarbon chains of the acids differ by more than two CH₂-groups.

**Linseed Oil Glycerides: Chromatographic Segregation.** F. T. Walker. *J. Oil & Colour Chemists’ Assoc.*, 1945, 28, 119-134. The constitution of linseed oil is briefly outlined and chromatographic methods applied for the detailed study of the component glycerides are described. In a preliminary experiment the adsorbent column of alumina was divided into ten fractions, the oil was dissolved from each one and its iodine value and refractive index were determined. In this way four distinct zones were recognised which corresponded with those of glycerides containing 7, 6, 5 and 4 double bonds, respectively. In order to discover whether glycerides existed with an unsaturation greater than 7 ethenoid linkages a fractional adsorption method was evolved. The presence of trilinolenin (9 double bonds) and linoleodilimolenin (8 double bonds) was thus ascertained. Thiocyanogen values were determined, and from these, together with iodine values and saturated acid content, the percentage of oleic, linoleic and linolenic acids was calculated.

**Reducing Sugars: Analysis.** R. F. Jackson and Emma J. McDonald. *J. Assoc. Offic. Agric. Chem.*, 1945, 28, 371-385. An investigation is described of the determination of reducing sugars by copper reduction in a citrate-carbonate reagent. A preliminary study was made to determine the effect of varying the composition of the copper reagent on the ratio of reduced copper to dextrose, the effects of varying the citrate and the carbonate concentrations, the relative merits of Na and K salts for preparing reagents, the effect of varying the boiling time, and the best way to prepare the iodide-iodate solution and to
make the blank test. The experimental results obtained with the established method are tabulated and the conclusion is drawn that the method is valuable for rapid work that does not require a precision greater than 0.5 per cent., but that it is inferior in respect of precision to the methods in which caustic alkali is a constituent of the copper reagent.

Resins: Softening Point Determination. V. E. Grotlisch and H. N. Burstein. *Ind. Eng. Chem., Anal. Edn.*, 1945, 17, 476-480. A method is described for determining softening points of resins in which the sample is heated in an air bath immersed in a liquid bath held at a predetermined constant temperature. The best practical conditions were established by a series of curves showing the time-temperature increment on resins run at varied temperatures above their softening points. A method is presented for computing the correction to be applied for correlating values obtained at different bath temperatures. The corrected softening point values are in close agreement with the usual ring and ball values according to the method of the American Society for Testing Materials. Data are tabulated showing the application of the method over a range of softening points between 70° and 170° C. A recommended procedure is presented, quicker than the A.S.T.M. method, applicable to a wide range of softening points and resin types.

Sulphonated and Sulphated Surface-active Compounds: Colorimetric Determination. J. H. Jones. *J. Assoc. Offic. Agric. Chem.*, 1945, 28, 398-409. A colorimetric method for the determination of small quantities of sulphonated or sulphated surface-active compounds is based on the combination of the cation of methylene blue with the anion of a sulphonated compound to form a coloured salt. Photometric data are presented. The proposed method may be applied to mixtures containing soap, alkaline detergents and non-ionic detergents.

Glycols, Starch and Cellulose: Oxidation Resulting in Dialdehyde Cleavage. L. J. Heidt, E. K. Gladding and C. B. Purves. *Paper Trade J.*, 1945, 121, TAPPI, 81-89. A review of the literature showed that both periodate and lead tetra-acetate oxidise glycol in an apparently identical, highly selective way. The authors assumed that any other oxidant producing the dialdehyde cleavage in glycols, starch or cellulose must closely resemble heptavalent iodine and tetravalent lead in their atomic characteristics. Consideration of various physical data, including atomic radii, atomic radius ratios, and standard oxidation potentials led to the establishment of a list of oxidants whose central atoms are large enough to coordinate a total of six oxygen atoms and which can accommodate at least two additional oxygens before the total of six is reached. Sodium perbismuthate and the hydrated trivalent silver ion were found to cleave ethylene glycol to give formaldehyde in high yield. Other common oxidants failed to produce dialdehyde cleavage, but they either do not undergo the requisite single-step decrease of two units to the next lower valency state or they do not have the required oxidation potential. Experiments showed that periodate, tetravalent lead, perbismuthate and trivalent silver all have the same effective oxidation potential of about -1.2 volts at 25° in the pH range 2-4.5. The critical oxidation potential, i.e. that at which the velocity of oxidation of a given substrate becomes vanishingly small, of cellulose or starch with respect to periodate at 25° is somewhat less than -0.8 volt and was found to be -0.9 volt toward dichromate. Since chlorite is without effect on cellulose the critical oxidation potential for the chlorine-cellulose system is assumed to be more than -0.85 volt; hypochlorite must possess a critical potential smaller than -0.85 volt. These observations lead to the conclusion that chlorite, but not hypochlorite, is capable of bleaching cellulose without risk of damage by oxidation. The magnitude of the critical oxidation potential for a given substrate seems to vary with the nature of the oxidant. A list of 50 references is given.

