1946

The mordanting of cellulose-acetate rayon, nylon, and silk with potassium dichromate

Lorraine Anne Mero
Iowa State College

INFORMATION TO USERS

This manuscript has been reproduced from the microfilm master. UMI films the text directly from the original or copy submitted. Thus, some thesis and dissertation copies are in typewriter face, while others may be from any type of computer printer.

The quality of this reproduction is dependent upon the quality of the copy submitted. Broken or indistinct print, colored or poor quality illustrations and photographs, print bleedthrough, substandard margins, and improper alignment can adversely affect reproduction.

In the unlikely event that the author did not send UMI a complete manuscript and there are missing pages, these will be noted. Also, if unauthorized copyright material had to be removed, a note will indicate the deletion.

Oversize materials (e.g., maps, drawings, charts) are reproduced by sectioning the original, beginning at the upper left-hand corner and continuing from left to right in equal sections with small overlaps.

ProQuest Information and Learning
300 North Zeeb Road, Ann Arbor, MI 48106-1346 USA
800-521-0600

THE MORDANTING OF CELLULOSE-ACETATE RAYON, NYLON, AND SILK WITH POTASSIUM DICHROMATE

by

Lorraine Anne Mero

A Thesis Submitted to the Graduate Faculty
for the Degree of

DOCTOR OF PHILOSOPHY

Major Subject: Textile Chemistry

Approved:

Signature was redacted for privacy.

In Charge of Major Work

Signature was redacted for privacy.

Head of Major Department

Signature was redacted for privacy.

Dean of Graduate College

Iowa State College
1946

UMI Number: DP12459

ProQuest Information and Learning Company
300 North Zeeb Road
P.O. Box 1346
Ann Arbor, MI 48106-1346

TABLE OF CONTENTS

INTRODUCTION

This investigation is an attempt to obtain quantitative information about the inorganic mordanting of cellulose-acetate rayon, nylon, and silk fibroin. The initial pH, concentration, and volume of an aqueous mordanting bath of potassium dichromate, the temperature and time of mordanting, and the weight of fiber are studied as separate factors.

REVIEW OF LITERATURE

The first mordanting with chromium, suggested by Lassaigne in 1819, was the printing of Indiennes at MM. Nichlas Koechlin et frères in Alsace and was accomplished the next year (81), twenty-three years after Vauquelin's discovery of this element which was to become the most important modern mordant (132).

Apparently no quantitative information about the mordanting of cellulose-acetate rayon or nylon with potassium dichromate has been published although use of this salt has been described for mordanting cellulose diacetates (21, 73, 14, 106, 72, 13).

Dr. Ruth Donohue Tevebaugh in the Laboratory of Textile Chemistry at Iowa State College studied the effects of concentration and pH on mordanting of nylon in fifty volumes of aqueous potassium dichromate during one hour at 100° C. and showed that, as the concentration of solute was increased sixfold from 0.0207 g. per gram of fiber, the slight fixation of chromium sesquioxide increased and exhaustion and distribution coefficient decreased logarithmically as equilibrial concentration increased, and that equilibrial pH increased semilogarithmically with equilibrial concentration. She also showed that, as initial pH of mordanting bath, 0.0517 g. solute per gram of fiber, was lowered to 0.95 by hydrochloric acid, nylon lost half its wet strength and fixation (a decreasing rectilinear function of initial pH between 0.85 and 1.5), exhaustion, and distribution

coefficient decreased logarithmically with equilibrial concentration, of which equilibrial pH became an increasing semilogarithmic function, and that under the same conditions, except for an initial pH of 0.85, the nylon fixed 2.60 per cent Cr_2O_3, gained 2.66 per cent in oven-dry weight, changed none in total nitrogen, and lost 59 per cent in wet strength (28).

In 1874 Jacquemin (75) described chromic acid as combining with silk without altering the structure of the silk, and in 1905 Schellens (119) reported a percental fixation of 0.20 on silk immersed several days in fifty volumes of potassium dichromate, 0.0052 g. solute per gram of fiber. The literature seems to offer no other information about the mordanting of silk with potassium dichromate.

EXPERIMENTAL METHODS

Preparation of Samples

Samples of cellulose-acetate rayon for determination of acetyl, ash, and residual weight were cut into rectangles, approximately 1 g. in weight for the first and 2.5 g. in weight for the latter determinations, and the edges were raveled to prevent loss of yarn. All samples of cellulose-acetate rayon were treated with boiling water, rinsed thoroughly, and dried at room temperature. Specimens for warp breaking strength were cut 6 in. in the warp direction and 1.25 in. wide and then raveled to 1 in. by removing an equal number of warp yarns from each side.

Sets of five breaking-strength strips were piled alternately with rectangles and left in the balance room at least fifteen hours before they were weighed. Each rectangle was heated in a tared weighing bottle at 105 to 110° C. for two-hour periods until constant in weight. The oven-dry weight of the other samples was calculated from these data.

Samples of nylon, approximately 1.5 g., were cut, raveled 3/8 in. from edges, and whipped with yarn of the fabric. Breaking-strength strips were cut 6 in. in the filling direction and 1.5 in. wide. A one-inch strip within the width was outlined by drawing a yarn from each side. The wet strips were raveled to the drawn yarns before they were broken. All

rectangles of nylon were heated in tared weighing bottles for two-hour periods at 105 to 110°C. till constant. Sets of five breaking-strength specimens piled alternately with rectangles were left in the balance room fifteen hours before weighing. The rectangles were then heated until constant in tared weighing bottles at 105 to 110°C. for calculation of the oven-dry weight of the breaking-strength strips.

Raw silk crepe was boiled in 100 volumes of 20 per cent olive-oil soap three times for one-hour periods and rinsed thoroughly after each boiling. The degummed silk was then boiled three times, each time in 100 volumes of distilled water for half-hour periods, and rinsed thoroughly after each boiling. After drying at room temperature the silk was cut either into rectangles (approximately 1.5 g.) raveled for 1/8 in. or into warp breaking-strength specimens, 6 in. in the warp direction and 1.25 in. wide and raveled to 1 in. by taking an equal number of warp yarns from each side. All the silk samples were extracted twenty hours with sulfur-free benzene in modified Soxhlet extractors, dried at room temperature, conditioned at least fifteen hours in the balance room, and weighed. For calculation of the oven-dry weight every fifth sample, a rectangle, was heated in a tared weighing bottle at 105 to 110°C. for two-hour periods until constant.

Analysis of New Textiles

The cellulose-acetate rayon was analyzed in the original piece, the silk after degumming. The nylon had been analyzed previously in the Laboratory of Textile Chemistry at Iowa State College (28).

Acetyl (46)

A one-gram sample of cellulose-acetate rayon was placed in a 250-milliliter Erlenmeyer flask containing 40 ml. of 75 per cent ethanol; the flask was loosely stoppered and heated thirty minutes at 50 to 60°C. before 40.00 ml. of approximately 0.25N sodium hydroxide were added. After fifteen minutes more at 50 to 60°C. the flask was tightly stoppered and kept, with occasional swirling, at a temperature not exceeding 35°C. for 24 to 48 hours when the sodium hydroxide in excess was titrated with 0.25N hydrochloric acid, using phenolphthalein as an indicator. An excess of 1 ml. of acid was added and after several hours at room temperature, any acid or alkali then in excess was titrated. Parallel blank determinations were made.

Ash

Four rectangles, each approximately 2.5 g., were dried to constant weight at 105 to 110°C. and ignited to constant weight in a porcelain crucible in a muffle furnace at red heat.

Breaking strength and elongation at breaking load (1).

Forty warp and forty filling specimens were cut as described before and conditioned for one week at 70±2°F. and 65±2 per cent relative humidity. Twenty of each set were then individually clamped under an initial load of 6 ounces between the two-inch jaws of a calibrated Scott Universal Tester whose movable jaw was 3 in. below the stationary jaw. The initial load was removed before the lower jaw was started downward at a speed of 12.0±0.5 in. per minute. The remaining specimens were immersed in distilled water for two hours before they were broken wet.

Elongation at breaking load was measured from the autographically recorded stress-strain curves.

Diameter of fiber.

A fiber was mounted on a slide under a cover glass and examined with the high power of a microscope equipped with a calibrated eyepiece micrometer. The diameters of ten individual fibers from warp and filling yarns were measured.

Distribution of yarns in fabric by number (1).

The warp and filling yarns were counted at ten different places in the fabric, no nearer the selvage than one-tenth the width, with a needle moving against a calibrated metal scale under a magnifying glass.

Distribution of yarns in fabric by weight.

Four two-inch squares, none of the same warp or filling yarns and none cut nearer the selvage than one-tenth the width of the fabric, were conditioned for one week before they were weighed. The warp and filling yarns were raveled and weighed separately.

Moisture.

Four 2.5-gram samples were conditioned for one week, weighed, and dried to constant weight in tared weighing bottles at 105 to 110°C. in an electric oven.

Thickness of fabric.

Thickness was measured at ten different places in the fabric, no nearer the selvage than one-tenth the width, with a Brown and Sharpe micrometer which pressed upon a circle of fabric 0.25 in. in diameter with a pressure of 6 ounces.

Twist of yarn.

The twist of ten warp and ten filling yarns was determined with an Improved United States Testing Company Tester. The yarn was removed from the fabric for a distance of more than 10 in., gripped in the right clamp, and clipped 0.5 in. to the right of the clamp. With locking bar open the yarn was pulled

under definite tension (for a single yarn a load in grams equal to 131 divided by its yarn number in typp) until the index pointer came in line with the starting mark, tightened, clamped ten inches from the right clamp, and clipped 0.5 in. to the left of this clamp. The right clamp was rotated until all twist was removed from the yarn as shown by passing a needle from clamp to clamp between its parallel strands.

The direction of twist of each kind of yarn was observed. A yarn is described as of S twist if, when held in a vertical position, its spirals conform in slope to the central portion of the letter S, of Z twist if the spirals slant as the middle line of the letter Z.

Weight of fabric.

Four samples, 4 in. long and the entire width of the fabric, were conditioned for one week before they were weighed.

Yarn number.

Four ten-yard lengths of each kind of yarn were removed from the fabric, measured, and conditioned for one week before they were weighed.

Reagents

Chromium acetate. C. P. Mallinckrodt Chemical Works.

The percentage of chromic oxide was determined according

to Willard and Diehl (139). Fifteen milliliters of water, 15 ml. of 1:1 phosphoric acid, and 0.4 ml. of 1:1 sulfuric acid were added to 0.25 g. of the chromic salt in a 500-milliliter Erlenmeyer flask and the mixture was heated until the salt dissolved. This solution was diluted to 300 ml., a few pieces of porcelain were added, and after heating to boiling 10 ml. of silver nitrate (2.5 g. per liter) were added. A crystal of ammonium persulfate was cautiously added and then 1.5 to 2.0 g. more till the color of dichromate ion appeared. The solution was boiled ten minutes to decompose the excess of persulfate and then cooled. After the addition of 0.5 ml. of 0.1 per cent oxidized diphenylaminesulfonic acid as indicator, the chromic acid was titrated with 0.1N ferrous sulfate.

Table II.

Determination number	Chromium acetate gram	Ferrous sulfate milliliter of 0.1104N	Cr_2O_3 percentage
1	0.4415	57.90	36.68
2	0.3127	40.97	36.65
3	0.3174	41.60	36.66
Mean			36.66
Deviation			0.01

Diphenylaminesulfonic acid (139)

A stock solution of 0.01M diphenylaminesulfonic acid was made by dissolving 0.32 g. of barium diphenylaminesulfonate in 100 ml. of water, adding 3 ml. of concentrated sulfuric acid, and, after heating and digesting the solution, decanting the liquid from the settled barium sulfate.

To oxidize this solution, a given volume was placed in a small beaker and 5 ml. of water, 5 to 6 drops of 0.02N ferrous sulfate, 3 or 4 drops of concentrated sulfuric acid, and 3 or 4 drops of 0.1N potassium dichromate were added. A solution of 0.02N ferrous sulfate was added dropwise to the purple solution till the color just turned blue-green. This solution of the oxidized indicator was added to the solution to be titrated.

Ferrous ammonium sulfate (139)

A solution of 0.1N ferrous sulfate was prepared by dissolving 40 g. of ferrous ammonium sulfate (General Chemical Company) in water containing 40 ml. of concentrated sulfuric acid and diluting the mixture to 1 liter. This solution was standardized against potassium dichromate the same day that it was used. Samples, 0.16 to 0.24 g., of pure potassium dichromate (General Chemical Company) were dissolved in a little water and 5 ml. of 1:1 sulfuric acid, 5 ml. of 1:1 phosphoric acid, and 0.3 ml. of 0.01M oxidized diphenylamine

indicator, prepared as described before, were added. The mixture was diluted to 300 ml. and titrated with the ferrous sulfate.

Table III.

Determination	Potassium dichromate	Ferrous sulfate	
number	gram	milliliter	normality
1	0.2829	52.29	0.1103
2	0.2042	37.62	0.1107
3	0.1996	36.96	0.1101
Mean			0.1104
Deviation			0.0002
1	0.2040	37.38	0.1113
2	0.2118	38.90	0.1110
3	0.1883	34.57	0.1111
Mean			0.1111
Deviation			0.0001

Hydrochloric acid.

Hydrochloric acid solutions were standardized against sodium hydroxide solutions using phenolphthalein as indicator.

Potassium dichromate. C. P. General Chemical Company

Maximum limit of impurities is 0.037 per cent. The salt yields 0.5167 per cent chromic oxide.

Potassium hydroxide.

Solutions of potassium hydroxide were standardized against weighed portions of 99.95 per cent potassium hydrogen phthalate (General Chemical Company) using phenolphthalein as indicator. The carbonate was precipitated by barium chloride in those solutions which were used for standardization of acid solutions.

Sodium hydroxide.

Solutions of sodium hydroxide were standardized in the same manner as those of potassium hydroxide.

Treatment of Textiles

Mordanting solutions.

All solutions were prepared by dissolving weighed amounts of potassium dichromate in water in volumetric flasks and adding standard hydrochloric acid or potassium hydroxide in such volume as to produce the desired pH after final dilution.

The pH of each solution was determined with a Cameron pH-Meter in the Biophysical Laboratory. The glass electrode of this instrument was calibrated against 0.05M potassium hydrogen phthalate, pH 4.0.

The volume of each solution required for a mordanting bath was measured into an Erlenmeyer flask of appropriate size.

For determining effect of volume at varying pH on fixation on cellulose-acetate rayon, nylon, and silk the 100-volume, 150-volume, 200-volume, 250-volume, and 300-volume mordanting baths were prepared by diluting the fifty-volume bath with water. The pH of each solution was then determined.

Mordanting of cellulose-acetate rayon, nylon, and silk with potassium dichromate.

A set of breaking-strength strips or a rectangle of nylon or silk, treated and weighed as described, was placed in the desired volume of water or mordanting solution at room temperature in an Erlenmeyer flask of appropriate size. The cellulose-acetate rayon was immersed in hot water for a few minutes and squeezed free of as much water as possible before it was put in the mordanting bath. A water-cooled condenser was fitted to each Erlenmeyer flask in a boiling water bath before the mordanting baths were brought to boiling and then refluxed for the reported time. The barometric pressure was observed to determine the temperature of the solution. Each sample was then removed and rinsed, cellulose-acetate rayon was rinsed ten and nylon and silk five times, in distilled water until the final rinse was colorless. Each rectangle was dried at room temperature; the breaking-strength strips were tested wet at once.

Samples treated at temperatures below boiling were put into mordanting baths in Erlenmeyer flasks which had been placed in a constant-temperature bath and brought to the desired temperature, tightly stoppered, and left for a designated period of time. The samples were removed, rinsed, and either dried at room temperature or broken wet at once.

Rectangles of cellulose-acetate rayon, nylon, and silk for determination of residual weight were conditioned at 70±2°F. and 65±2 per cent relative humidity for 48 hours before weighing. The oven-dry weights of the samples to be mordanted were calculated from the mean oven-dry weight of four of these weighed samples which were heated in tared weighing bottles at 105 to 110°C. until constant. The rectangles were put into flasks containing fifty volumes of mordanting solution of different concentrations but the same pH and the tightly stoppered flasks were left for 48 hours in a constant-temperature bath at 40°C. The samples were removed, rinsed, and air-dried; their absorption of light, ash, and residual weight were then determined.

Analysis of Residual Textiles

Absorption of light (3)

Absorption of light by each sample mordanted for residual weight was determined before it was heated in the oven. The

instrument used was a Pfaltz and Bauer Reflectometer Universal Model MU with a voltage of 3.8 and a lamp for an hour. With photocell insert on t he white standard the pointer of the microammeter was set on zero of the scale by means of the regulating resistances; with photocell insert on the black standard the pointer was set on 100 by adjustment of the sensitivity, and resetting and readjustment were continued until the pointer showed zero on the white and 100 on the black without adjustment. Several thicknesses of fabric were used for photometric reading; the mean of five determinations is reported as absorption of light. Absorption of light by each fabric before mordanting was also determined.

Acetyl.

Acetyl of mordanted cellulose-acetate rayon was determined as for the new textiles. To correct for the amount of sodium hydroxide which had reacted with the fixed dichromate, weighed portions of potassium dichromate, corresponding to weights of chromic oxide fixed on the cellulose-acetate rayon at different pH, were treated in parallel with analysis of the residual textile for acetyl.

Ash.

Total ash was determined for the mordanted as for the new textiles.

The chromic oxide in the ash was determined by a modification of the method of Race, Rowe, Speakman, and Vickerstaff[112]. The ash was oxidized by boiling with a mixture of 10 ml. of concentrated sulfuric acid, 30 ml. of concentrated nitric acid, and 10 ml. of 70 per cent perchloric acid in an Erlenmeyer flask under a hood. After oxidation was complete (thirty minutes to an hour) the solution was cooled a minute and 40 ml. of water were added. The mixture was boiled again three or four minutes, diluted, and cooled. The chromic acid was titrated with ferrous sulfate using oxidized diphenylaminesulfonic acid as indicator.

Table IV.

Determination number	Fiber gram	Ash gram	Ferrous sulfate milliliter of 0.1111N	Cr_2O_3 Determined gram	Cr_2O_3 Determined percentage	Cr_2O_3 Calculated* percentage
A. Cellulose-acetate rayon						
1	2.4574	0.0640	22.00	0.0619	2.52	2.54
2	2.4604	0.0259	8.73	0.0245	1.00	0.99
3	2.4651	0.0355	12.25	0.0345	1.40	1.38
B. Silk						
1	1.2679	0.0797	27.78	0.0782	6.17	6.16
2	1.2251	0.0780	27.40	0.0771	6.29	6.24
3	1.2192	0.0777	27.10	0.0763	6.26	6.24

* Percentage of ash minus 0.06 per cent for ash of cellulose-acetate rayon and minus 0.13 per cent for ash of silk.

Breaking strength.

Wet breaking strength was determined for the mordanted fabric as for the new textiles.

Residual weight.

Residual conditioned weight of each textile was determined by weighing the mordanted samples after conditioning them for 48 hours at 70±2°F. and 65±2 per cent relative humidity. To obtain the residual oven-dry weight each sample was then heated for two-hour periods in a tared weighing bottle at 105 to 110°C. until constant in weight.

