WHAT PHYSICAL AND CHEMICAL INFLUENCES PRODUCE THE EFFECT OF MERCERIZING COTTON.

In The Revue Generale des Matieres Colorantes Messrs. Fraenkel and Friedlander describe experiments to determine what physical and chemical influences produce the effect obtained by treating cotton by the Thomas and Prevost mercerizing process.

Caustic alkalies in cold solution and at a certain degree of concentration exercise a remarkable influence on cellulose. Solutions of caustic soda exceeding 10 per cent. strength at the ordinary temperature modify the structure of cotton fiber in such a manner that the original flat filaments are transformed into a thick cylindrical shape with a sunken central cavity. This effect is manifested in woven fabrics by a shrinkage in the length and width, and by a corresponding increase in thickness, the fabric at the same time becoming transparent. These changes are attributable to a decisive reaction between the cellulose of the fiber and the alkali, a reaction occurring in the molecular proportion $C_6H_{10}O_{5=2}NaHO$, and accompanied by combination with water. The compound thus formed is decomposed on washing with water, which removes the alkali and leaves the cellulose behind in a modified form—namely, the hydrate $C_6H_{10}O_5H^2O$. If the alkali cellulose compound be treated with alcohol, one-half of the alkali passes into solution, leaving the remainder combined in the form $C_6H_{10}O_5NaHO$. This constitutes the reaction to which the name of "mercerization" has been applied in honor of its inventor, John Mercer. It is probable that the modifications which the cotton undergoes during the foregoing treatment are partly physical and partly chemical. To the latter belongs the action of the caustic soda, resulting in the formation of a readily decomposable cellulose sodium salt, which when washed decomposes and leaves a hydrated cellulose, with increased capacity for fixing dyes and mordants. The physical change effected in the fiber is undoubtedly due to the alteration in volume which is connected with the transformation of the cellulose into its sodium compound.

This explanation, however, although sufficient in respect of the phenomena of mercerization in general, falls short when applied to the observations made by Thomas and Prevost, who showed that the fiber when mercerized while under tension, assumes a different aspect. An explanation of this difference may be found by microscopical examination of the mercerized fiber. The fiber in cotton, as is well known, is covered by a thin skin of cuticle, which varies in thickness according to the kind of cotton, and has a surface more or less roughened in appearance. This skin can be isolated by dissolving out the cellulose by the aid of ammoniacal copper oxide, which causes the distention of the fiber, finally resulting in the rupture of the insoluble skin. Now the microscopic examination of mercerized cotton shows that the fiber, which has then a light silky lustre, and is strongly attacked by bleaching and washing, is entirely destitute of cuticle. The fiber appears quite cylindrical and perfectly transparent, owing to the absence of the rough cuticle, and the conditions necessary to impart a silk lustre are thus entirely fulfilled. The threads, laid as closely together as possible, side by side, form a surface capable of reflecting light. This physical effect is due particularly to the absence of the cuticle, and it is therefore evident that the classes of cotton best suited for the mercerization are those in which the cuticle is least developed, and therefore the most readily eliminated. The nature of the cuticle of cotton fiber is not yet thoroughly understood. Witt considers it as an oxycellulose, but this appears very improbable—for then cotton would possess dyeing properties which it has not. Kulger and Gilsen have made some valuable observations on cork, and the former detected a considerable quantity of fat in suberine. He isolated a crystallizable phellenic acid from cork, while Gilsen isolated cerine, glycerine, and a new acid, phloionic acid, as well as suberic acid. This observer having indicated a characteristic reaction of phellenic acid, the test was applied to cotton, but investigations tend to show that Gilsen's alleged color reaction is based on some error. On the other hand, from the properties of the products extracted from cotton by treating it with 3½ per cent of alcoholic potash, subsequent to extraction with alcohol, ether and sodium carbonate, it is quite probable that the cuticle of the fiber is really a suberous substance. The definite proof must be postponed until a characteristic reagent for phellenic acid shall have been discovered.

The practical significance of this observation is that in all cases the cuticle is dissolved in part by the caustic soda, but that the greater portion is separated by the distension of the fiber, which, in conjunction with the tension exerted during or after the operation in the Thomas and Prevost process, results in its entire removal. Other reagents have been tried to ascertain if the same results could be obtained as with soda, and in particular the action of alcoholic soda was investigated.

When cotton is immersed in a 10 per cent. solution of caustic soda in 96 per cent. alcohol, no effect of mercerization is noticeable, even after prolonged exposure to the reagent. When removed from the liquid the fiber at first preserves its original length and appearance, but after being left in the air a short time while damp the fiber contracts in length and then elongates anew, but it is permanently shortened and appears to be mercerized. If subjected to tension after removal from the alcoholic lye, and washed while still extended, it furthermore assumes a silky lustre. The effects thus obtainable leave nothing to be desired, in comparison with those produced with aqueous solutions. In this case the mercerization is effected by the moisture of the air to which the cotton fiber, moistened with the alcoholic solution, is exposed, and, in fact, if the operation be carried out in the absence of water and atmospheric moisture, with a solution prepared with metallic sodium in alcohol, and then washing with absolute alcohol, no mercerization takes place. The water attracted by the fiber moistened with the alcoholic solution is that necessary for the formation of the sodium compound of cellulose, which is transformed into hydro-cellulose by a larger proportion of water. When the fiber is boiled in alcoholic lye and exposed to air, mercerization also occurs, the sodium compound being formed on withdrawing the fiber from the liquid, but apparently boiling increases the amount of cuticle dissolved.

THE COTTON SITUATION.

Alfred B. Shepperson, the eminent cotton expert, of New York, in a recent contribution to a New York journal gives his views of the present cotton situation and epitomizes salient features as follows: First.—The large receipts of the American crop since September 1 (the beginning of the season) and the large visible supply at this time. Second.—The unusually large quantity of cotton still in the fields and the uncertainty as to how much of it will be saved, and in what condition. Third.—The large proportion of stained and low grade cotton, with the correspondingly small proportion of high grades in the crop. Fourth.—The improved condition of the cotton-goods trade in this country.

He states the quantity of our crop which has come into sight as about four hundred thousand bales greater than to the end of December last season, 1,300,000 bales more than the previous season, and 700,000 bales more than the season of 1894-95, in which the largest crop was ever marketed, except the crop of last season.