Globular Proteins: Conversion to the Fibrous Form. F. R. Senti, M. J. Copley and J. C. Nutting. *J. Phys. Chem.*, 1945, 49, 192-211. By means of heat, water and mechanical shear, several globular proteins, including lactoglobulin, casein, peanut protein, serum albumin, etc., have been converted into fibrous form giving an X-ray diffraction pattern nearly identical with that of β-keratin of stretched hair and wool. The process is most effective when applied to proteins that can be denatured by heating. When a protein is
heated in the presence of water the diffraction pattern sharpens and new lines appear, indicating an ordering of chains analogous to that occurring in the annealing of cellulose ester and polyamides. Relative dimensions of the crystallites giving the fibre patterns are deduced from the sequence in the arc patterns of the X-ray reflections when a protein filament is stretched. Comparative data on birefrigence, X-ray diffraction, and swelling anisotropy as measures of molecular orientation are presented. Tensile strength is increased by conversion of the globular protein to the orientated fibrous form. Wet strength after treatment with boiling water and dimensional stability of orientated ovalbumin filaments are improved by acetylation and hardening with formaldehyde or quinone.

Gum Arabic: Molecular Weight. S. Säverborn. "The Svedberg" Commemoration Vol., 1944, 508-522. A sample of purified gum arabic has been examined by sedimentation and diffusion methods with a view to determining its molecular weight. From values of the sedimentation and diffusion constants and the partial specific volume, molecular weights of the order 280,000-300,000 are derived for the acid gum and 250,000-270,000 for the soda gum. The mean molecular weight derived from sedimentation equilibrium for the soda gum is 300,000. Auto-hydrolysis of acid gum has been followed by measurements on the sedimentation constant of the products. After 24 hours the gum molecules had been reduced to fragments of molecular weights not higher than about 10,000.

High Polymers: Degradation. R. F. Tuckett. Trans. Faraday Soc., 1945, 41, 351-359. The random degradation of high polymers is treated as a problem in statistics which can be solved by the same technique as that for finding the partition of energy among a set of harmonic oscillators. The Darwin and Fowler method is used in which the required quantities are expressed as coefficients in related power series, and these are then evaluated as contour integrals by the method of steepest descents. This formulation of the problem makes it possible to apply the theory to poly-disperse systems immediately. The method is then applied to a specific case of non-random degradation in which preferential splitting at the ends of the chains occurs. The kinetics of this type of degradation, which is found experimentally, are also discussed.

Melamine and Melamine Resins. J. Olsson. "The Svedberg" Commemoration Vol., 1944, 344-351. The industrial production of melamine by polymerisation of dicyandiamide is discussed and a short survey is given of the condensation products of melamine with formaldehyde. The properties and technical application of melamine resins are briefly reviewed.

Methyl Methacrylate: Heat of Polymerization. L. K. J. Tong and W. O. Kenyon. J. Amer. Chem. Soc., 1945, 67, 1278-1281. A simple isothermal calorimeter is described for the determination of heats of polymerization. The method utilizes the heat evolved from the polymerization reaction to evaporate a liquid which is in equilibrium with its own vapour at its boiling point. The heat of polymerization is calculated from the amount of liquid evaporated and its heat of vaporisation. Data on methyl methacrylate are presented to illustrate the method. The measurements obtained were in agreement with those of other authors arrived at by different experimental methods.

Pectin: Alkaline De-esterification; Acceleration by Electrolytes. H. Line-weaver. J. Amer. Chem. Soc., 1945, 67, 1292-1293. Na, Ca and Mg chlorides increase the rate of de-esterification of pectin as much as 400 per cent. at pH above 6. The results lead to the interpretation that the negatively charged carboxyl groups are close enough to the ester groups for interaction with the hydroxyl ions to occur as they approach the ester bonds. The stability of pectin materials in neutral or slightly acid solution is enhanced if the salt concentration is held to a minimum and multivalent cations are avoided.

Phenolic Resins: Technology. A. Lewin and P. Rabitschek. British Plastics, 1945, 17, 316-322, 385-391. The authors link some theoretical aspects with the properties and applications of resins in order to establish criteria for the choice of the type of resin most suited for a given purpose. The fundamentals of the reaction between phenol and formaldehyde are described and the effects of acid and alkaline catalysis are discussed. The different phenols are reviewed with regard to their suitability for resination. The influence
of a filler, the manner in which the filler is compounded with the resin, and the effect of the form in which the resin is applied upon the properties of the plastics composition are also discussed. The main factors influencing the choice of phenolic resin—the processing technique, the properties required of the final product and the nature of the filler—are considered. Moulding compositions, including those that are required to possess superior electrical characteristics, moisture resistance or shock absorbing properties, laminates, resin bonded plywoods and cast resins are discussed.