DERIVED TABLES

TABLE 1. ANALYSIS OF NEW TEXTILES

Determination	Cellulose-acetate	Nylon*	Silk
1. Fabric			
Acetyl, percentage of fabric	38.57(0.06)**		
Ash, percentage of fabric	0.14(0.00)	0.35(0.01)	0.18(0.00)
Breaking strength of fabric			
Warp			
Conditioned, pound/inch	59(2)	95(4)	24(2)
Wet, pound/inch	32(2)	79(4)	18(2)
Filling			
Conditioned, pound/inch	18(0)	41(0)	20(2)
Wet, pound/inch	8(0)	34(0)	15(1)
Carbon, percentage of nylon***		63.56(0.07)	
Distribution of yarns in fabric			
Warp, number/inch	231(2)	236(1)	174(3)
percentage by weight	76.0(0.3)	70.04(0.04)	64.6(0.1)
Filling, number/inch	69(0)	104(0)	130(3)
percentage by weight	24.3(0.1)	30.16(0.07)	37.4(0.8)
Elongation of fabric at breaking load			
Warp			
Conditioned, percentage	24	32	24
Wet, percentage	35	29	33
Filling			
Conditioned, percentage	32	30	21
Wet, percentage	44	31	26
Hydrogen, percentage of nylon***		9.75(0.05)	

* Donohue, R. O. The chemical resistance of polyhexamethylene adipamide. Unpublished Ph. D. Thesis, Ames, Iowa, Iowa State College Library, 1942.

** Mean deviations are within parentheses.

*** The weight of nylon was corrected for 0.35 per cent of ash.

TABLE I. (Continued)

Determination	Cellulose-acetate	Nylon	Silk
Moisture, percentage by weight at 70 -2°F and 62 - 2 per cent R. H.	4.17(0.04)	2.97(0.04)	8.24(0.02)
Nitrogen, percentage of nylon***		12.08(0.03)	
Oxygen, percentage of nylon****		14.61	
Sulfur, percentage of nylon		None	
Thickness, inch x 10^3	2.80(0.07)	3.5(0.1)	6.90(0.37)
Titanium dioxide			
By the KWCZ Photometer, percentage of fabric		0.28(0.01)	
By the Nessler method, percentage of fabric		0.29(0.01)	
Weave	4/1 satin	2/1 filling rib	plain
Weight, ounce/square yard	3.71(0.01)	2.00(0.00)	1.82(0.01)
2. Fiber			
Diameter			
Warp, inch x 10^3	2.518(0.484)	0.73(0.003)	1.208(0.206)
Filling, inch x 10^3	4.427(0.373)		1.241(0.154)
Dechroism		Positive	
Length	Continuous	Continuous	Continuous
Melting point			
By macroscopic method, °C		248.8(0.6)	
By microscopic method, °C		250.5(0.5)	
Refractive index for ray vibrating lengthwise		1.501 to 1.550	

*** The weight of nylon was corrected for 0.35 per cent of ash.

**** Calculated by difference.

TABLE 1. (Continued)

Determination	Cellulose-acetate	Nylon	Silk	
3. Yarn				
Twist				
Warp, number/inch	2.8(0.2)	17(2)	74.8(0.9), 77.0(0.2)	
direction	Z	Z	S	Z
Filling, number/inch	2.4(0.2)	15(2)	74.1(1.1), 73.5(0.09)	
direction	Z	Z	S	Z
Yarn number				
Warp, typp	47.77(0.49)	95.8(0.3)	86.4(2.5)	
Filling, typp	44.33(0.16)	97.4(0.3)	111(0)	

TABLE 2. EFFECT OF INITIAL pH OF FIFTY-VOLUME MORDANTING BATH OF POTASSIUM DICHROMATE ON ACETYL, FIXATION OF MORDANT, AND WET STRENGTH OF FIBER IN ONE HOUR AT BOILING.

Initial pH of bath	Fiber			
	Acetyl	Fixation	Wet breaking strength of fabric	
	percentage of fiber	gram Cr_2O_3/ 100 g. fiber	pound/ inch	percentage of original wet strength
A. Cellulose-acetate rayon, 2.0000 g. $K_2Cr_2O_7$/ gram fiber				
0.91			16(1)	50
0.95	37.36(0.23)*	1.29(0.04)	17(1)	53
1.00	37.63(0.09)	1.33(0.02)	18(0)	56
1.10	37.85(0.08)	1.48(0.02)	20(1)	62
1.17	37.84(0.14)	1.88(0.03)	20(1)	62
1.22	37.88(0.44)	3.13(0.02)	22(1)	69
1.29	37.37(0.16)	4.03(0.05)	22(1)	69
1.32	37.34(0.13)	3.90(0.03)	25(1)	78
1.43	37.35(0.07)	3.04(0.10)	27(1)	84
1.50	37.72(0.28)	2.62(0.04)	29(1)	91
1.57	38.25(0.11)	1.79(0.02)	29(1)	91
1.62	38.28(0.15)	1.33(0.03)	29(2)	91
1.67	38.05(0.18)	0.96(0.01)	31(1)	97
1.96		0.64(0.00		
1.99	37.91(0.16)	0.55(0.04)	31(1)	97
2.27	37.12(0.21)	0.29(0.02)	32(1)	100
3.72			33(2)	103
5.33			34(2)	106
5.68			34(1)	106
6.10			35(1)	109
6.47			35(1)	109
6.68			33(3)	103
6.88			34(1)	106

* Mean deviations are within parentheses.

TABLE 2. (Continued)

Initial pH of bath	Fiber			
	Acetyl	Fixation	Wet breaking strength of fabric	
	percentage of fiber	gram Cr_2O_3/ 100 g. fiber	pound/ inch	percentage of original wet strength
B. Nylon, 0.5000 g. $K_2Cr_2O_7$/ gram fiber				
0.93		10.30(0.02)		
1.05		9.49(0.01)		
1.10		8.33(0.05)		
1.15		7.71(0.04)		
1.36		5.79(0.05)		
1.70		2.64(0.03)		
2.08		0.86(0.04)		
3.72		0.27(0.00)		
C. Silk, 0.5000 g. $K_2Cr_2O_7$/ gram fiber				
0.93		6.61(0.02)	< 1	
1.05		7.65(0.05)	< 1	
1.15		8.59(0.10)	< 1	
1.21		8.36(0.03)	3(1)	17
1.36		8.17(0.06)	4(1)	22
1.70		6.25(0.06)	7(1)	39
2.03		2.92(0.03)	13(2)	72
2.32		1.39(0.03)	17(2)	94
3.72		0.17(0.00)		
6.47		0.51(0.02)		
8.65		*	*	
D. Silk**, 0.5000 g. $K_2Cr_2O_7$/ gram fiber				
0.96		6.79(0.04)		
1.05		7.85(0.07)		
1.15		8.55(0.27)		
1.21		8.34(0.05)		
1.36		8.58(0.50)		
1.70		6.40(0.13)		
2.03		2.92(0.05)		
2.32		1.39(0.02)		
3.72		0.17(0.00)		

* Degradation too great for determination
** Not extracted with benzene

Table 3. Effect of Concentration of Fifty-volume Mordanting Bath of P
Fixation of Mordant, and Absorption of Light by Mordanted Fi

Mordanting bath: Initial concentration gram Cr_2O_3/gram fiber	pH	Mordanting bath: Initial concentration mole $K_2Cr_2O_7$/liter	Equilibrial: Exhaustion percentage of total solute	Equilibrial: Distribution coefficient Cf/os	Weight: Conditioned percentage of conditioned weight	Weight: Oven-dry percentage of calculated dry weight
A. Cellulose-acetate rayon						
0.05167	1.26	0.0056	17.0	10	101.24(0.02)*	98.49(0.07)
0.2584	1.27	0.0298	12.4	7.07	105.09(0.00)	101.26(0.02)
0.5167	1.28	0.0620	8.77	4.80	107.44(0.07)	102.78(0.06)
1.0334	1.29	0.1282	5.70	3.02	109.62(0.05)	104.42(0.03)
2.0668	1.29	0.2630	3.28	1.70	111.47(0.09)	105.21(0.03)
	1.30	0.3292	3.13	1.62		
B. Nylon						
0.005167	1.12	0.0003	62	80		
0.05167	1.13	0.0026	61.5	79.9		
0.2584	1.15	0.0253	25.7	17.3		
0.5167	1.15	0.0588	13.4	7.76		
0.7750	1.15	0.0930	8.79	4.82		
C. Nylon**						
0.005167	1.11	0.0003	60	70	100.57(0.02)	100.34(0.02)
0.05167	1.13	0.0026	61.4	79.4	104.81(0.15)	104.08(0.04)
0.2584	1.15	0.0247	27.3	18.8	110.26(0.16)	109.24(0.05)
0.5167	1.15	0.0585	13.9	8.10	110.58(0.18)	109.35(0.05)
0.7750	1.15	0.0920	9.73	5.39	111.06(0.05)	109.63(0.06)
D. Silk						
0.02584	1.67	0.0015	55.3	62.0	102.66(0.24)	100.59(0.46)
0.05167	1.68	0.0038	43.9	39.2	103.80(0.09)	101.55(0.04)
0.2584	1.70	0.0294	13.7	7.91	105.84(0.26)	103.14(0.08)
0.5167	1.70	0.0629	7.53	4.07	106.59(0.38)	103.66(0.34)
0.7750	1.70	0.0965	5.39	2.85	107.56(0.16)	104.46(0.04)
	1.70	0.1978	2.99	1.54		

*Mean deviations are within parentheses.
**Not heated before mordanting.

Bath of Potassium Dichromate on the Residual Weight of Fiber,
danted Fiber in 48 hours at 40°C.

m-dry rcentage calculated r weight	Residual fiber x/m gram Cr_2O_3/ 100 g. fiber	gram $K_2Cr_2O_7$/ gram fiber	Calculated from conditioned weight gram Cr_2O_3/ 100 g. fiber	fraction of determined fiber	Absorption of light increased percentage	k	n slope of $x/m = kc^n$
3.49(0.07)	0.88(0.01)	0.017	0.64	0.73	47.0(2.4)	1.3	0.84
1.26(0.02)	3.20(0.02)	0.0619	2.63	0.82	68.2(3.9)	1.2	
3.78(0.06)	4.53(0.01)	0.0877	3.84	0.85	76.8(4.7)	0.24	0.36
4.42(0.03)	5.89(0.05)	0.114	4.97	0.84	77.1(1.3)	0.24	
5.21(0.03)	6.78(0.04)	0.131	5.93	0.87	80.3(2.2)	0.21	
	8.09(0.03)	0.157				0.23	
	0.32(0.03)	0.0062			18.2(1.5)	50	1.11
	3.18(0.01)	0.0615			61.0(0.8)	46	
	6.64(0.06)	0.129			74.6(0.6)	0.16	0.06
	6.94(0.02)	0.134			78.1(0.8)	0.16	
	6.81(0.02)	0.132			76.5(0.3)	0.15	
0.34(0.02)	0.30(0.02)	0.0058	0.29	0.97	16.0(1.6)	56	1.13
4.08(0.04)	3.17(0.03)	0.0614	2.49	0.79	61.5(2.1)	51	
9.24(0.05)	7.05(0.03)	0.136	5.30	0.75	76.5(0.5)	0.16	0.08
9.35(0.05)	7.20(0.06)	0.139	5.47	0.76	76.3(0.2)	0.16	
9.63(0.06)	7.54(0.03)	0.146	5.71	0.76	77.0(0.3)	0.16	
0.59(0.46)	1.43(0.00)	0.0277	1.37	0.96	41.3(1.2)	0.87	0.53
1.55(0.04)	2.27(0.00)	0.0439	1.96	0.86	50.2(0.8)	0.84	
3.14(0.08)	3.53(0.02)	0.0683	3.02	0.86	56.9(0.4)	0.10	0.12
3.66(0.34)	3.89(0.04)	0.0753	3.41	0.88	61.9(0.2)	0.10	
4.46(0.04)	4.18(0.01)	0.0809	3.91	0.94	62.9(1.2)	0.11	
	4.63(0.04)	0.0896				0.11	

TABLE 4. EFFECT OF CONCENTRATION OF FIFTY-VOLUME BATH OF POTASSIUM DICHROMATE ON FIXATION OF MORDANT IN ONE HOUR AT BOILING.

Mordanting bath				X/m		k	n
Initial	Equilibrial						
pH	C	Exhaustion	Distribution coefficient				
	mole $K_2Cr_2O_7$/liter	percentage of total solute	Cf/Cs	gram Cr_2O_3/100 g.fiber	gram $K_2Cr_2O_7$/gram fiber		slope of $X/m=kc^n$
A. Cellulose-acetate rayon							
1.26	0.0062	8.3	4.5	0.43(0.01)*	0.0083	0.94	0.93
1.27	0.0314	7.47	4.04	1.93(0.01)	0.0374	0.93	
1.28	0.0637	6.23	3.32	3.22(0.01)	0.0623	0.19	0.40
1.29	0.0971	4.81	2.53	3.73(0.01)	0.0722	0.18	
1.29	0.1307	3.90	2.03	4.03(0.05)	0.0780	0.18	
1.29	0.1646	3.14	1.62	4.06(0.05)	0.0786	0.16	
1.29	0.1979	2.93	1.52	4.57(0.04)	0.0884	0.17	
1.29	0.2311	2.83	1.46	5.12(0.06)	0.0991	0.18	
1.30	0.2644	2.76	1.42	5.71(0.04)	0.111	0.19	
1.30	0.3323	2.22	1.13	5.73(0.08)	0.111	0.17	
B. Nylon							
1.11	0.0004	42	37	0.22(0.01)	0.0043	6.2	0.93
1.12	0.0021	38.8	31.6	1.00(0.04)	0.0194	6.0	
1.13	0.0042	38.3	31.0	1.98(0.06)	0.0383	6.2	
1.14	0.0108	36.4	28.7	4.71(0.03)	0.0912	6.2	
1.15	0.0239	29.8	21.3	7.71(0.04)	0.149	0.49	0.32

* Mean deviations are within parentheses.

TABLE 4. (Continued)

Mordanting bath				X/m		k	n
Initial pH	Equilibrial C	Exhaustion	Distribution coefficient				
	mole $K_2Cr_2O_7$/liter	percentage of total solute	Cf/Cs	gram Cr_2O_3 / 100 g.fiber	gram $K_2Cr_2O_7$/gram fiber		slope of $X/m=kc^n$
1.15	0.0394	22.7	14.7	8.80(0.04)	0.170	0.48	
1.15	0.0553	18.6	11.4	9.62(0.08)	0.186	0.47	
1.15	0.0879	13.8	7.99	10.68(0.03)	0.207	0.45	
1.15*	0.1197	11.9	6.77	12.32(0.08)	0.238		
1.16*	0.1534	9.72	5.39	12.57(0.09)	0.243		
1.16*	0.1870	8.29	4.52	12.85(0.05)	0.249		
C. Silk							
1.65	0.0016	53.1	56.6	1.37(0.01)	0.0265	5.2	0.82
1.66	0.0035	48.5	47.2	2.51(0.01)	0.0486	5.0	
1.69	0.0112	33.8	25.6	4.37(0.07)	0.0846	0.37	0.33
1.70	0.0258	24.2	16.0	6.25(0.06)	0.121	0.40	
1.70	0.0420**	17.6	10.7	6.82(0.08)	0.132		
1.70	0.0583**	14.3	8.32	7.37(0.01)	0.143		

* Visible degradation of fiber.
** Equilibrial solution was turbid.

TABLE 5. EFFECT OF CONCENTRATION OF FIFTY-VOLUME MORDANTING BATH OF CHROMIUM ACETATE ON FIXATION OF MORDANT ON SILK IN ONE HOUR AT BOILING.

Initial pH of bath	Equilibrial bath			X/m		k	n
	C	Exhaustion	Distribution coefficient				
	mole $(CH_3COO)_3Cr$ / liter	percentage of total solute	Cf/Cs	gram Cr_2O_3/ 100 g. fiber	gram $(CH_3COO)_3Cr$ / gram fiber		slope of $X/m=kc^n$
4.38	0.0320	5.22	2.75	1.34(0.04)*	0.0404	0.19	0.45
4.42	0.0649	3.88	2.02	1.99(0.02)	0.0600	0.21	
4.44	0.0983	2.91	1.50	2.24(0.02)	0.0675	0.21	
4.45	0.1317	2.46	1.26	2.53(0.04)	0.0763	0.21	

* Mean deviations are within parentheses.

TABLE 6. EFFECT OF TEMPERATURE OF FIFTY-VOLUME MORDANTING BATH OF POTASSIUM DICHROMATE ON FIXATION OF MORDANT IN ONE HOUR

Mordanting bath Temperature °A.	Equilibrial Exhaustion percentage of total solute	Distribution coefficient Cf/Cs	X/m gram Cr_2O_3/ 100 g.fiber	X/m gram $K_2Cr_2O_7$/ gram fiber
A. Cellulose-acetate rayon, 2.0000 g. $K_2Cr_2O_7$/ gram fiber at pH 1.29.				
298.0	0.06	0.03	0.06(0.00)*	0.0012
313.0	0.12	0.06	0.12(0.00)	0.0023
333.0	0.44	0.22	0.45(0.01)	0.0087
353.0	1.55	0.79	1.60(0.06)	0.0310
372.0	3.90	2.03	4.03(0.05)	0.0780
B. Nylon, 0.5000 g. $K_2Cr_2O_7$/ gram fiber at pH 1.15.				
300.0	3.2	1.7	0.83(0.01)	0.016
313.0	5.57	2.95	1.44(0.03)	0.0279
353.0	16.3	9.76	4.22(0.08)	0.0817
372.4	29.8	21.3	7.71(0.04)	0.149
C. Silk, 0.5000 g. $K_2Cr_2O_7$/ gram fiber at pH 1.70.				
298.0	1.9	0.95	0.48(0.03)	0.0093
313.0	2.5	1.3	0.65(0.01)	0.013
333.0	5.61	2.97	1.45(0.02)	0.0281
353.0	11.0	6.17	2.84(0.02)	0.0550
371.6	24.2	16.0	6.25(0.06)	0.121

* Mean deviations are within parentheses.

Table 7. Effect of Time of Mordanting on Fixation of Mordant from Fifty

t	Equilibrial bath			x/m		k x
	pH	Exhaustion	Distribution coefficient			
minute		percentage of total solute	Cf/cs	gram Cr_2O_3/ 100 g. fiber	gram $K_2Cr_2O_7$/ gram fiber	
A. Cellulose-acetate rayon, 2.000 g. $K_2Cr_2O_7$/ gram fiber at pH 1.29						
60		0.12	0.058	0.12(0.00)*	0.0023	0.03
240	1.42	0.45	0.22	0.46(0.01)	0.0089	0.02
540	1.44	1.28	0.637	1.30(0.02)	0.0252	0.03
960	1.48	2.35	1.20	2.43(0.03)	0.0470	0.03
1500	1.53	3.40	1.76	3.51(0.01)	0.0679	0.03
2160	1.60	4.64	2.44	4.80(0.08)	0.0929	0.02
2940	1.65	5.65	2.99	5.84(0.02)	0.113	4.6
3840	1.83	6.79	3.64	7.02(0.04)	0.136	5.0
4320		7.37	3.98	7.62(0.00)	0.147	5.2
4860		7.91	4.29	8.17(0.00)	0.158	5.3
5520		8.30	4.53	8.58(0.01)	0.166	5.3
6000	2.00	8.49	4.64	8.77(0.02)	0.170	5.2
12660	1.98	11.03	6.199	11.40(0.04)	0.2206	5.0
29100	2.02	11.66	6.600	12.05(0.05)	0.2332	3.8
B. Nylon, 0.5000 g. $K_2Cr_2O_7$/ gram fiber at pH 1.15						
60		5.61	2.97	1.45(0.03)	0.0281	5.0
240	1.18	10.0	5.57	2.59(0.04)	0.0501	5.0
540		14.3	8.33	3.69(0.02)	0.0714	5.1
960	1.22	18.8	11.6	4.85(0.02)	0.0939	5.2
1500	1.26	22.5	14.5	5.81(0.08)	0.112	5.2
2160	1.32	25.2	16.8	6.51(0.05)	0.126	5.0
2940	1.43	27.0	18.5	6.99(0.08)	0.135	3.8
3840		28.8	20.2	7.43(0.11)	0.144	3.8
6000	1.50	30.8	22.3	7.96(0.06)	0.154	3.8
6840**	1.70	30.3	21.7	7.82(0.01)	0.151	

*Mean deviations are within parentheses.