**Unsaturated Fatty Acids: Oxidation; Spectrophotometric Studies.** R. T. Holman, W. O. Lundberg, W. M. Lauer and G. O. Burr. *J. Amer. Chem. Soc.*, 1945, 67, 1285-1292, 1386-1396, 1390-1394. (1) A study is presented of the absorption spectra of some of the possible products of fat oxidation. The ultraviolet absorption spectra of lard showed an increase in absorption with proceeding oxidation which was not due to peroxide. A mild oxidation of partially oxidised oleic and elaidic acids increased the absorption only slightly, but prolonged oxidation caused marked increases. Tests showed that dihydroxy-stearic and oxidostearic acids cannot account for the absorption bands observed in oxidised fatty acids. Isomeric ketols do not accumulate in more than traces in oxidised mono-ethenoic acids. Diketostearic acid could also not account for the observed absorption maxima. The absorption was also studied in alkaline solution. It is suggested that the increased absorption found in oxidised fats is due in part to the conjugated unsaturated systems containing carbonyl groups or to conjugated polyenes formed by enolisation of these systems. During the oxidation monoethenoic acids showed increased absorption at 2350A indicating the probable formation of conjugated dienes. (2) Doubly unsaturated fatty acids, as linoleic acid, were studied in the same way. The autoxidation products of linoleic acid are spectroscopically unlike those of oleic acid. (3) The study of spectra changes induced by the oxidation of fatty acids containing three double bonds, isolated or conjugated, showed very similar spectral curves for the oxidised linolenic acids as for the oxidised oleic and linoleic acids. They all have bands at 2750A which are intensified by alkali and which do not show fine structure. Both of these properties indicate that the absorption is due to chromophores that contain oxygen. The possibility of the formation of conjugated dienes and trienes is discussed and rejected.

**High Speed Centrifuge Dynamic Brake.** D. J. Mitham and V. A. Yardley. *Chemistry and Industry*, 1945, 307-308. Experiments have been carried out to incorporate a dynamic braking device in a high-speed laboratory centrifuge. The method is described and the circuit diagram for the arrangement and constructional details are shown. The results of running tests with and without the brake show the utility and effectiveness of the dynamic method. Thus it stopped a centrifuge running at 6,000 r.p.m. in 1½ minutes, against 7 minutes without its aid.

**Recording Surface Force Balance.** K. J. I. Andersson, S. Stollberg-Stenhagen and E. Stenhagen. "The Svedberg" Commemoration Vol., 1944, n-32. The author describes an automatic surface balance of the Wilhemy-Dervichian type for recording force/area curves in monolayer work in the temperature range 0° to +55°C. The principle of the method is outlined and the instrument and its accessories are fully described. Special features of the apparatus are a torsion balance with a very low moment of inertia and a very smoothly acting hydraulic driving mechanism which allows a continuous range of compression rate to be used. The accuracy of the balance is discussed. Studies of stearic acid and 1:2-dihydroxyhexacosane films on o:01N hydrochloric acid are reported by way of illustration.

**Ultracentrifuge Magnetic Support.** T. J. Dietz and T. V. Kishbaugh. *J. Franklin Inst.*, 1943, 236, 445-449. A magnetic support for an air-driven ultracentrifuge has been designed similar to one developed for the electrically-driven ultracentrifuge. A comparison of operating characteristics shows that the magnetically supported system compares favourably in efficiency with the pneumatically supported system. The use of the magnetic support as a means of reducing the thrust-bearing friction in the air-driven ultracentrifuge is found to be practical in routine operation.

**Ultracentrifuge Recording and Controlling System.** T. J. Dietz. *J. Franklin Inst.*, 1943, 236, 451-459. A control system is described for operation with the
magnetically-supported, air-driven ultracentrifuge. Experience in the use of the equipment indicates that standard industrial control apparatus, particularly of the pneumatic type, can be applied advantageously to the operation of air-driven ultracentrifuges.

C. Silica Gel: Adsorption of Alcohols, Esters and Ketones. B. P. Gyani and P. B. Ganguly. *J. Phys. Chem.*, 1945, 49, 226-238. The adsorption of different homologues of alcohols, esters and ketones on silica gel has been measured. A static method of investigation is used, in which the gel is thoroughly degassed. The apparatus is shown and all results are tabulated. Silical gel is found to be a powerful adsorbent for the vapours of all the substances tested. Some of the values are almost the same as those obtained for active charcoal by previous authors. At high relative pressures the amounts of adsorption are always in the inverse order of the molecular weights in the same series of compounds. These orders are not maintained at lower relative pressures, and may further change according to the mode of plotting adopted. Esters and ketones give smooth isotherms; those for alcohols reveal multiple branches. The peculiar behaviour of the alcohols is discussed. The authors assume that the adsorbing materials enter into a loose chemical combination with the alcohols, giving rise to alcolohates.

Amphipathic Organic Liquids: Equilibrium Spreading Coefficient on Water. E. Heymann and A. Yoffe. *J. Phys. Chem.*, 1945, 49, 239-245. A theoretical discussion is given of the equilibrium spreading coefficient of amphipathic organic compounds on water, with particular reference to intermolecular forces. The experimental material is briefly reviewed. The work of cohesion of amphipathic compound is found to be markedly greater (approx. 20 per cent. for alcohols and up to 30 per cent. for fatty acids of medium chain length) than that of the corresponding hydrocarbons. The contribution of the polar groups to the work of cohesion of amphipathic liquids decreases markedly with increasing chain length.

Compressed Monolayers on Water; Rates of Evaporation through. I. Langmuir and V. J. Schaefer. *J. Franklin Inst.*, 1943, 235, 119-162. Experiments were undertaken to test the hypothesis of the sensitivity of impermeable films to traces of permeable substances. The experimental method depended on the increase in weight of calcium chloride in a covered box placed over the water surface in the Langmuir trough. The observed high evaporation resistances of some films involve forces upon single molecules of water about 100 times greater than those previously known to exist in monolayers. Experimental determinations of evaporation resistances of monolayers of highly purified fatty acids having from 16-23 C atoms were carried out and typical curves, obtained by plotting the surface pressure on the film as a function of the area per molecule, are discussed. Experiments were then conducted with films prepared by mixing the C3 acid in different proportions with cholesterol, which has a very low resistance. Minute amounts of foreign substances appear to have very great effects on the resistances. In order to obtain a high state of compression at a definite level in the monolayer, dihydroxystearic acid was added to a C31 acid film. It was found that if too many molecules of this type, which have an increased cross section in the middle of the chain, are present, they interfere with the formation of the condensed film and produce an expanded film of little resistance. The evaporation resistance of thicker films of the hydrocarbon oils was also determined and found to be wholly a diffusion phenomenon. The results are discussed and energy barriers and internal stresses in monolayers are calculated. It is considered that condensed films have their molecules arranged in an imperfectly crystalline form.

Colloids: Electro-optical Effect. O. Snellman. *"The Svedberg" Commemoration Vol.*, 1944, 200-212. A theoretical study of the electro-optical double refraction of an aqueous solution of colloids in an alternating field is presented in the light of the orientation theory, the conductivity of the particles being taken into consideration. The theory of non-conducting liquids is a limiting case of the general theory of conducting liquids. It is shown that certain observed electro-optical effects can be explained by this theory.

Electrophoretic Moving Boundary Fractionation: Theory. H. Svensson. *"The Svedberg" Commemoration Vol.*, 1944, 213-223. The moving boundary method of electrophoretic fractionation has been studied theoretically in order
to establish the influence exercised upon the separation speed by different factors, such as concentration of the component to be isolated, mobility difference between that and the subsequent component, current density, conductivity, construction of the U-tube, temperature and diffusion.

**Solutions: Theory.** P. G. Nutting. *J. Franklin Inst.*, 1943, 236, 573-580. A number of phenomena have been observed in the investigation of solutions by means of a glass electrode for pH measurement, which indicate that some revision and extension of solution theory may be necessary. Exact relations in solution theory were studied and the linear relation between pH and log. concentration is found to be consistent with the fundamental solution theory. Increased acidity on adding base to an acid solution and the reverse effect are also shown to be expected by this theory. A study of electrolytic potentials shows that the increase in hydrogen ions is proportional to the concentration of adsorbed anions. Multiple pH readings at buffer points are to be expected when a number of different species of anion are present, each with its own adsorption coefficient and none so outstanding as to overpower the rest.

**Solids: Drying; Theory.** P. G. Nutting. *J. Franklin Inst.*, 1944, 238, 177-184. As a contribution to the problem of drying, a general relation is developed between the energy of retention of fluids by solids, and the pressure and temperature, by thermodynamic methods, applicable even to cases where the energy varies with the amount of fluid present. The three classes of experimental data on adsorption, namely, heat of wetting, change of weight with temperature, and change of weight with vapour pressure, are reviewed, their interpretation in the light of thermodynamic theory is discussed and relations between energy of change of phase and amount of fluid retained are deduced.

**Dried Collodion Membranes: Structure and Electrical Behaviour.** K. Sollner. *J. Phys. Chem.*, 1945, 49, 171-191. The characteristic behaviour of "dried" collodion membranes, i.e. that no specific swelling effect is observed with solutions of inorganic electrolytes and those non-electrolytes which are not strongly adsorbable, must be explained on the basis of the porous, micellar-structural character of these membranes. Adsorbable solutes often cause pronounced specific swelling. The dissociable group located in the interstices of the membranes which determines the electrochemical behaviour ("activity") of collodion membranes can be determined by base-exchange measurements. High base-exchange capacity is always found with preparations of great "electrochemical activity"; medium and low base-exchange capacities occur with electrochemically active as well as with inactive preparations. The inherent acidity of various collodion preparations, their "acid number," has been determined by electrometric titration. The acid numbers over the whole range investigated differ only in the ratio of 1:3:3, whereas the base-exchange values differ in the range of 1:200. The high base-exchange capacity of the electrochemically active preparations is due not so much to their higher acid numbers as to their more open structure. Short-period base-exchange experiments indicated that in membranes prepared even from the most active collodion not more than one in 500 acid groups may be available for the typical membrane functions.