**Visible degradation of fiber.

tion of Mordant from Fifty-volume Bath of Potassium Dichromate at 40°C.

x/m		k x 10^3	n	Velocity constant	Diffusion constant	Wet strength of mordanted fabric
r	gram $K_2Cr_2O_7$/ gram fiber		slope of $x/m = kt^n$	mole/liter/ minute $\frac{10^4(C_o-C)}{t(C_o \times C)}$	$\frac{D \times 10^5}{r^2}$	percentage of original wet strength
: pH 1.29						
*	0.0023	0.031	1.05	1.4		
	0.0089	0.028		1.4		94
	0.0252	0.034		1.7		94
	0.0470	0.035		1.8	0.9	88
	0.0679	0.031		1.7	1.3	81
	0.0929	0.029		1.7	1.8	84
	0.113	4.6	0.40	1.5	2.0	91
	0.136	5.0		1.4	2.4	88
	0.147	5.2		1.4	2.6	
	0.158	5.3		1.3	2.8	
	0.166	5.3		1.2	2.8	
	0.170	5.2		1.1	2.7	94
	0.2206	5.0		0.72	3.5	
	0.2332	3.8		0.33		72
	0.0281	5.0	0.42	290	12	
	0.0501	5.0		140	10	68
	0.0714	5.1		91	10	
	0.0939	5.2		71	11	32
	0.112	5.2		57	11	18
	0.126	5.0		46	11	9
	0.135	3.8	0.16	37	10	6
	0.144	3.8		31	10	
	0.154	3.8		22		
	0.151			19		

Table 7. (Continued)

t	Equilibrial bath			x/m		$k \times 10^3$
	pH	Exhaustion	Distribution coefficient			
minute		percentage of total solute	Cf/cs	gram Cr_2O_3/ 100 g. fiber	gram $K_2Cr_2O_7$/ gram fiber	
C. Silk, 0.5000 g. $K_2Cr_2O_7$/gram fiber at pH 1.70						
60		2.5	1.3	0.65(0.01)	0.013	2.3
240	1.92	5.03	2.65	1.30(0.00)	0.0252	2.5
540	2.10	7.35	3.97	1.90(0.02)	0.0368	2.6
960	2.25	9.64	5.33	2.49(0.02)	0.0482	2.7
1500	2.40	10.9	6.10	2.89(0.01)	0.0544	2.5
2160	2.60	12.7	7.29	3.29(0.02)	0.0637	2.5
2940	2.85	14.4	8.44	3.73(0.01)	0.0722	2.5
4320	3.20	16.5	9.86	4.26(0.04)	0.0824	2.4
7200	3.40	20.6	12.9	5.31(0.02)	0.103	2.5
10140	3.50	25.0	16.7	6.46(0.02)	0.125	2.6
13740	3.70	29.6	21.1	7.66(0.03)	0.148	2.7

am $K_2Cr_2O_7$/ am fiber	$k \times 10^3$	n	Velocity constant	Diffusion constant	Wet strength of mordanted fabric
		slope of $x/m = kt^n$	mole/liter/minute $\frac{10^4(C_o-C)}{t(C_o \times C)}$	$\frac{D \times 10^5}{r^2}$	percentage of original wet strength
0.013	2.3	0.42	130		
0.0252	2.5		65	2.5	89
0.0368	2.6		43	2.6	78
0.0482	2.7		33	2.5	72
0.0544	2.5		24	2.1	61
0.0637	2.5		20	2.1	56
0.0722	2.5		17	2.0	50
0.0824	2.4		13	1.9	44
0.103	2.5		11	2.0	39
0.125	2.6		9.7	2.6	
0.148	2.7		9.0		

TABLE 8. EFFECT OF TIME OF MORDANTING ON FIXATION OF MORDANT FROM FIFTY-VOLUME BATH OF POTASSIUM DICHROMATE AT BOILING.

t	Equilibrial bath		X/m		kx10	n	Velocity constant	Diffusion constant
	Exhaustion	Distribution coefficient						
minute	percentage of total solute	Cf/Cs	gram Cr_2O_3/ 100 g.fiber	gram $K_2Cr_2O_7$/ gram fiber	slope of X/m=kt		mole/liter minute $\frac{10^4(C_o-C)}{t(C_o x C)}$	$\frac{Dx10^5}{r^2}$
A. Cellulose-acetate rayon, 2.000 g. $K_2Cr_2O_7$/ gram fiber at pH 1.29.								
15	1.35	0.087	1.40(0.01)*	0.0271	2.2	0.92	67	47
30	2.44	1.25	2.52(0.00)	0.0488	2.1		61	87
45	3.60	1.87	3.72(0.00)	0.0720	2.2		61	140
60	3.90	2.03	4.03(0.05)	0.0780	18	0.36	50	130
120	4.92	2.58	5.08(0.04)	0.0983	18		32	110
240	7.22	3.89	7.46(0.05)	0.144	20		24	
B. Nylon, 0.5000 g. $K_2Cr_2O_7$/ gram fiber at pH 1.15.								
15	12.5	7.17	3.24(0.02)	0.0627	13	0.58	2800	190
30	18.8	11.6	4.86(0.06)	0.0941	13		2300	240
45	23.5	15.4	6.08(0.04)	0.118	13		2000	280
60	29.8	21.3	7.71(0.04)	0.149	14		2100	430
90	35.6	27.6	9.19(0.10)	0.178	13		1800	
120**	39.3	32.4	10.16(0.06)	0.197			1600	
180**	46.8	44.0	12.09(0.01)	0.234			1400	

* Mean deviations are within parentheses.
** Visible degradation of fiber.

TABLE 8. (Continued)

t	Equilibrial bath		X/m		kx10^3	n	Velocity Constant	Diffusion Constant
	Exhaustion	Distribution coefficient						
minute	percentage of total solute	Cf/Cs	gram Cr_2O_3/ 100 g.fiber	gram $K_2Cr_2O_7$/ gram fiber		slope of $X/m=kt^n$	mole/liter/ minute $\frac{10^4(C_o-C)}{t(C_o x C)}$	$\frac{Dx10^5}{r^2}$
C. Silk, 0.5000 g. $K_2Cr_2O_7$/ gram fiber at pH 1.70.								
15	11.0	6.17	2.84(0.05)	0.0550	12	0.57	2400	340
30	15.7	9.30	4.05(0.04)	0.0784	11		1800	400
45	20.3	12.8	5.25(0.05)	0.102	12		1700	590
60	24.2	16.0	6.25(0.07)	0.121	12		1600	
90*	29.4	20.8	7.59(0.03)	0.147			1400	
120*	31.0	22.5	8.01(0.08)	0.155			1100	

* Equilibrial solution was turbid.

TABLE 9. EFFECT OF VOLUME OF MORDANTING BATH OF POTASSIUM DICHROMATE ON FIXATION OF MORDANT IN ONE HOUR AT BOILING

Mordanting bath				X/m	
Initial		Equilibrial			
V	pH	Exhaustion	Distribution coefficient		
milliliter/gram fiber		percentage of total solute	Cf/Cs	gram Cr_2O_3/100 g.fiber	gram $K_2Cr_2O_7$/gram fiber
A. Cellulose-acetate rayon, 2.0000 g. $K_2Cr_2O_7$/ gram fiber					
50	1.30	3.90	2.03	4.03(0.05)*	0.0780
100	1.39	1.27	1.28	1.31(0.02)	0.0254
150	1.57	0.45	0.69	0.47(0.02)	0.0091
200	1.70	0.31	0.62	0.32(0.02)	0.0062
250	2.04	0.19	0.48	0.20(0.01)	0.0039
300	2.17	0.15	0.44	0.15(0.02)	0.0029
100	1.30	3.29	3.40	3.40(0.01)	0.0658
150	1.30	2.50	3.84	2.58(0.05)	0.0499
200	1.30	1.95	3.99	2.02(0.02)	0.0391
250	1.30	1.69	4.30	1.75(0.01)	0.0339
300	1.30	1.36	4.15	1.41(0.02)	0.0273
B. Nylon, 0.5000 g. $K_2Cr_2O_7$/ gram fiber					
50	1.15	29.8	21.3	7.71(0.04)	0.149
100	1.45	12.1	13.8	3.13(0.04)	0.0606
150	1.64	6.89	11.1	1.78(0.01)	0.0344
200	1.75	3.99	8.30	1.03(0.01)	0.0199
250	1.83	3.2	8.2	0.82(0.01)	0.016
300	1.92	2.4	7.5	0.63(0.00)	0.012
100	1.15	22.1	28.3	5.70(0.03)	0.110
150	1.15	17.1	30.9	4.41(0.04)	0.0853
200	1.15	13.2	30.4	3.41(0.07)	0.0660
250	1.15	11.1	31.4	2.88(0.03)	0.0557
300	1.15	9.48	31.4	2.45(0.05)	0.0474
C. Silk, 0.5000 g. $K_2Cr_2O_7$/ gram fiber					
50	1.70	24.1	16.0	6.25(0.06)	0.121
100	1.92	16.5	19.7	4.26(0.04)	0.0824

* Mean deviations are within parentheses

TABLE 9. (Continued)

Mordanting bath				X/m	
Initial		Equilibrial			
V	pH	Exhaustion	Distribution coefficient		
milliliter/gram fiber		percentage of total solute	Cf/Cs	gram Cr_2O_3/100 g.fiber	gram $K_2Cr_2O_7$/gram fiber
150	2.13	12.1	20.6	3.12(0.00)	0.0604
200	2.24	9.79	21.7	2.53(0.01)	0.0490
250	2.34	8.09	22.0	2.09(0.01)	0.0404
300	2.43	6.81	21.9	1.76(0.02)	0.0341

TABLE 10. EFFECT OF WEIGHT OF FIBER ON FIXATION OF MORDANT FROM 600-MILLILITER BATH OF POTASSIUM DICHROMATE IN ONE HOUR AT BOILING.

m	Equilibrial bath		X/m	
gram	Exhaustion percentage of total solute	Distribution coefficient Cf/Cs	gram Cr_2O_3/ 100 g.fiber	gram $K_2Cr_2O_7$/ gram fiber
A. Cellulose-acetate rayon, 2.0000 g. $K_2Cr_2O_7$ at pH 1.30.				
1.0244(0.0104)*	0.80	4.7	0.81(0.01)	0.016
3.9989(0.0143)	2.8	4.3	0.72(0.00)	0.014
7.1343(0.0506)	4.6	4.1	0.67(0.01)	0.013
9.8247(0.0234)	6.0	3.9	0.63(0.02)	0.012
13.0558(0.0441)	7.5	3.7	0.59(0.01)	0.011
B. Nylon, 0.5000 g. $K_2Cr_2O_7$ at pH 1.15				
1.0164(0.0052)	4.51	27.9	3.44(0.05)	0.0666
4.0464(0.0167)	16.7	29.6	3.19(0.05)	0.0617
7.1953(0.0417)	25.7	28.9	2.77(0.01)	0.0536
10.3690(0.0500)	34.8	30.9	2.60(0.03)	0.0503
13.4398(0.0752)	41.3	31.4	2.38(0.04)	0.0461
C. Silk, 0.5000 g. $K_2Cr_2O_7$ at pH 1.70				
1.0211(0.0017)	9.88	64.4	2.50(0.03)	0.0484
4.0876(0.0126)	31.1	66.5	1.97(0.01)	0.0381
7.2278(0.0330)	43.1	62.8	1.54(0.00)	0.0298
10.1008(0.0576)	50.0	59.5	1.28(0.00)	0.0247
13.3136(0.0334)	55.1	55.4	1.07(0.00)	0.0207

* Mean deviations are within parentheses.

TABLE 11. REDISTRIBUTION OF Cr_2O_3 FROM MORDANTED FIBERS AT 40°C.

Time	Initial bath*		Final bath				Fiber	Ash		Cr_2O_3
	Potassium dichromate	pH	Potassium dichromate	pH	Exhaustion	Distribution coefficient				
hour	gram Cr_2O_3/ gram fiber		gram Cr_2O_3/ gram fiber		percentage of total solute	Cf/Cs	gram	gram	percentage of fiber	percentage of fiber
A. Cellulose-Acetate rayon										
49D**	1.0334	1.29	0.9750		5.65	2.99				5.84
211S***	0.0000	1.30	0.0036	1.40			2.5253	0.1255	4.99	4.93
211S	0.0000	1.30	0.0036	1.40			2.5254	0.0062	0.25	0.19
Total										5.12
B. Nylon										
49D	0.2584	1.15	0.1884		27.1	19.4				6.99
211S	0.0000	1.12	0.0033	1.19			1.4037	0.0806	5.74	5.43
211S	0.0000	1.12	0.0033	1.19			1.4037	0.0806	1.21	0.90
Total										6.33
C. Silk										
49D	0.2584	1.70	0.2211		14.3	8.4				3.73
211S	0.0000	1.67	0.0070	1.80			1.2773	0.0264	2.07	1.94
211S	0.0000	1.67	0.0070	1.80			1.2780	0.0066	0.52	0.39
Total										2.33

* Fifty-volume
** Separate bath; see Table 7.
*** Same bath

TABLE 12. DISTRIBUTION DURING MORDANTING OF CELLULOSE-ACETATE RAYON WITH POTASSIUM DICHROMATE.

Temperature	Time	Initial bath			Final bath		Exhaustion	Distribution coefficient	Fiber	Ash		Cr_2O_3
		Potassium dichromate	Volume	pH	Potassium dichromate	pH						
°C	hour	gram Cr_2O_3/ gram fiber	milliliter/ gram fiber		gram Cr_2O_3/ gram fiber		percentage of total solute	Cf/Cs	gram	gram	percentage of fiber	percentage of fiber
40.0	13D*	1.0334	100	1.37	1.0251	1.77	0.80	0.81	1.0616	0.0094	0.89	0.83
	26D	1.0334	100	1.37	1.0182	1.80	1.47	1.49	2.1703	0.0343	1.58	1.52
	26S**	1.0334	100	1.37			1.34		2.4651	0.0355	1.44	1.38
	13S	0.5122	50	1.77	0.5067	1.90	0.58		2.4685	0.0163	0.66	0.60
Total							1.92	0.98				1.98
99.1	1D	1.0334	100	1.37	1.0203		1.27	1.28				1.31***
	2D	1.0334	100	1.37	1.0099		2.27	2.33	2.4773	0.0596	2.41	2.35
	2S	1.0334	100	1.37			2.46		2.4574	0.0640	2.60	2.54
	1S	0.5100	50		0.4988		0.96		2.4603	0.0259	1.05	0.99
Total							3.42	1.76				3.53

* Separate bath
** Same bath
*** See Table 9.

TABLE 13. DISTRIBUTION DURING MORDANTING OF NYLON WITH POTASSIUM DICHROMATE AT 40°C.

Time	Initial bath			Final bath				Fiber	Ash		Cr_2O_3
	Potassium dichromate	pH	Volume	Potassium dichromate	pH	Exhaustion	Distribution coefficient				
hour	gram Cr_2O_3/gram fiber		milliliter/gram fiber	gram Cr_2O_3/gram fiber		percentage of total solute	Cf/Cs	gram	gram	percentage of fiber	percentage of fiber
74D*	0.05167	1.43	100	0.03217	1.45	37.7	60.6	1.4066	0.0318	2.26	1.95
527D	0.05167	1.43	100	0.00537	1.50	89.6	862.0	1.4071	0.0696	4.95	4.63
122S**	0.05167	1.43	100			45.7		1.4056	0.0375	2.67	2.36
48S	0.03217	1.45	50	0.0119	1.60	8.1		1.4046	0.0103	0.73	0.42
Total						53.8	58.2				2.78
170S	0.05167	1.43	100			48.6		1.4061	0.0396	2.82	2.51
96S	0.03217	1.45	50	0.0081	1.55	20.1		1.4044	0.0189	1.35	1.04
Total						68.7	109.6				3.55
194S	0.05167	1.43	100			49.7		1.4061	0.0405	2.88	2.57
120S	0.03217	1.45	50	0.0072	1.55	22.2		1.4043	0.0205	1.46	1.15
Total						71.9	128.4				3.72
242S	0.05167	1.43	100			51.5		1.4061	0.0418	2.97	2.66
168S	0.03217	1.45	50	0.0064	1.50	23.8		1.4049	0.0217	1.54	1.23
Total						75.3	152.1				3.89
527S	0.05167	1.43	100			55.4		1.4055	0.0446	3.17	2.86
453S	0.03217	1.45	50	0.0039	1.50	29.6		1.4050	0.0259	1.84	1.53
Total						85.0	282.2				4.39

* Separate bath
** Same bath

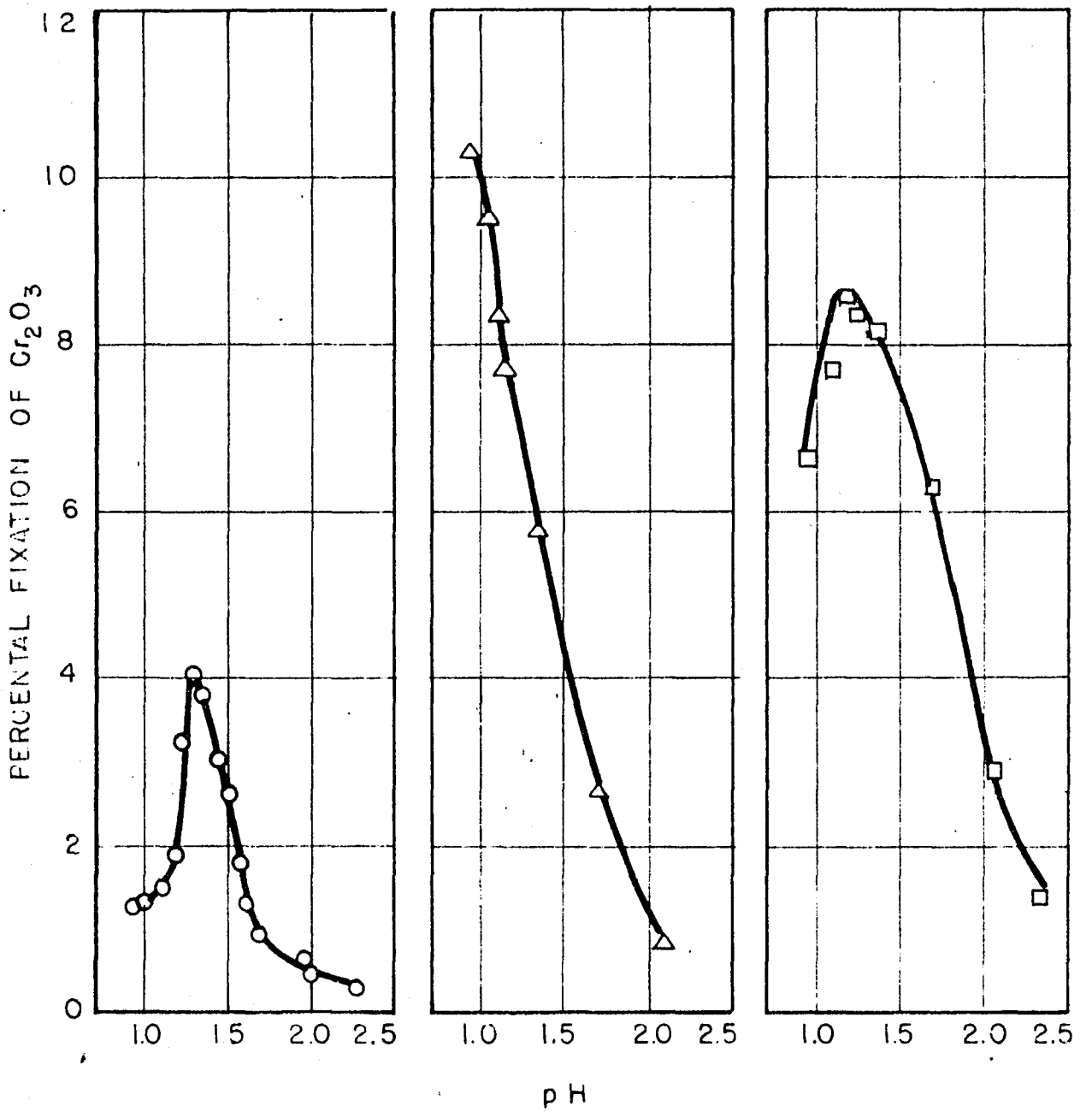

Fig. 1. EFFECT OF INITIAL pH OF MORDANTING BATH ON FIXATION OF MORDANT FROM FIFTY-VOLUME BATH OF POTASSIUM DICHROMATE IN ONE HOUR AT BOILING. ○ Cellulose-acetate rayon (2.0000 g. $K_2Cr_2O_7$/gram fiber); △ Nylon (0.5000 g. $K_2Cr_2O_7$/gram fiber); □ Silk (0.5000 g. $K_2Cr_2O_7$/gram fiber).

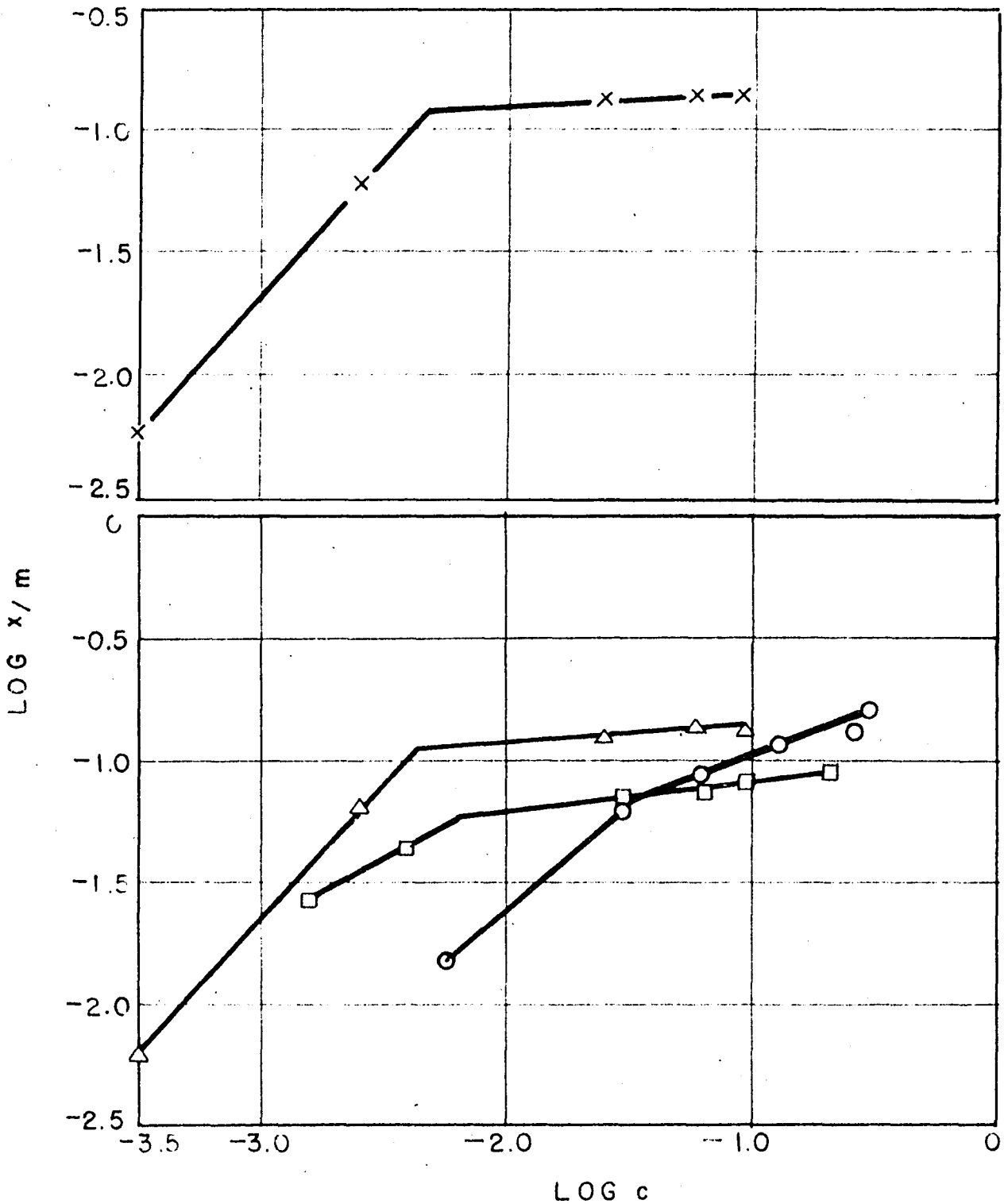

Fig. 2. EFFECT OF CONCENTRATION OF FIFTY-VOLUME MORDANTING BATH OF POTASSIUM DICHROMATE ON FIXATION OF MORDANT IN 48 HOURS AT 40° C.
o Cellulose-acetate rayon; △ Nylon; × Nylon (not heated before treatment); □ Silk.

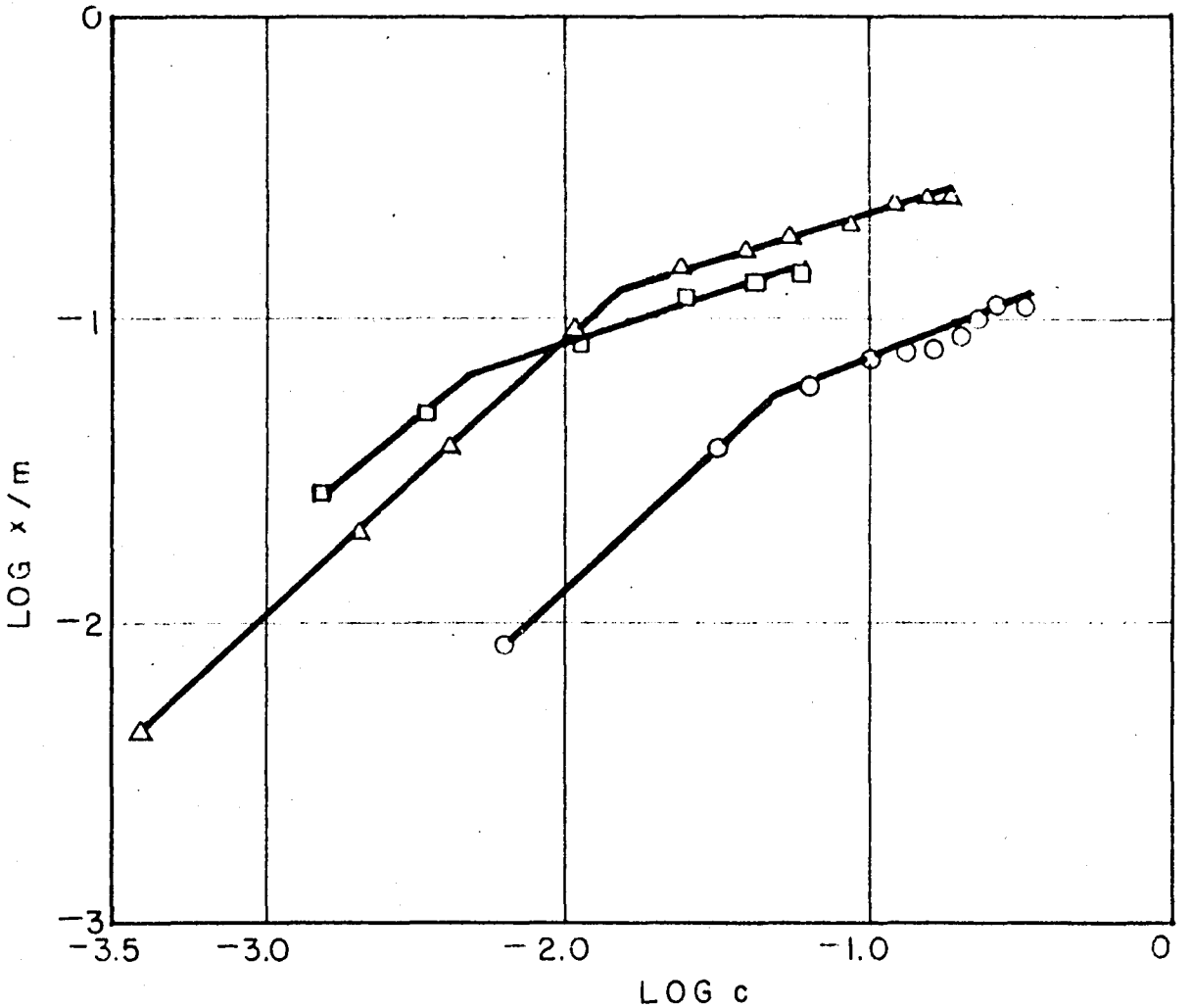

Fig. 3. EFFECT OF CONCENTRATION OF FIFTY-VOLUME MORDANTING BATH OF POTASSIUM DICHROMATE IN ONE HOUR AT BOILING. ○ Cellulose-acetate rayon; △ Nylon; □ Silk.

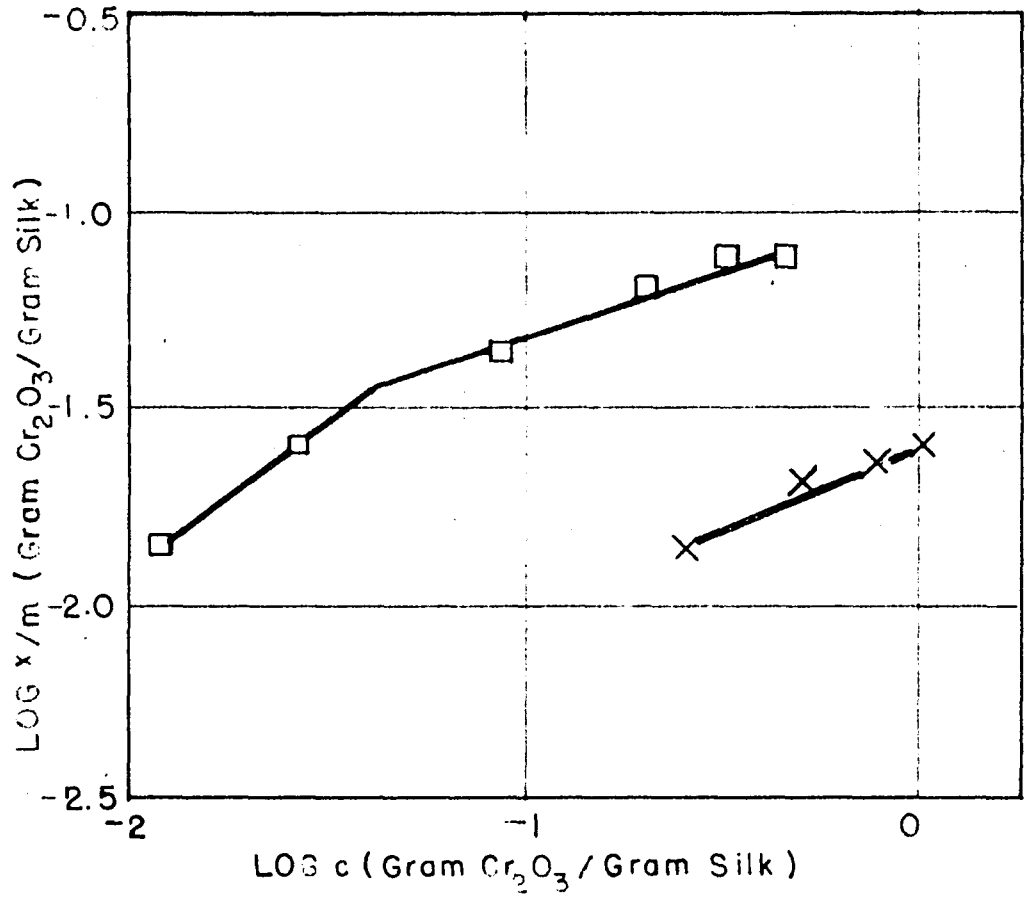

Fig. 4. EFFECT OF CONCENTRATION, gram Cr_2O_3/gram fiber, OF FIFTY-VOLUME MORDANTING BATH ON FIXATION OF MORDANT ON SILK IN ONE HOUR AT BOILING.
□ Potassium dichromate; × Chromium acetate.

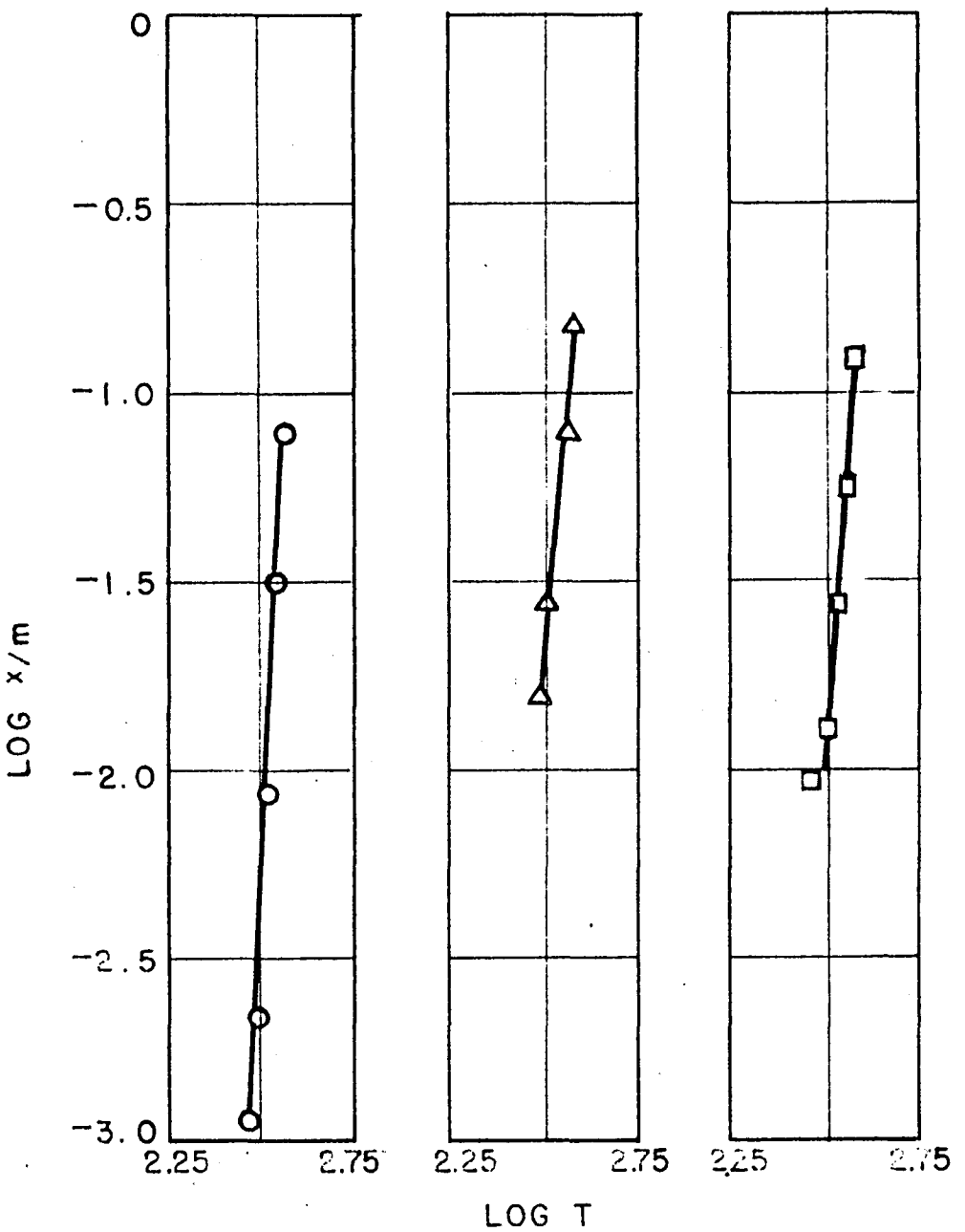

Fig. 5. EFFECT OF TEMPERATURE OF MORDANTING ON FIXATION OF MORDANT FROM FIFTY-VOLUME BATH OF POTASSIUM DICHROMATE IN ONE HOUR.
o Cellulose-acetate rayon (2.0000 g. $K_2Cr_2O_7$/gram fiber at pH 1.29); △ Nylon (0.5000 g. $K_2Cr_2O_7$/gram fiber at pH 1.15); □ Silk (0.5000 g. $K_2Cr_2O_7$/gram fiber at pH 1.70).