**Phycoerythrin: Diffusion Constant; Optical Determination.** O. Quensel. "The Svedberg" Commemoration Vol., 1944, 193-199. A review of the theory of a method for the determination of diffusion constants is given and the experimental procedure and some diffusion measurements on phycoerythrin are described. The method is applicable only under the condition that the solution of the substance, whose diffusion constant is to be determined, has a light absorption different from that of the solvent.

**Porous Solids: Density Measurements.** K. A. Krieger. *Ind. Eng. Chem., Anal. Edn.*, 1945, 17, 532. An apparatus for the measurement of surface area previously described has been found convenient for the measurement of the density of porous solids with helium as the displaced fluid.

**Suspensions: Sedimentation Equilibrium Theory.** O. Lamm. "The Svedberg" Commemoration Vol., 1944, 182-188. It is shown theoretically that the thermodynamic factor \((1 + \frac{\delta \log f}{\delta \log N})\) for binary solutions in general can be established through the sedimentation equilibrium obtained in the ultra-
centrifuge. In deducing the equations required, some observations regarding the usual interpretation of the sedimentation equilibrium have been made, which should be considered in certain cases of precision molecular weight determination by the method in question. \((N=\text{molar fraction}; \gamma=\text{corresponding activity coefficient})\)

**Rotational Viscometer Flow-curve Recorder.** Ruth N. Weltmann. Rev. Sci. Instruments, 1945, 16, 184-191. A recorder has been developed for use with a rotational viscometer, which can plot the up and down branches of the flow curve (rate of shear/shearing stress) automatically within any desired specified time. The principle of the flow-curve recorder is discussed and its construction is described. A number of measurements made with the recorder are shown. The recorded flow curves permit immediate interpretation and calculation of the plastic viscosity, the yield value, and the thixotropic behaviour of the tested materials. A method is proposed for determining the plastic viscosity and the yield value at initial agitation, which are identified as the "initial thixotropic viscosity" and the "initial thixotropic yield value." The accuracy of the recorder is very satisfactory; its average deviation does not exceed \(\pm 0.5\) per cent.

**Photo-electric Extinction Measurement Apparatus.** S. Bodforss and B. Adell. "The Svedberg" Commemoration Vol., 1944, 33-44. The convenience and precision of an electrical photometer with selenium barrier-layer photo-tube for extinction measurements has been tested. A new instrument with alkali metal photo-cells has been constructed and tested with secondary emission. The extinction measurement of a solution in monochromatic light is discussed. The agreement between the bridge values for relative extinction and the corresponding angle value justify the assumption that the secondary emission current is proportional to the intensity of the light. Furthermore, the complex velocity constant of the fading reaction of phenolphthalein in the presence of excess caustic soda has been calculated; the values lend support to the above assumption.

**Atmosphere: Light Absorption.** J. Dufay. J. Physique et le Radium, 1940, [viii], 1, 251-259. It has been shown that at high altitudes, outside the region of selective absorption, the absorption by a dry atmosphere is almost exclusively due to molecular diffusion. The objections raised against the \(\lambda^{-4}\) law by Duclaux are challenged, and it is shown that the law is obeyed with all the precision of spectrophotometric measurements.

**Daylight: Seasonal Variations in Ultra-violet Energy.** M. Luckiesh, A. H. Taylor and G. P. Kerr. J. Franklin Inst., 1944, 238, 1-7. Average monthly variations of erythematous and anti-rachitic short-wave ultra-violet energy have been recorded by means of a Cd-Mg alloy photo-tube for a continuous six-year period at Cleveland, Ohio, and the results are presented. A unit of energy called the \(E\)-viton is proposed; it is equivalent to \(10\) micro-watts of energy at \(\lambda 2967\), the wave-length at which relative erythemal effectiveness is greatest, or \(10E\) micro-watts at any wave-length having a relative erythemal effectiveness \(E\). To produce a minimum perceptible erythema on an average untanned skin requires an exposure of about \(40\) \(E\)-viton-minutes per sq. cm. The relationships between the sunshine records and the erythemally effective energy output are expressed in histograms for each month, averaged over the 6-year period. Graphs are also given to show the hourly variations in \(E\)-vitons \((a)\) for single days in April, June and September, and \((b)\) for radiation from the sky and from the sun in May and September. They show that for about 8 months of the year a clear sky contributes more than half of the erythemal ultra-violet energy incident on a horizontal plane in daylight at all hours. Even in the summer there are only a few hours round mid-day when the sun contributes more of this energy than the sky. The total erythemal ultra-violet energy received in the six months from October to March is only about \(10\) per cent. more than that received in the single month of June or July, and December affords only about \(1\) per cent. of the total annual output.

**Solar Micro-wave Radiation: Occurrence.** G. C. Southworth. J. Franklin Inst., 1945, 239, 285-297. A small but measurable amount of micro-wave radiation coming from the sun was observed as random noise in the output of a conventional double-detection radio receiver designed to work at centimetre wave-lengths. Measurements of solar radiation were made at the longest,
intermediate, and shortest wave-lengths, and the results established the existence, in the sun's spectrum, of components much longer than have hitherto been found. Over a considerable portion of the frequency range, the energy appears to be substantially that predicted by black-body radiation theory. C.