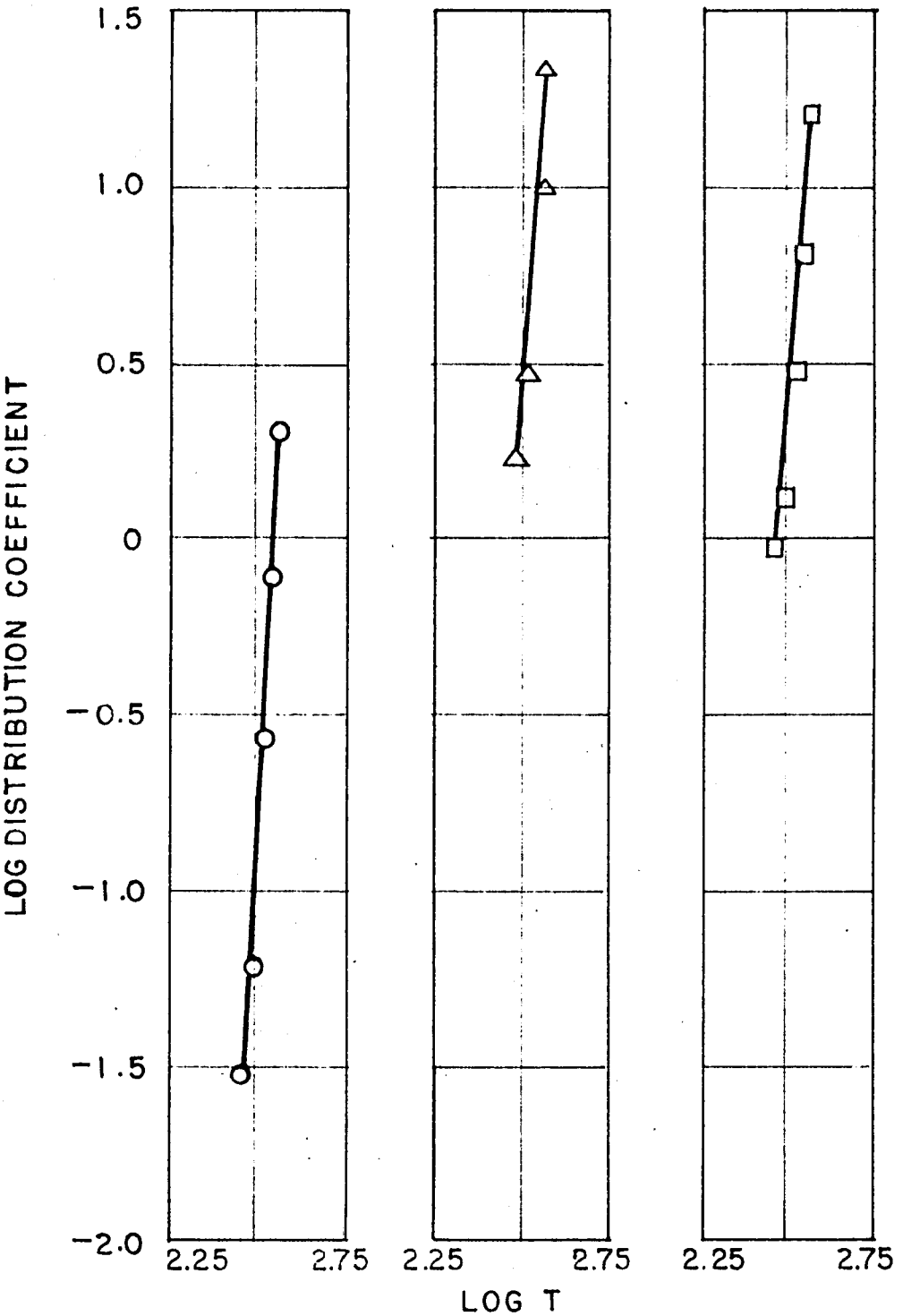

Fig. 6. EFFECT OF TEMPERATURE OF MORDANTING ON EXHAUSTION OF POTASSIUM DICHROMATE FROM FIFTY-VOLUME BATH IN ONE HOUR.
○ Cellulose-acetate rayon (2.0000 g. $K_2Cr_2O_7$/gram fiber at pH 1.29); △ Nylon (0.5000 g. $K_2Cr_2O_7$/gram fiber at pH 1.15); □ Silk (0.5000 g. $K_2Cr_2O_7$/gram fiber at pH 1.70).

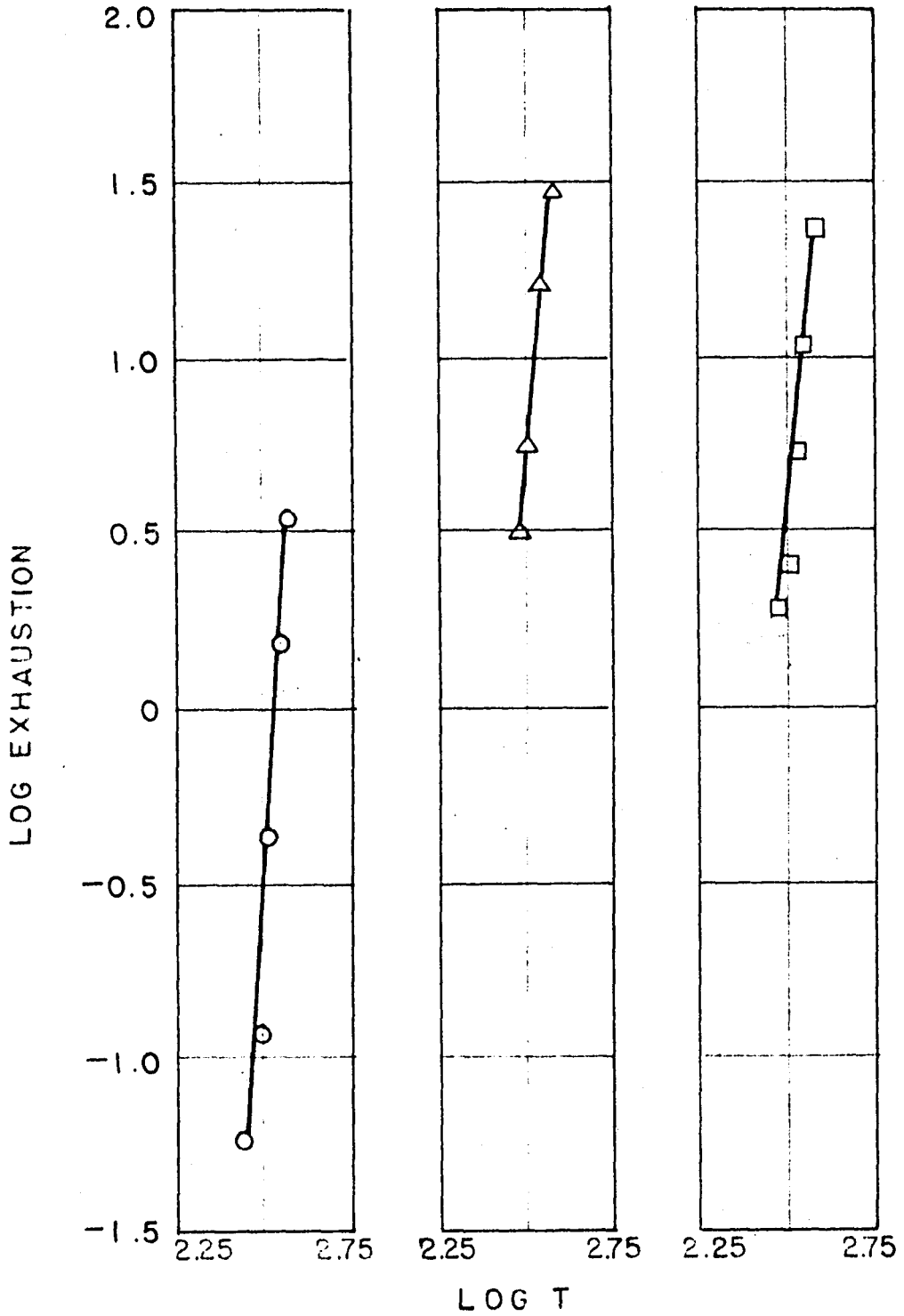

Fig. 7. EFFECT OF TEMPERATURE OF MORDANTING ON DISTRIBUTION COEFFICIENT OF POTASSIUM DICHROMATE IN FIFTY-VOLUME BATH IN ONE HOUR.

o Cellulose-acetate rayon (2.0000 g. $K_2Cr_2O_7$/gram fiber at pH 1.29); △ Nylon (0.5000 g. $K_2Cr_2O_7$/gram fiber at pH 1.15); □ Silk (0.5000 g. $K_2Cr_2O_7$/gram fiber at pH 1.70).

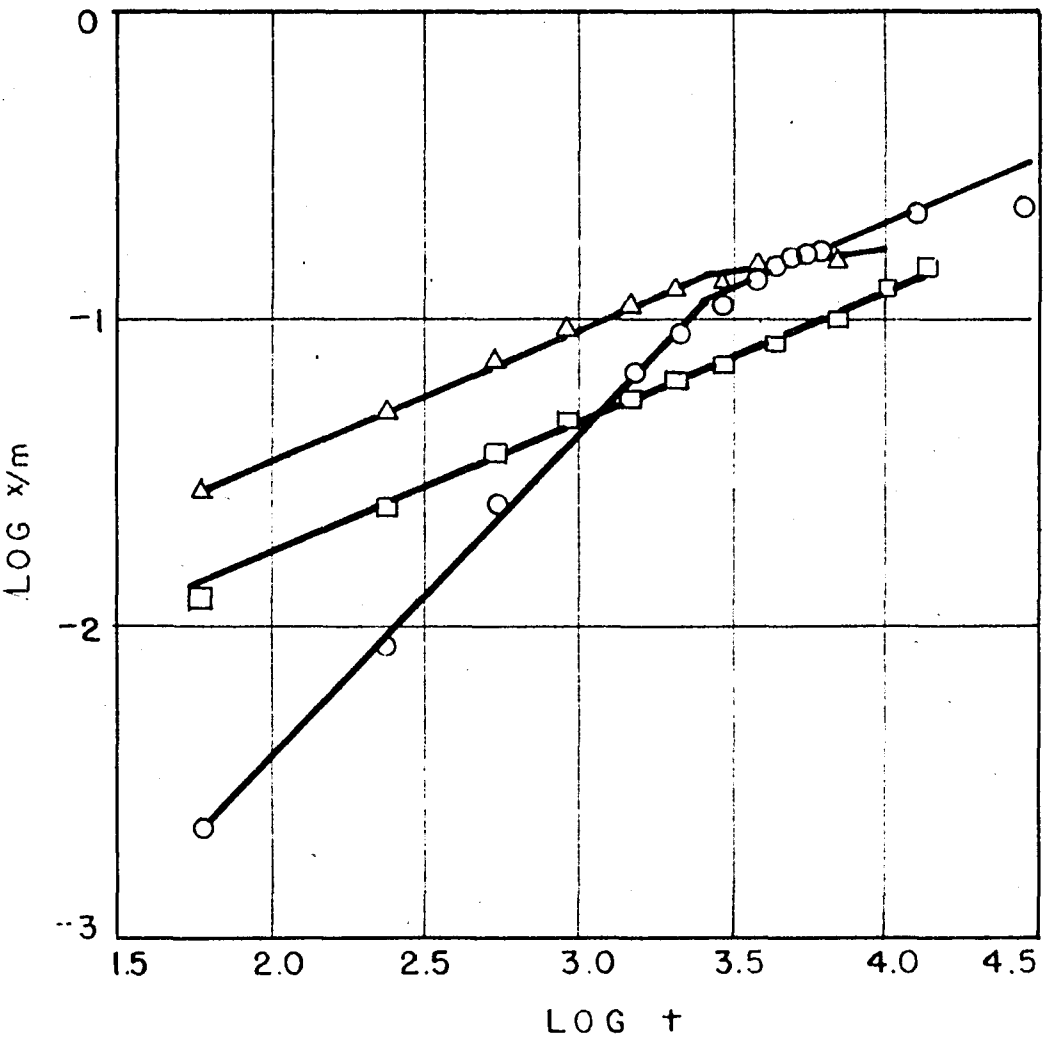

Fig. 8. EFFECT OF TIME OF MORDANTING ON FIXATION OF MORDANT FROM FIFTY-VOLUME BATH OF POTASSIUM DICHROMATE AT 40°C.
○ Cellulose-acetate rayon (2.0000 g. $K_2Cr_2O_7$/gram fiber at pH 1.29); △ Nylon (0.5000 g. $K_2Cr_2O_7$/gram fiber at pH 1.15); □ Silk (0.5000 g. $K_2Cr_2O_7$/gram fiber at pH 1.70).

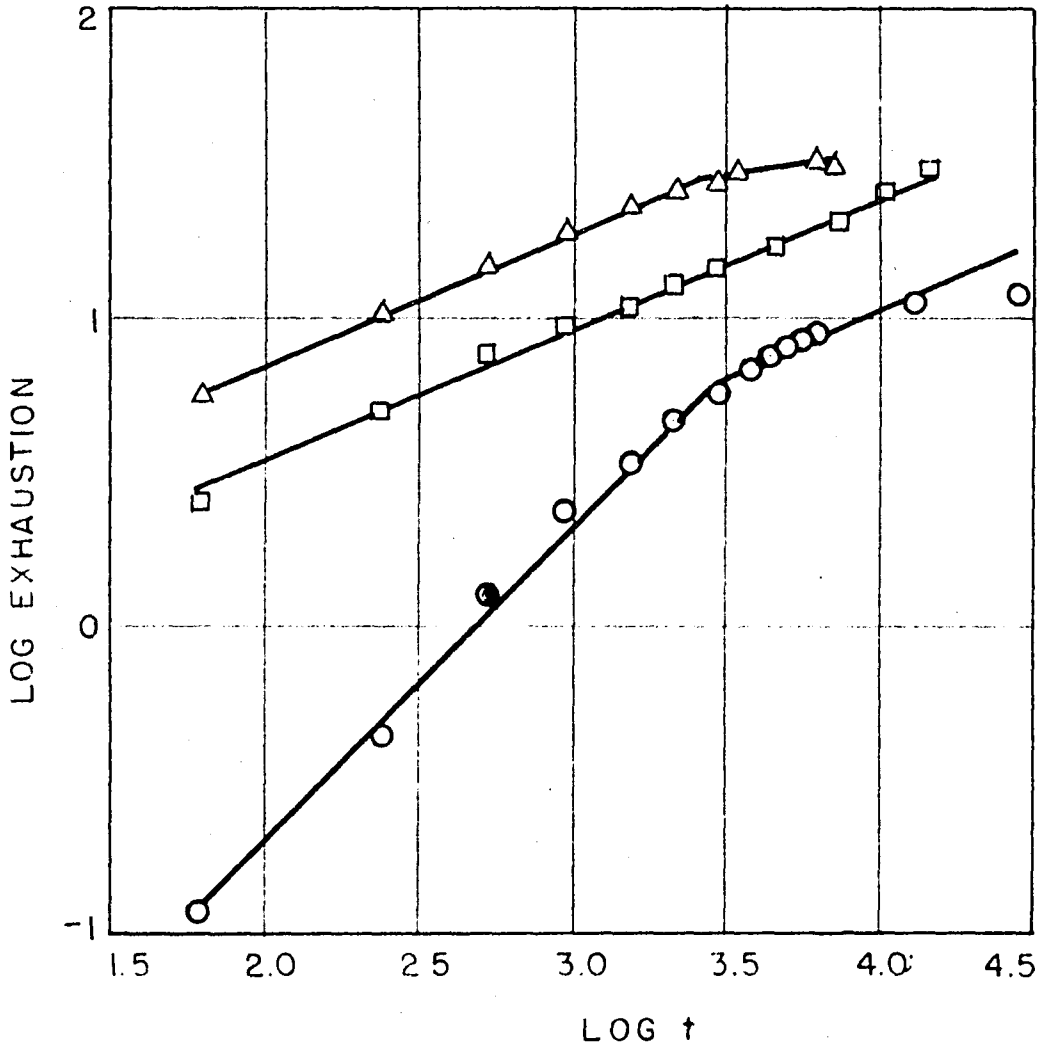

Fig. 9. EFFECT OF TIME OF MORDANTING ON EXHAUSTION OF POTASSIUM DICHROMATE FROM FIFTY-VOLUME BATH AT 40°C.

o Cellulose-acetate rayon (2.0000 g. $K_2Cr_2O_7$/gram fiber at pH 1.29); △ Nylon (0.5000 g. $K_2Cr_2O_7$/gram fiber at pH 1.15); □ Silk (0.5000 g. $K_2Cr_2O_7$/gram fiber at pH 1.70).

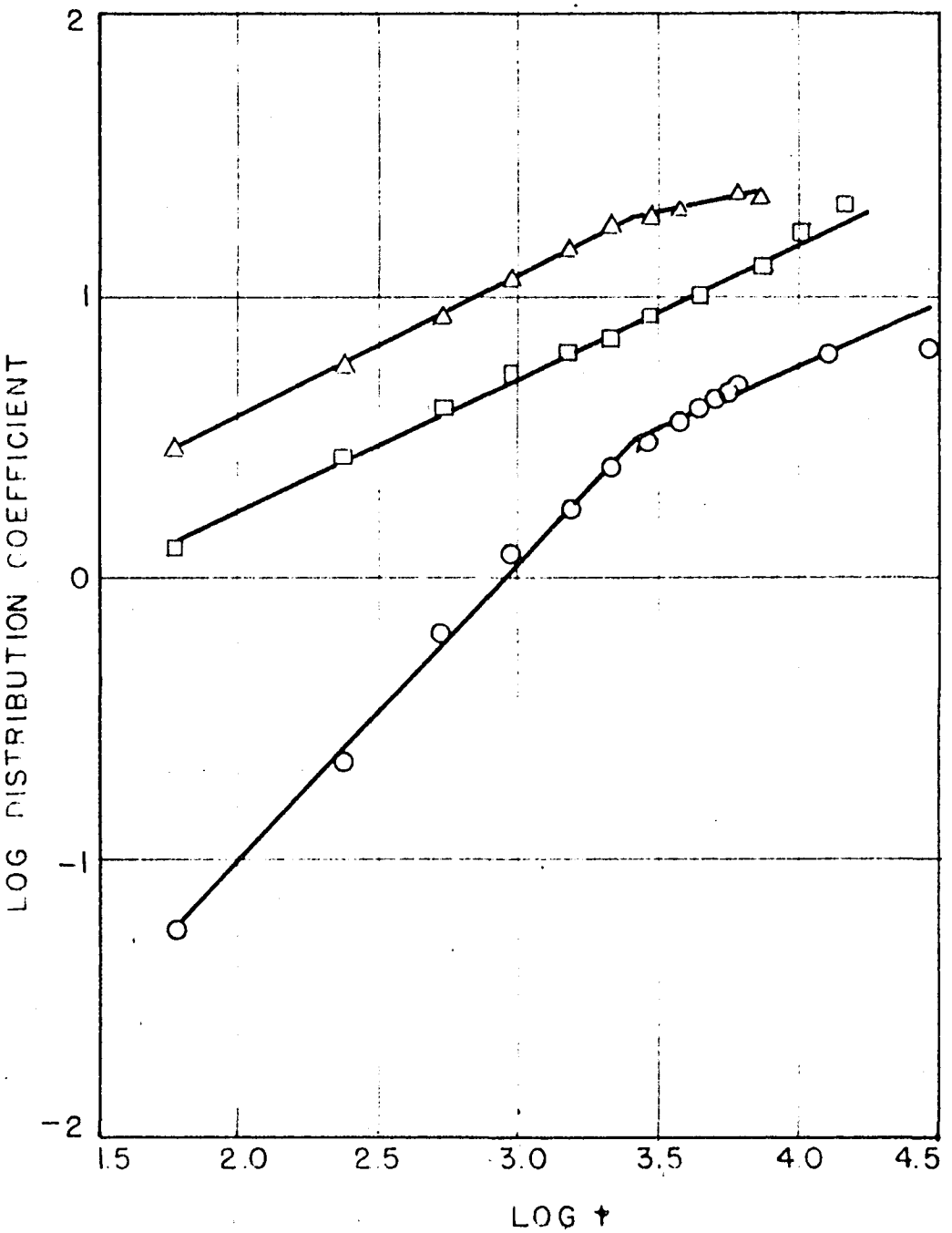

Fig. 10. EFFECT OF TIME OF MORDANTING ON DISTRIBUTION COEFFICIENT OF POTASSIUM DICHROMATE IN FIFTY-VOLUME BATH AT 40°C.

o Cellulose-acetate rayon (2.0000 g. $K_2Cr_2O_7$/gram fiber at pH 1.29); △ Nylon (0.5000 g. $K_2Cr_2O_7$/gram fiber at pH 1.15); □ Silk (0.5000 g. $K_2Cr_2O_7$/gram fiber at pH 1.70).

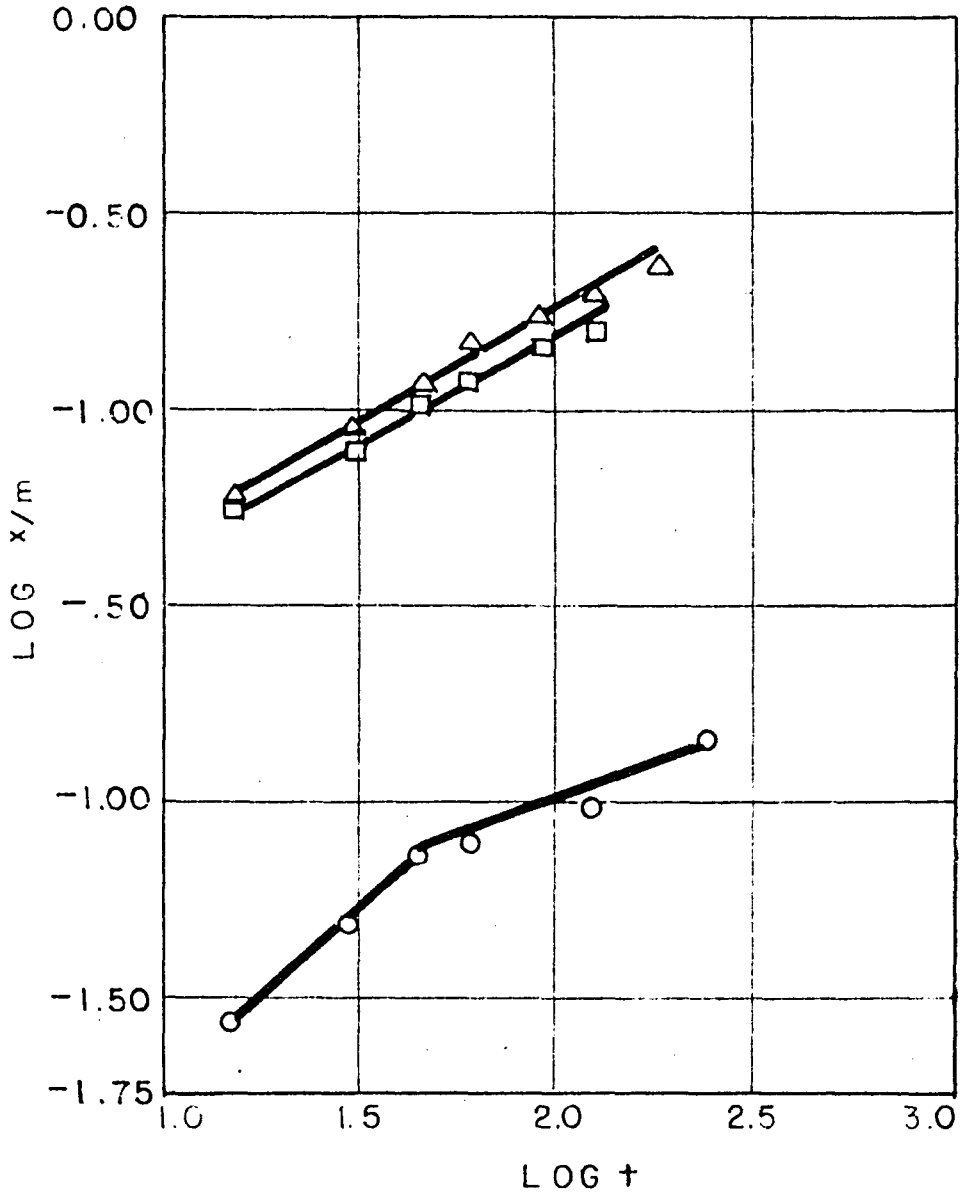

Fig. 11. EFFECT OF TIME OF MORDANTING ON FIXATION OF MORDANT FROM FIFTY-VOLUME BATH OF POTASSIUM DICHROMATE AT BOILING.
○ Cellulose-acetate rayon (2.0000 g. $K_2Cr_2O_7$/gram fiber at pH 1.29); △ Nylon (0.5000 g. $K_2Cr_2O_7$/gram fiber at pH 1.15); □ Silk (0.5000 g. $K_2Cr_2O_7$/gram fiber at pH 1.70).

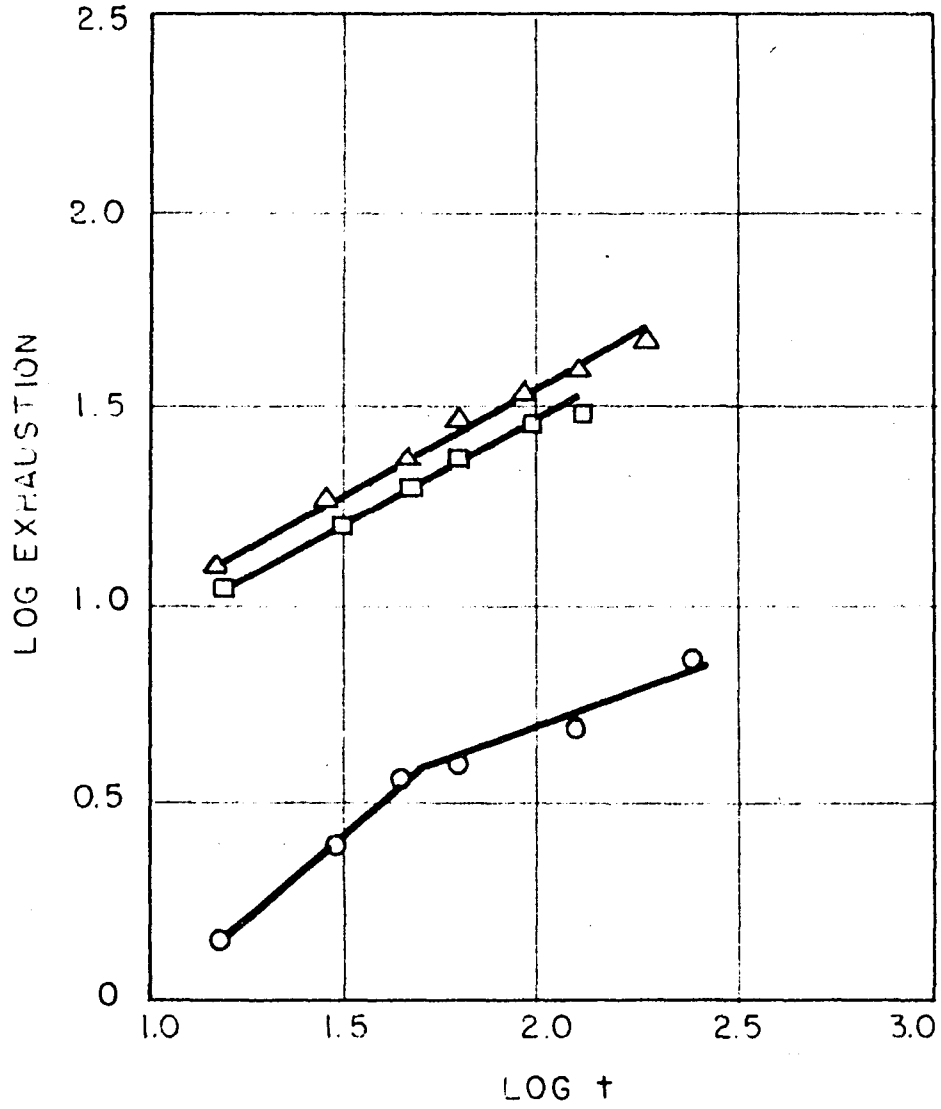

Fig. 12. EFFECT OF TIME OF MORDANTING ON EXHAUSTION OF POTASSIUM DICHROMATE FROM FIFTY-VOLUME BATH AT BOILING.
○ Cellulose-acetate rayon (2.0000 g. $K_2Cr_2O_7$/gram fiber at pH 1.29); △ Nylon (0.5000 g. $K_2Cr_2O_7$/gram fiber at pH 1.15); □ Silk (0.5000 g. $K_2Cr_2O_7$/gram fiber at pH 1.70).

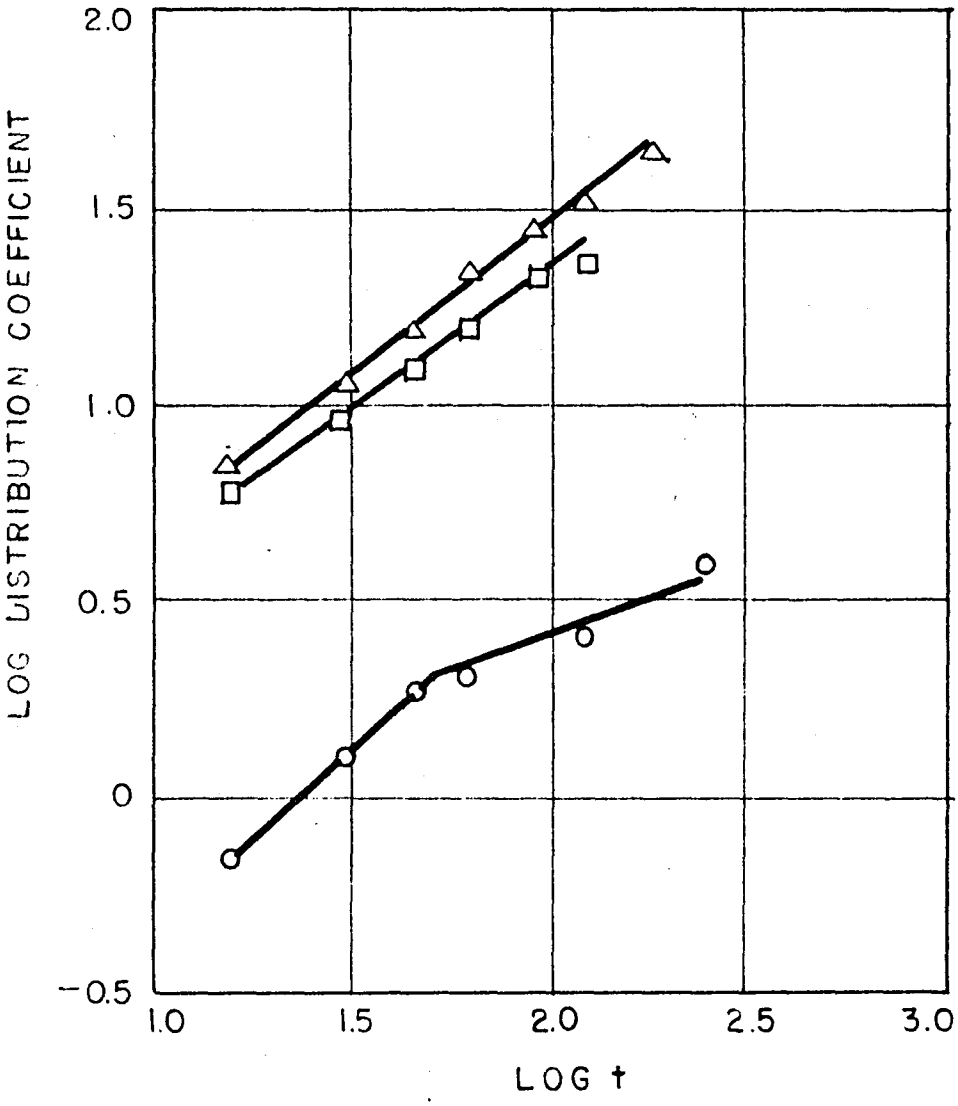

Fig. 13. EFFECT OF TIME OF MORDANTING ON DISTRIBUTION COEFFICIENT OF POTASSIUM DICHROMATE IN FIFTY-VOLUME BATH AT BOILING.
○ Cellulose-acetate rayon (2.000 g. $K_2Cr_2O_7$/gram fiber at pH 1.29); △ Nylon (0.5000 g. $K_2Cr_2O_7$/gram fiber at pH 1.15); □ Silk (0.5000 g. $K_2Cr_2O_7$/gram fiber at pH 1.70).

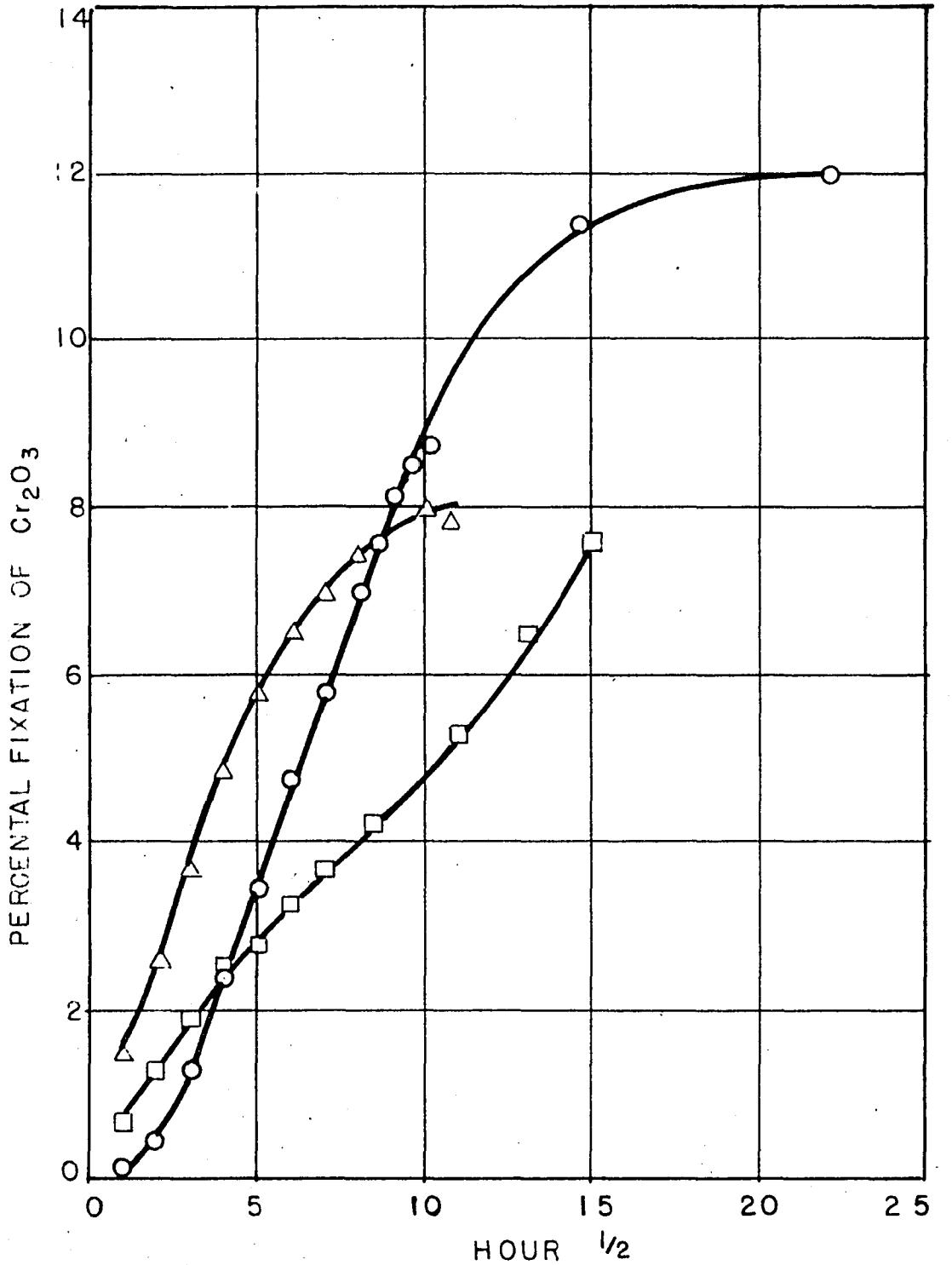

Fig. 14. EFFECT OF TIME OF MORDANTING ON FIXATION OF MORDANT FROM FIFTY-VOLUME BATH OF POTASSIUM DICHROMATE AT 40°C.
○ Cellulose-acetate rayon (2.0000 g. $K_2Cr_2O_7$/gram fiber at pH 1.29); △ Nylon (0.5000 g. $K_2Cr_2O_7$/gram fiber at pH 1.15); □ Silk (0.5000 g. $K_2Cr_2O_7$/gram fiber at pH 1.70).

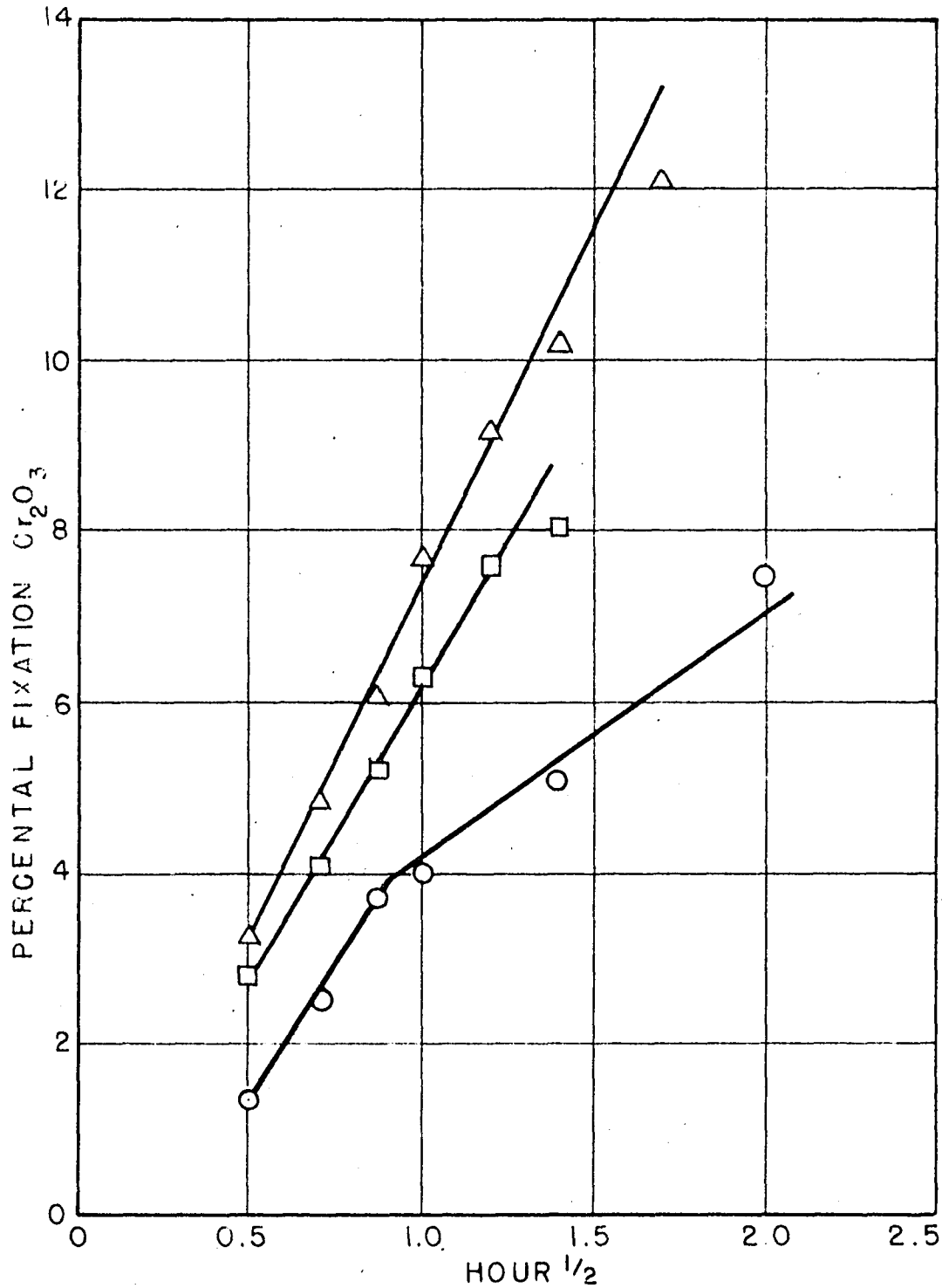

Fig. 15. EFFECT OF TIME OF MORDANTING ON THE FIXATION OF MORDANT FROM FIFTY-VOLUME BATH OF POTASSIUM DICHROMATE AT BOILING.
○ Cellulose-acetate rayon (2.0000 g. $K_2Cr_2O_7$/gram fiber at pH 1.29); △ Nylon (0.5000 g. $K_2Cr_2O_7$/gram fiber at pH 1.15); □ Silk (0.5000 g. $K_2Cr_2O_7$/gram fiber at pH 1.70).