**Alcohol/Hydrocarbon Dipolar Solutions: High-frequency Dispersion and Absorption.** P. Girard and P. Abadie. *J. Physique et le Radium*, 1940, [viii], 1, 281-284. A comparative study of the high-frequency dispersions and absorptions of a pure polar liquid such as an alcohol on the one hand and its solutions in different hydrocarbons on the other, shows the influence exercised on the dispersion and absorption by the interactions between the dipoles of the alcohol and the non-polar molecules of the solvent. The comparative method used for these dispersion and absorption measurements is described. It permits of the experimental study of molecular interactions, which are shown to be dependent on the structure of the molecules.

**Glycosides: Photolysis.** R. J. Heidt. *J. Franklin Inst.*, 1942, 234, 473-485. Experiments on the photolysis of various α- and β-aryl-d-glycosides are reported which show that light liberates the aglycone from the reducing sugar. Photolyses were carried out with monochromatic light of A2514 μ. Absorption spectra obtained at 25° for β-benzylfructopyranoside and α-benzylfructofuranoside were found to be the same as those previously obtained for benzylglucosides and benzyl alcohol. The absorption spectrum for freshly purified fructose gave a deeper minimum than previously reported values which were, however, approached when the dry crystals had stood in air for several months. Quantum yields for the breakdown of the fructosides and the glucosides are tabulated. The absorption spectra, the products of photolysis, and the quantum yields lead to the hypothesis that the photochemical reaction is produced by an intramolecular transfer of absorbed energy from the aglycone to the hemiacetal oxygen bridge, which is the reactive centre, whilst the remainder of the glycoside plays scarcely any part. The efficiency of this transfer is greater for benzyl- than for phenylethyl-glucosides and is smallest for phenylglucosides.

**Ozone: Absorption Coefficients.** D. Barbier and D. Chalouge. *J. Physique et le Radium*, 1940, [viii], 1, 217-220. Absorption coefficients of ozone have been determined at room temperature in the region of 3416-3130 A. The graphical method was applied to obtain the values for the thicknesses of the ozone traversed, this being proportional to the optical density. The absorption coefficients obtained showed good agreement with those of Chinese authors (1933).

**Starch: Photo-hydrolysis.** M. R. Madhok and F. Uddin. *Indian J. Agric. Sci.*, 1944, 14, 383-385. Starch undergoes hydrolysis in solution under the action of light in the presence of catalysts, being first converted into dextrin and then into reducing sugars. Shorter waves of light are more active than longer waves. The rate of hydrolysis varies with different starches, but is not affected by changes in pH values from 5.2 to 8.6. Sodium nitrite, zinc oxide and mercuric oxide act as catalysts in the reaction.

**p-Benzoquinones: Light Absorption Studies.** E. A. Braude. *J. Chem. Soc.*, 1945, 490-497. The selective visible and ultra-violet light-absorption properties of p-benzoquinone in a number of solvents and of 26 substituted benzoquinones in n-hexane and in chloroform have been measured and are discussed. Except with the higher members of the mono-alkyl series, the differences in the extinction curves of isomers or homologues are sufficiently great for identification purposes. Beer's law is obeyed within the experimental error and the range of concentrations (0.01-1 per cent. w/v) employed.

**2:4-Dinitrophenylhydrazones: Light Absorption Studies.** E. A. Braude and E. R. H. Jones. *J. Chem. Soc.*, 1945, 498-503. Data are tabulated for the light-absorption maxima of solutions of some fifty 2:4-dinitrophenylhydrazones in alcohol and in chloroform over the range 2200-5000 A. The light absorption properties were found to depend not only upon the extent of the conjugated unsaturation present in the parent carbonyl compound, but also on the degree of alkyl substitution. The close correlation between structure and light absorption in this series is of theoretical interest with regard to the optical properties of the >C:N- and >NH groups.
**Colour: Specification; Geometry of Colour-space.** Domina E. Spencer. *J. Franklin Inst.*, 1943, **236**, 293-302. Recent developments in the specification of colour are reviewed. For most practical purposes it is customary to specify the colour by three numbers and to represent it geometrically by a point in a three-dimensional affine space. For a specification of colour tolerances, however, the range of colours must be determined which will appear identical to the observer. A Euclidean metric has been introduced which satisfies these requirements. To designate the effect of the surroundings on the appearance of the colour the composite colour stimulus and the tensor that represents it are introduced.

**Colour: Specification; Geometry of Colour-space.** D. L. MacAdam. *J. Franklin Inst.*, 1944, **238**, 195-210. Chromaticity diagrams are presented and discussed. The maximum possible luminous reflectance for each chromaticity is shown, but for technological reasons these theoretical limits are never equalled by actual colorants. The choice of the coordinate system employed in a chromaticity diagram is discussed. Reference is made to recent papers by Moon and Spencer, and it is argued that all the conclusions and recommendations of the authors are incorrect as they are based on a wrong derivation.