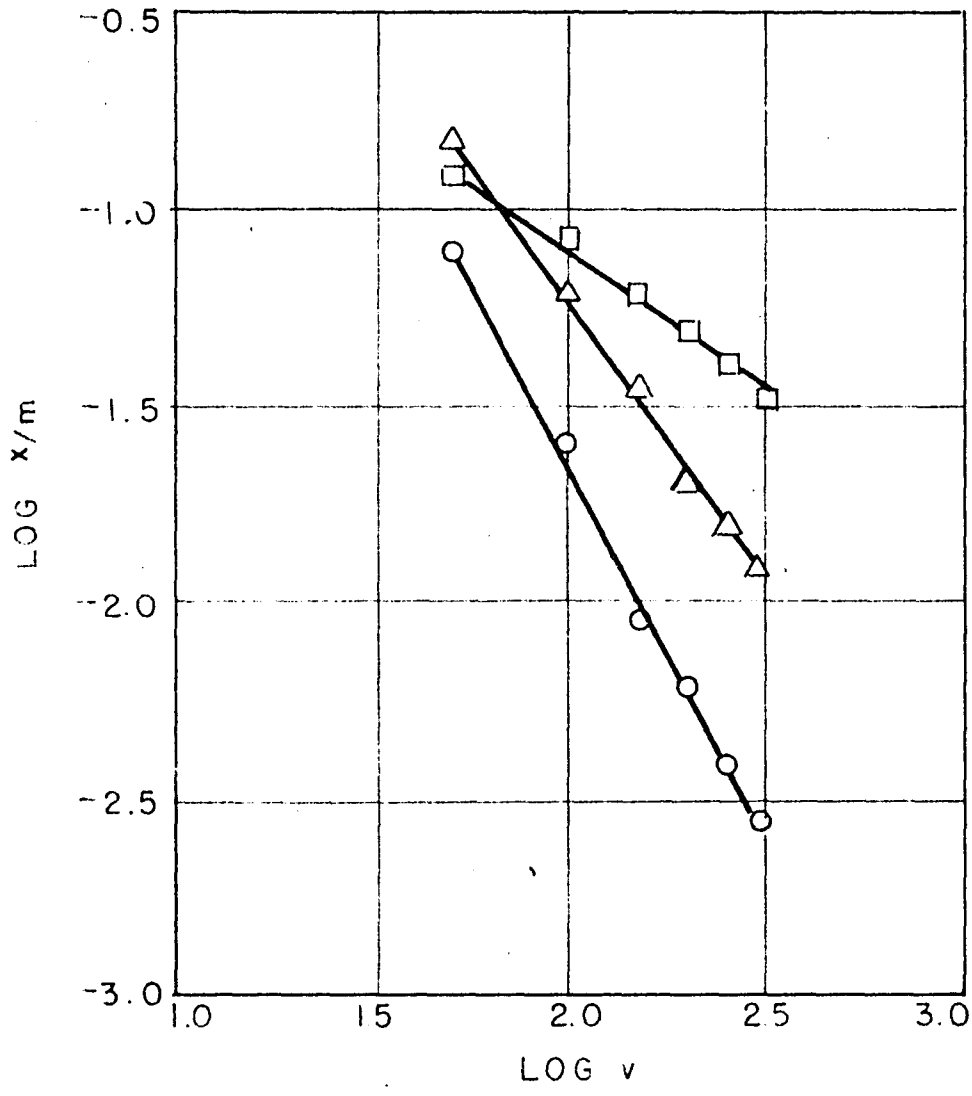

Fig. 16. EFFECT OF VOLUME OF MORDANTING BATH OF POTASSIUM DICHROMATE ON FIXATION OF MORDANT IN ONE HOUR AT BOILING.
○ Cellulose-acetate rayon (2.0000 g. $K_2Cr_2O_7$/gram fiber); △ Nylon (0.5000 g. $K_2Cr_2O_7$/gram fiber); □ Silk (0.5000 g. $K_2Cr_2O_7$/gram fiber).

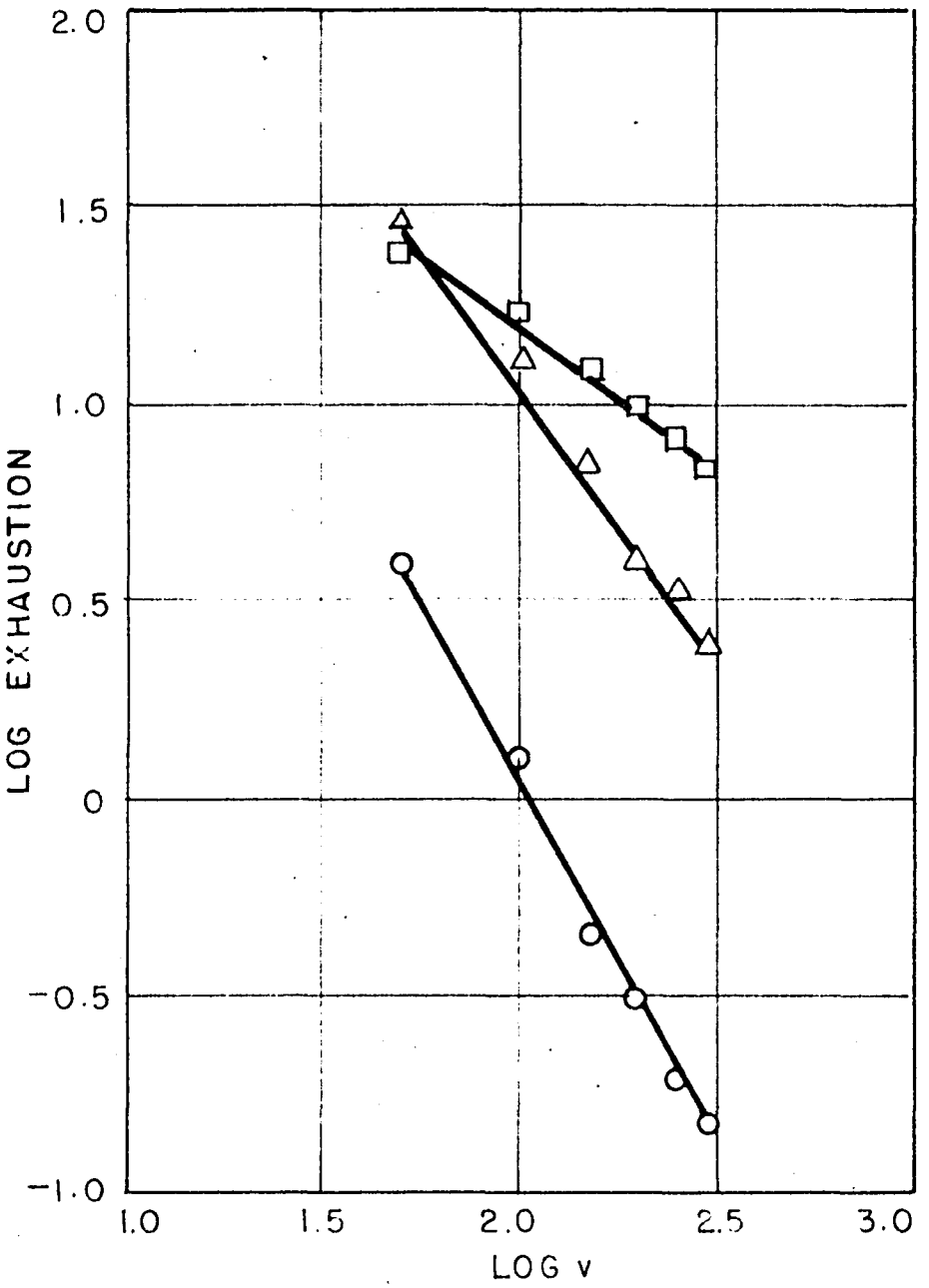

Fig. 17. EFFECT OF VOLUME OF MORDANTING BATH ON EXHAUSTION OF POTASSIUM DICHROMATE IN ONE HOUR AT BOILING. ○ Cellulose-acetate rayon (2.0000 g. $K_2Cr_2O_7$/gram fiber); △ Nylon (0.5000 g. $K_2Cr_2O_7$/gram fiber); □ Silk (0.5000 g. $K_2Cr_2O_7$/gram fiber).

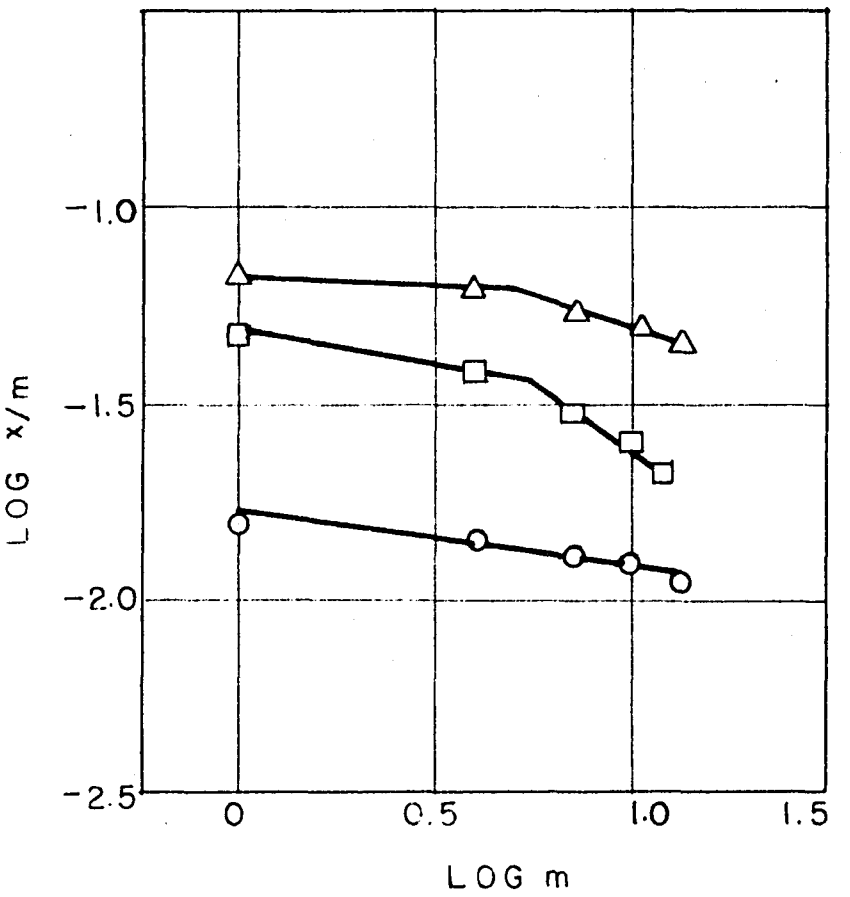

Fig. 18. EFFECT OF WEIGHT OF FIBER ON FIXATION OF MORDANT FROM 600-MILLILITER BATH OF POTASSIUM DICHROMATE IN ONE HOUR AT BOILING.

o Cellulose-acetate rayon (2.0000 g. $K_2Cr_2O_7$ at pH 1.30); △ Nylon (1.5000 g. $K_2Cr_2O_7$ at pH 1.15); □ Silk (0.5000 g. $K_2Cr_2O_7$ at pH 1.70).

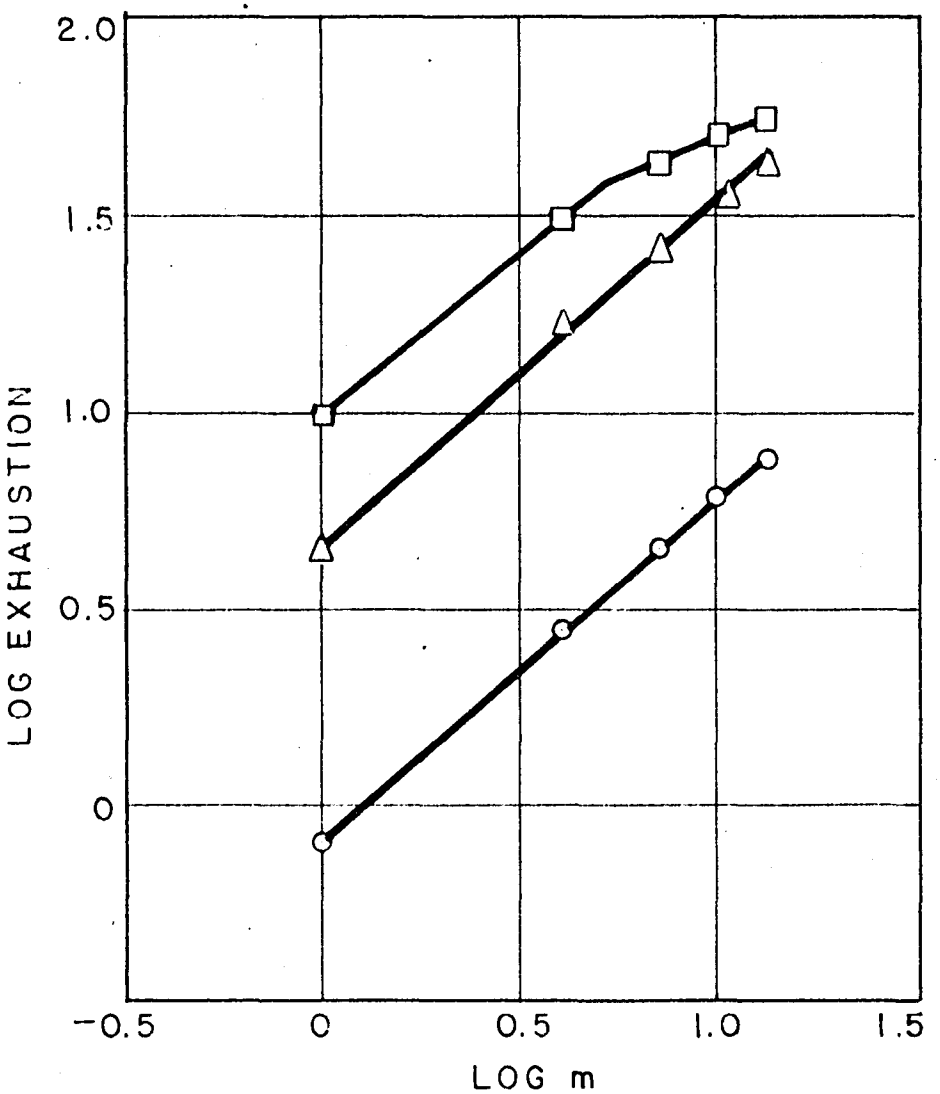

Fig. 19. EFFECT OF WEIGHT OF FIBER ON EXHAUSTION OF POTASSIUM DICHROMATE FROM 600-MILLILITER BATH IN ONE HOUR AT BOILING.

○ Cellulose-acetate rayon (2.0000 g. $K_2Cr_2O_7$ at pH 1.30); △ Nylon (1.5000 g. $K_2Cr_2O_7$ at pH 1.15); □ Silk (0.5000 g. $K_2Cr_2O_7$ at pH 1.70).

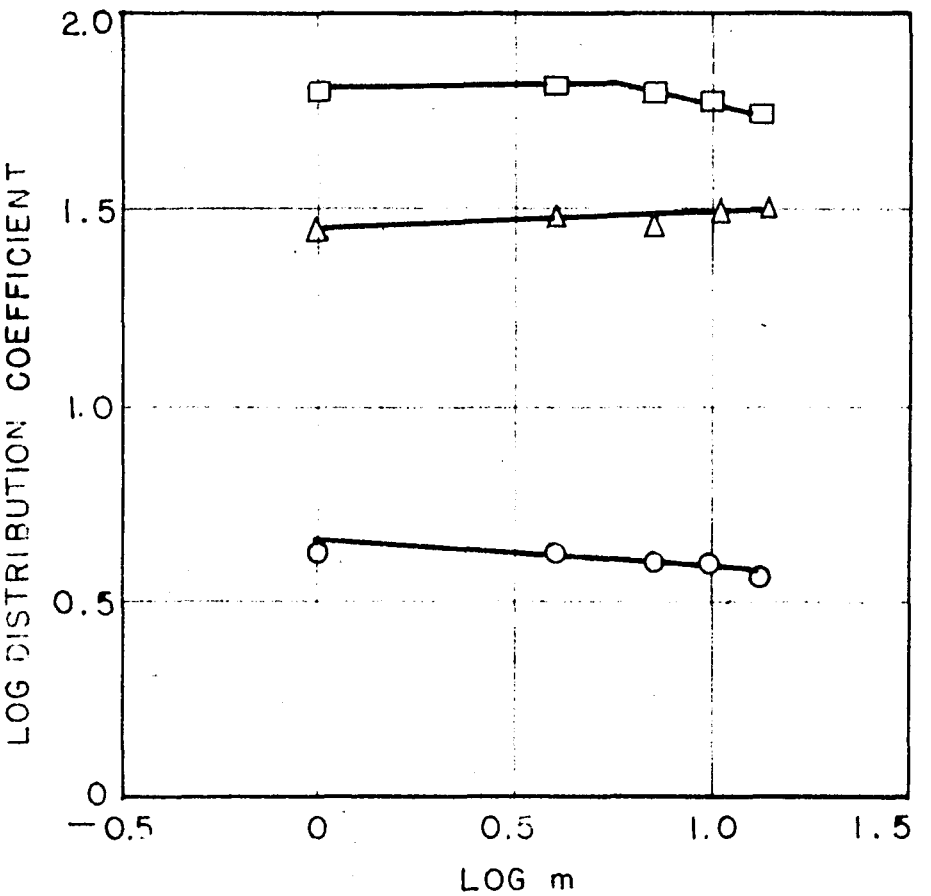

Fig. 20. EFFECT OF WEIGHT OF FIBER ON DISTRIBUTION COEFFICIENT OF POTASSIUM DICHROMATE IN 600-MILLILITER BATH IN ONE HOUR AT BOILING.
○ Cellulose-acetate rayon (2.0000 g. $K_2Cr_2O_7$ at pH 1.30); △ Nylon (1.5000 g. $K_2Cr_2O_7$ at pH 1.15); □ Silk (0.5000 g. $K_2Cr_2O_7$ at pH 1.70).