**Dichroic Materials: Spectrophotometry by means of Retardation Plates.** G. L. Buic and E. I. Stearns. *J. Optical Soc. America*, 1945, **35**, 521-524. A theory of rotating retardation plate flickering is presented and is compared with the Rochon flickering. It is shown that the problem of getting the absorption of dichroic samples in a single measurement may be solved by the use of a thick retardation plate in a polarisation spectrophotometer, which will duplicate the results of absorption measurements on dichroic samples obtained with unpolarised light. (Dichroism is particularly prevalent in materials like rayon satins.)

**Rapid-response Thermocouples: Design and Construction.** L. C. Roess and E. N. Dacus. *Rev. Sci. Instruments*, 1945, **16**, 164-172. The design and construction of rapid-response thermocouples for use as radiation detectors in infra-red spectographs is described. These thermocouples have an output under radiation interrupted at a frequency of 7 cycles per sec. of not less than half that under continuous radiation, they are as sensitive as ordinary fine-wire thermocouples, and they have resistances of from 20 to 50 ohms. They are made by condensing overlapping bismuth and antimony films about 800 A thick on a film 500 A thick of Formvar, which is stretched across an opening in a glass support. The overlapping region forms the hot junction, which is suitably blackened, and the cold junction is formed by the parts of the films in contact with the glass support. The thermocouples are designed to be operated in a high vacuum. The signal-to-noise ratio (defined as the ratio of the interruption frequency component of the thermocouple output to the square root of the thermocouple resistance) is the only criterion of the goodness of the thermocouple design. In an infra-red spectrograph a single junction thermopile, i.e. a thermocouple has a greater signal-to-noise ratio than a multi-junction thermopile.

**Rugosimeter for Measuring Surface Roughness.** M. Mooney. *Ind. Eng. Chem., Anal. Edn.*, 1945, **17**, 514-517. A new instrument for measuring the surface roughness (rugosity) of calendered raw rubber sheet or similar samples is fully described. The property actually measured is the resistance to air flow between the rough surface and a plane surface resting on it. The rugosity, defined as the height of the hills above the valleys in the surface, can be calculated from the air flow by formulae which are derived by considering an idealised rough surface that has a sinusoidal profile.

**"Sylphon" Bellows Accelerometer.** J. E. Shrader. *J. Franklin Inst.*, 1943, **236**, 333-362. An accelerometer is described that employs a Sylphon bellows instead of the usual pendulum as the active element, and utilises it also as a means of pneumatic damping. If it is required to record the accelerations at a distance, the motions of the bellows may be translated photo-electrically into electric impulses. Mechanical amplification and photographic recording are also described.
Industrial "Lot": Sampling Implications. L. E. Simon. *J. Franklin Inst.*, 1944, 237, 359-370. The "lot" is defined as an aggregation of articles which are essentially alike. The lot-size and the lot itself, with all the properties which describe its quality, are determined by the production process. By taking small samples from arbitrary divisions of the alleged lot and testing them, assurance of a relation between the inspected sample and the uninspected remainder can be obtained. The valid quality prediction then pertains to the echelon one order higher than the unit sampled. Methods of making valid inferences from samples are pointed out.

Integument of Mammals: Uric Acid Content. A. Bolliger. *Australian J. Sci.*, 1945, 7, 150. Using Folin's method (*J. Biol. Chem.*, 1934, 106, 311), further investigations were made on the uric acid content of the hairs of the opossum (*Trichosurus vulpecula*) from different body regions (see also these *Abs.*, 1945, A90). The white hairs nearest to the ventral mid-line contained approximately three times as much uric acid as the black dorsal hairs, the figure for the latter being 70 mg. per cent. In five fully-grown rabbits, the dorsal hairs averaged 470 mg. per cent. uric acid, and the ventral hairs 380 mg. per cent.

**PATENTS**

Metal Hypochlorites: Preparation. Mathieson Alkali Works and C. A. Hampel. B.P. 570,962 of 31/7/1945 and 570,992 of 1/8/1945 (Conv. 24/6/1942). (i) Metal hypochlorites are prepared by the interaction of an alkyl hypochlorite vapour with a metal base. For example, 42 parts of 93 per cent. tert.-butyl hypochlorite vapour carried by a current of moist air are passed through 10 parts of lime in a tube at 25° C. during several hours. The product has 59.2 per cent. Ca (OCl)₂, 22.8% per cent. Ca (OH)₂ and 18 per cent. water. (2) The above reaction is effected between an aqueous slurry of the base and an excess of the alkyl hypochlorite.

Vinyl Polymer Anion Adsorbent: Application. British Thomson-Houston Co. Ltd. B.P. 571,029 of 2/8/1945 (Conv. 11/8/1942). Anions are removed from aqueous solutions by adsorption on an amoniated polymer containing at least one divinyl-aryl compound (e.g. divinylbenzene) with or without a mono­vinyl compound (e.g. styrene).

10—ECONOMICS

Paint, Varnish, Lacquer and Distemper Raw Materials: Post-war Requirements. *J. Oil & Colour Chem. Assoc.*, 1945, 28, 109-116. A survey of recently developed raw materials, including oils, resins, pigments, solvents and plastioisers. It is attempted to assess the extent to which certain materials of foreign origin are likely to be of importance and to indicate the quantities likely to be involved.

Textile Statistics: Importance in Post-war Problems. L. Kuvin. *Industrial Standardization*, 1945, 16, 103-104. The textile technologist of the future should have a working knowledge of techniques and procedure in non-technological fields, including sales service and solution of complaints, product and process development, quality control in manufacture, market research, and merchandising. The statistical data necessary for these activities fall into three broad categories: static facts and grouping, which are the most elementary statistics and of limited use; relationship in time, where problems of correlation or covariation are touched; and dynamic statistics which reflect the quantitative achievement of objectives, by the measurement of performance in terms of these objectives.

Indian Cotton Cloth: Economics of Production. V. G. Ramakrishna Ayyar. *Indian Textile J.*, 1944, 55, 696-698. The costs of production of khadi (hand-woven) and mill cloth are discussed. Khadi is much more expensive than mill cloth, and has a poorer finish, and the wages in the khadi industry are lower than in the mills. On the other hand, the production of one million yards of cloth would give employment to 30,000 labourers on khadi but only 117 in the mill. The choice for India seems to be wide employment and a slightly higher cost or unemployment and cheaper goods.

Indian Textiles: Distribution of Production. L. R. Mehta. *Indian Textile J.*, 1945, 55, 705-707. The author discusses the shortage of cloth in India and
its causes, especially the high export of cloth for other than war purposes, the failure of distribution within the provinces, transport difficulties, and complications of control measures. Recent statistics are tabulated. C.

**Rayon Fabrics: Production in United States, 1944.** Rayon Textile Monthly, 1945, 26, 210-212. The following statistics are tabulated:—(1) Quarterly production (to December, 1944) of rayon broad woven fabrics by type, and the numbers of looms engaged on the different sorts, (2) Machinery in place and active, and (3) weights of rayon yarns consumed by the mills. C.

**Textile Operatives' Wages, January, 1945.** Textile Weekly, 1945, 36, 536. The average earnings for men, youths, women, girls and "all workers" at the last pay-week of January, 1945, are tabulated for the various branches of the textile industry, with the percentage increases over the figures for the last week in October, 1938. C.

**Wool Disposal Scheme.** Wool Rec., 1945, 68, (a)-(h), 35, 42. A conference of officials and experts from the United Kingdom, the Commonwealth of Australia, the Dominion of New Zealand and the Union of S. Africa was held in London, April-May, 1945, to discuss matters arising out of the accumulation of wool purchased by the United Kingdom from the Dominions under the wartime arrangements, and the disposal of stocks concurrently with the future clips of Dominions wool. A report for submission to the Governments represented at the conference was agreed upon unanimously at the final plenary session on 28 May. This report and recommendations are given in full. W.


### 11—INDUSTRIAL WELFARE, INDUSTRIAL PSYCHOLOGY AND EDUCATION

**American Patents System: Relation to Textile Research.** H. W. Rose. Textile Research, 1943, 13, No. 9, 9-16; No. 10, 2-8; No. 11, 10-17. The author discusses the workings of the American patents system as they affect (1) the individual inventor and his right of access to a field already fenced off by patent claims, (2) corporations (especially in the rayon industry), and (3) the commercialization of patents. C.

**"Platt" Cotton Textile Mission Report: Review.** J. A. Barber-Lomax. Textile Weekly, 1945, 36, 498-502, 542-546. The writer offers comments point by point on the "Platt" Report and argues that the chief reasons for the greater production per man-hour in the United States are to be found in the more scientific deployment of labour and assignment of tasks. C.

**Swedish Textile Research Institutes: Organisation.** A. Engblom. "The Svedberg" Commemoration Vol., 1944, 639-658. Recent advances in fundamental and directed textile research are summarized and the present programme and organisation of textile research in Sweden is reviewed, with illustrated descriptions of (1) the Textile Research Institute at Chalmers University of Technology (Gothenburg), Lenning's Institute for Textile Technology (Norrköping), and the Textile Institute (Boras). C.

**Scientific Research and the Pastoral Industry.** I. C. Ross. Pastoral Review, 1945, 55, 427-428. The passage of the Wool Use Promotion Bill through the Commonwealth Parliament will result in funds being made available for a great expansion of research into the problems of the sheep and wool industry. On the producing side, investigation is necessary into sheep diseases (to continue the major achievements of the Council for Scientific and Industrial Research and State Departments of Agriculture), the behaviour of the normal healthy sheep in relation to its environment, and the economic significance of many current practices. There should be laboratory facilities in a main centre for fundamental studies, and also a chain of sheep and wool research stations—covering eventually all the major sheep-growing areas of the Commonwealth—on which data are collected and investigations made into all the associated local problems of soil pastures and animal management, and into local disease incidence and methods of control. Associated with these stations should be agricultural economists investigating all aspects of costs of production of the region and defining the economic significance of measures proposed. W.
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