DISCUSSION OF RESULTS

The textile fibers

The three fibrous solids, cellulose-acetate rayon, nylon, and silk fibroin, are classed as molecular crystals and many of the properties of these polymers depend on their molar structure rather than their binding in the solid. Their x-ray diagrams have been read as arising from heterogeneous internal arrangement, elongated crystal lattices of small units embedded in amorphous larger units. The repeating unit of the micell, the primary-valence chain with lateral ionizable groups which result in a mosaic membrane, is thought to be an anhydride of glucose diacetate in cellulose-acetate rayon, $-(CH_2)_6NHCO(CH_2)_4CONH-$ in nylon, and a polypeptide residue in silk fibroin (124, 89, 2).

Stamm and Millett (128) have measured by adsorption two internal areas of cellulosic fibers, 2×10^3 cm.^{2}/g. inter-fiber space and 3×10^6 cm.^{2}/g. transient-capillary space. Frey-Wyssling (44) has determined by impregnation the mean intermicellar spaces of cellulose-acetate rayon and silk as 60 and 49 Å., respectively.

The mordanting bath

Of the equilibrial relations of a dichromate in aqueous solution (74),

$$Cr_2O_7^{--} + HOH \longleftrightarrow 2HCrO_4^{-}$$

$$HCrO_4^{-} \longleftrightarrow H^{+} + CrO_4^{--}$$

the latter, proposed as that of the isoelectric zone (79), would be disturbed by preferential adsorption of H^+ (74, 137). Sabalitschka and Kubisch (117) have observed that chromic acid dialyzes more quickly than potassium dichromate does and Ephraim (34) has stated that the chromate ion moves much more rapidly than the hydrogen chromate ion. Ionic mobilities for some of the involved ions have been listed (59) as 0.00362 cm./sec. at 25° C. and a potential gradient of one volt for H^+ compared with values of 0.00079 for Cl^-, 0.00076 for K^+, and 0.00054 for $Cr_2O_7^{--}$. Dean (23) has described diffusion of ions as nearly independent of the relative ionic mobilities of the supporting electrolyte but almost completely dependent on the conductivity of the latter.

Effect of pH of mordanting bath

Fixation, x/m, of chromium sesquioxide on cellulose-acetate rayon (Table 1) from fifty volumes of aqueous potassium dichromate during one hour at 100° C. has been shown to be an increasing rectilinear function of initial pH of mordanting bath, 2.0000 g. solute per gram of fiber, between pH 1.17 and 1.29 and a decreasing rectilinear function between this maximum, 4.03±0.05 per cent, and 0.96±0.01 per cent Cr_2O_3 at pH 1.67. The least loss of acetyl and wet strength did not occur at pH 1.29. Loss of acetyl over

the range investigated, pH 0.95 to 2.27, was less than 3.8 per cent of the original 38.57 per cent acetyl. No change in wet strength occurred when cellulose-acetate rayon was mordanted at pH 2.27, the threshold of fixation; wet strength of this fiber was increased by mordanting at greater pH, approximately 10 per cent at pH 6.47, and decreased by half its first value at pH 0.91 (Table 2 and Fig. 1). Cellulose-acetate rayon has been described as slightly acid because of some free carboxyl groups (89).

Fixation on nylon (Table 1) at variable pH and constant concentration, 0.5000 g. solute per gram of fiber, was a decreasing rectilinear function of initial pH of mordanting bath between 10.30±0.02 per cent Cr_2O_3 at pH 0.93 and 2.64±0.03 per cent at pH 1.70 (Table 2 and Fig. 1). This fixation on nylon occurs below the isoelectric zone at pH 2.7 reported for oriented nylon by Harris and Sookne (64) and is in agreement with Peters' statement (103) that fixation of acid dye on nylon increases as pH decreases from 1.3.

Fixation on silk (Table 1) from a like bath proved to be an increasing rectilinear function of initial pH from 0.93 to 1.15 and decreasing rectilinear function between this maximum, 8.59±0.10 per cent, and 1.30±0.03 per cent Cr_2O_3 at pH 2.32. The pH of maximal fixation on silk fibroin, 1.15, agrees with values for the isoelectric zone of silk reported by Elöd and Silva (32), Elöd and Balla (30, 31), and Theis and Jacoby (130)

and is below values obtained by others (24, 33, 88, 63, 65, 62, 25, 61, 76, 113, 26, 96, 136, 127). The greater fixation with greater deviation on silk not extracted with benzene was doubtless due to residual soap. The silk lost wet strength upon mordanting at pH 2.32 or less and retained but 17 per cent of its first wet strength after mordanting at pH 1.21 (Table 2).

Lachs and Michaelis (84) have observed that an anion is fixed more rapidly in the presence of a readily fixed cation and Rona and Michaelis (114) that H^+ is more strongly fixed than any other cation. Oryng (97) has found fixation of K^+ much weaker than that of a chromium-containing anion.

For each of the fibers fixation, exhaustion, and distribution coefficient (17),

$$\frac{\text{gram } Cr_2O_3 \text{ per kilogram of fiber}}{\text{gram } Cr_2O_3 \text{ per liter of aqueous solution}}$$

were logarithmic functions of equilibrial concentration, decreasing for nylon but passing through a maximum for cellulose-acetate rayon and silk.

Effect of concentration of mordanting bath

For each of the fibers, and during 48 hours at 40° C., as well as during one hour at 100° C., fixation of Cr_2O_3 from fifty volumes of aqueous potassium dichromate (between 0.1000 and 0.5000 g. solute per gram of cellulose-acetate rayon, 0.0100 and 1.5000 g. solute per gram of nylon, 0.0500 and 3.0000 g. solute per gram of silk at 40° C., and between

0.0500 and 0.2500 g. solute per gram of silk at 100° C.) plots as an increasing logarithmic function of equilibrial concentration with decrease in slope of logarithmic graph as initial pH becomes constant. This marked effect on fixation of slight change in pH at low concentration of solute again stresses the role of electrical selectivity (Tables 3 and 4 and Figs. 2, 3, and 4).

The expression for which the graph of fixation on a solid from solution is concave to the axis of equilibrial concentration,

$$x/m = kc^n$$

when x is the fixation,

m is the initial weight of fiber,

c is the equilibrial concentration of solute, and

k and n are constants,

has developed from Lowitz' observation in 1791 (129) and the early work of Boedeker (7), Kroeker (83), Georgievics (56, 54, 53, 51, 48, 58, 47, 49, 50, 52, 55, 57), Walker and Appleyard (135), Schmidt (120, 122, 123, 121), Freundlich (41, 42, 40, 43), and others (131) and has been variously known as Boedeker's distribution law (100, 140), the Kroeker curve (87), and the Freundlich adsorption isotherm (8, 60).

Exhaustion and distribution coefficient at both temperatures were decreasing logarithmic functions of equilibrial concentration with decrease in slope of their logarithmic graphs as initial pH attained constancy. Many investigators have

concluded that secondary cellulose acetates behave toward various organic solutes in aqueous solution like an immiscible liquid phase in which the penetrant dissolves (80, 92, 77, 90, 95, 78, 16, 118, 10, 9, 134) and have specified attainment of constant partition of solute between fiber and bath as the criterion of solution. Distribution coefficients have been called constant with these values, in order, for minimum, mean, and maximum: a) Knoevenagel (80): 5.59, 6.04, 6.43; 5.60, 6.35, 6.67; 1.29, 1.38, 1.48; 0.60, 0.90, 1.26; 6.11, 6.43, 6.67; 6.40, 6.67, 6.84; b) Meyer, Schuster, and Bülow (92): 170, 180, 186; c) Kartaschoff (78): 0.0174, 0.0179, 0.0186; 0.0264, 0.0279, 0.0307; 0.0613, 0.0663, 0.0697; 0.0556, 0.0573, 0.0588; 0.0839, 0.0878, 0.0930, etc.; d) Brandenburger (9, 10): 29.5, 31.5, 32.2; 128.5, 133.4, 137.3; e) Sachs (118): 0.0174, 0.01800, 0.0188. Vickerstaff and Waters (134) have emphasized that

> "a clear distinction between solution and adsorption can only be attained by establishing that a constant partition ratio is obtained up to complete saturation of the fiber."

Kolthoff and van der Goot (82) have summarized the situation,

> "In many cases it is impossible to determine the 'saturation value' in an experimental way, as either the solubility of the adsorptive is not large enough or the saturation value lies at such high concentrations that other factors influence the result. Although in many cases valuable conclusions can be drawn from the shape of the adsorption isotherm, the extrapolated value of the 'saturation' value to the point where the isotherm is parallel to the final concentration axis is rather uncertain."

In 1913 Sisley (125) reported that Berthollet's law on distribution of a dissolved substance between two immiscible

solvents held for dyeing silk with certain acid dyes; in 1927 Meyer and Fikentscher (90, 91) obtained 22.6, 25.0, and 27.4 as minimum, mean, and maximum for the distribution coefficient of o - nitraniline between silk and water and described the process as solution. In 1903 Heermann (68) published figures, for increase in weight and ash upon mordanting silk fibroin in chromium chloride, which plot as logarithmic functions of equilibrial concentration. His work was verified by Bloch (6). Later Hishiyama (70, 71) showed that fixation on silk was an increasing logarithmic function of equilibrial concentration not only of chromium chloride but also of chrome alum, chromium acetate, chromium nitrate, and chromium sulfate. Estrup (35) and Leunig (85) obtained fixation on carbon from potassium dichromate as increasing logarithmic functions of equilibrial concentration.

At different pH but the same initial concentration of solute, 1.0000 g. potassium dichromate per gram of fiber, the ratio of fixation on cellulose-acetate rayon to that on silk is 1.16, nearly the same ratio found by Frey-Wyssling for the intermicellar spaces of these fibers, 1.22.

The lower fixation on preheated nylon at 40° C. confirms statements by Whittaker (138) and others (104).

The mordanting efficiency for silk of potassium dichromate is compared with that of chromium acetate in Table 5 and Fig. 4.

Contrary to details in several patents (45, 12, 29, 22)

addition of acetone to mordanting bath dissolved much cellulose-acetate rayon instead of increasing fixation on it.

Maximal fixation, that from a saturated solution (11), was not obtained for any of the fibers because of the high solubility of potassium dichromate in water (36) and the lack of any non-aqueous solvent for the dichromate.

Magnetic (5) and ultrasonic fields (126) have been reported as increasing fixation.

The increase in conditioned weight of each fiber upon mordanting at 40° C., greater than the chromic-chromate equivalent (110, 111), less than the potassium-dichromate equivalent, but within experimental error of the chromic-acid equivalent of the fixed Cr_2O_3, and the increased absorption of light by the mordanted fiber (wider deviation for cellulose-acetate rayon is ascribed to greater gloss rather than less level fixation) were in creasing logarithmic functions of equilibrial concentration with decrease in slope of their logarithmic graphs as initial pH reached a constant value.

Effect of temperature of mordanting

Fixation of Cr_2O_3 on each fiber during one hour from fifty volumes of aqueous potassium dichromate (2.0000 g. solute per gram of cellulose-acetate rayon at pH 1.29, 0.5000 g. solute per gram of nylon at pH 1.15, or 0.5000 g. solute per gram of silk at pH 1.70) has been shown to be, between 25 and 100° C., an increasing logarithmic function of temperature of mordanting,

$$x/m = kT^n$$

Exhaustion and distribution coefficient also increased logarithmically with temperature of mordanting (Table 6 and Figs. 5, 6, and 7).

The thermal coefficient of fixation, for 100 compared with 40° C., was 34 for cellulose-acetate rayon, compared with 8 for chromium sulfate (94), 5.4 for nylon, and 9.6 for silk. Corresponding values for thermal coefficients of partition were 34, 7.2, and 12.3. Pelet-Jolivet and Siegrist (102) have reported the thermal coefficient independent of pH for fixing dye on carbon.

Heermann's figures for increased weight of silk fibroin mordanted in chromium chloride (67) plot as an increasing logarithmic function of temperature between 0 and 30° C. as do Michel's data for fixation on silk from chromium sulfate between 40 and 100° C. (74).

Increase in fixation with temperature has been an argument against considering fixation an adsorption (86).

Effect of duration of mordanting

Fixation of Cr_2O_3 on cellulose-acetate rayon from fifty volumes of aqueous potassium dichromate, 2.0000 g. solute per gram of fiber at pH 1.29, is pictured as an increasing logarithmic function of time of mordanting,

$$x/m = kt^n$$

between one and 211 hours at 40° C. and between fifteen minutes and four hours at 100° C. At 40° C. the slope of the logarithmic

graph of fixation decreased after 49 hours at an equilibrial pH of 1.65; at 100° C. the decrease in slope of the logarithmic graph came at 45 minutes (Tables 7 and 8 and Figs. 8, 9, 10, 11, 12, 13, 14, 15).

Kartaschoff (77) showed that fixation of Malachite green on cellulose-acetate rayon, from 27 minutes until it became constant at 516 minutes, was an increasing logarithmic function of time of dyeing.

Exhaustion and distribution coefficient were increasing logarithmic functions of time of mordanting at both temperatures and their logarithmic graphs changed slope like that of the fixation.

The arithmetic average (116) of velocity coefficients for the discontinuous isothermals, as computed for a second-order reaction with reactants in equal concentrations, are $1.6 \pm 0.1 \times 10^{-4}$ mole/liter/minute for the first and $1.2 \pm 0.2 \times 10^{-4}$ mole/liter/minute for the second interval at 40° C. and $6.3 \pm 0.3 \times 10^{-3}$ mole/liter/minute for the first period at 100° C. followed by a drop to 2.4×10^{-3} mole/liter/minute at four hours. Decreasing velocity coefficients have been ascribed to slower penetration of fiber after rapid adsorption on an immediately available surface (105) and to continuing exhaustion of bath (27).

For comparing diffusion into a single fiber the diffusion coefficient, D/r^2, has been computed according to Hill's plot (69) of x/s against Dt/r^2 for the series,

$$x/s = 1 - \alpha e^{-b\,Dt/r^2} - c e^{-b\,Dt/r^2} \quad \text{-----}$$

when x is percental fixation in time t,

s is percental fixation at maximal time,

D is diffusibility,

r is mean radius of fiber, and

α, b, and c are constants,

which he developed from Fick's law for diffusion into a semi-infinite solid (38).

At 40° C. the diffusion coefficient of cellulose-acetate rayon rose along the first slope of the logarithmic graph of fixation from $0.9 \times 10^{-5}\ D/r^2$ at sixteen hours to $2.0 \times 10^{-5} D/r^2$ at 49 hours but then kept quite constant at $2.7 \pm 0.1 \times 10^{-5} D/r^2$ for 51 hours. At 100° C. the diffusion coefficient increased from $4.7 \times 10^{-4} D/r^2$ at fifteen minutes to a maximum of $1.4 \times 10^{-3} D/r^2$ at 45 minutes and then dropped to $1.1 \times 10^{-3} D/r^2$ at two hours. If the pores of a fiber are so narrow as to hinder movement of some ion their sieve-like action changes the selectivity (20, 93). Increase in permeability is ascribable to chemical action and shrinkage of fiber, decrease in permeability to swelling or blocking.

Until the equilibrial pH at 40° C. became constant, in 100 hours at pH 2.00, it increased semilogarithmically as equilibrial concentration of potassium dichromate decreased.

No great loss in wet strength, 11 per cent, took place during the first 100 hours' mordanting of cellulose-acetate rayon

at 40° C.

The fixation of Cr_2O_3 on nylon from fifty volumes of aqueous potassium dichromate, 0.5000 g. solute per gram of fiber at pH 1.15, was a similar increasing logarithmic function of time of mordanting between one and 100 hours at 40° C. and between fifteen minutes and 1.5 hours at 100° C. At 40° C. the slope of the logarithmic graph of fixation decreased at 49 hours and an equilibrial pH of 1.43.

Exhaustion and distribution coefficient were increasing logarithmic functions of time of mordanting nylon at both temperatures and their logarithmic graphs at 40° C. changed slope like that of the fixation.

The velocity coefficient of nylon decreased with time at each temperature; at 40° C. it fell from 2.9×10^{-2} mole/liter/minute at one hour to 2.2×10^{-3} mole/liter/minute at 100 hours and at 100° C. from 0.28 mole/liter/minute at fifteen minutes to 0.18 mole/liter/minute at 1.5 hours.

At 40° C. the diffusion coefficient of nylon stayed at $1.1 \pm 0.0 \times 10^{-4} D/r^2$ through 64 hours but at 100° C. it mounted from $1.9 \times 10^{-3} D/r^2$ at fifteen minutes to $4.3 \times 10^{-3} D/r^2$ at one hour, resulting in a value of 36 for the thermal coefficient of diffusibility.

After 49 hours' mordanting at an equilibrial pH of 1.43 at 40° C. but 6 per cent of the original wet strength of nylon was left.

Equilibrial pH of mordanting bath increased semilogarithmically as equilibrial concentration decreased.

The fixation of Cr_2O_3 on silk fibroin from fifty volumes of aqueous potassium dichromate, 0.5000 g. solute per gram of fiber at pH 1.70, progressed as an increasing logarithmic function of time of mordanting between one and 229 hours at 40° C. and between fifteen minutes and one hour at 100° C. Data presented by Heermann (66) for increase in weight of silk fibroin upon mordanting with chromium chloride plot as an increasing logarithmic function of time of mordanting between one minute and seven days.

Exhaustion and distribution coefficient were increasing logarithmic functions of time of mordanting at each temperature.

The velocity coefficient for silk decreased with time; at 40° C. it fell from 1.3×10^{-2} mole/liter/minute at one hour to 0.9×10^{-3} mole/liter/minute at 229 hours and at 100° C. from 0.24 mole/liter/minute at fifteen minutes to 0.16 mole/liter/minute at one hour. The ratio of velocity coefficient at 100 to that at 40° C. was 36, 7, and 12, respectively, for cellulose-acetate rayon, nylon, and silk.

At 40° C. the diffusion coefficient for silk stayed at $2.3 \pm 0.3 \times 10^{-5} D/r^2$ from four to 169 hours but at 100° C. rose from $3.4 \times 10^{-3} D/r^2$ at fifteen minutes to $5.9 \times 10^{-3} D/r^2$ at 45 minutes.

The wet strength of silk fibroin upon mordanting 120 hours at 40° C. fell to 39 per cent of its first value while the pH of the mordanting bath rose to 3.40.

No time of half saturation was computable since fixation on none of the fibers reached a maximum. Oryng (98) considered oxidation the cause of failure to obtain maximal fixation on carbon.

Substitution in the Arrhenius equation,

$$Ha = \frac{\log K_2/K_1 \times 2.3026 \times 1.98711 \times T_2 \times T_1}{T_2 - T_1}$$

gives values for energy of activation for cellulose-acetate rayon, nylon, and silk fibroin of 13820, 7655, and 9707 calorie/mole, respectively, computed from velocity coefficients for 100 and 40° C. at one hour; similar values of 13747, 7618, and 9706 are obtained by substitution of the distribution coefficients but substitution of diffusion coefficients gives a value of 13840 for nylon. Busse, Lessing, Loughborough, and Larrick (18, 19) showed that the logarithm of life of nylon under a given load was a linear function of reciprocal of absolute temperature and reported 19,870 calorie/degree for the energy of activation of nylon. Vickerstaff (133) obtained 21,000 to 37,000 gram calorie for the energy of activation of nylon in reaction with various dyes.

Distribution of mordant during mordanting

An exploration of the migration of Cr_2O_3 from mordanted to unmordanted fiber at 40° C. is shown in Table XI. Each fiber was mordanted 49 hours at 40° C., rinsed with water, dried at room temperature, conditioned at 70±2° F. and

65 ± 2 per cent R. H., and immersed in hydrochloric acid with an unmordanted fiber for 211 hours before removal and determination of equilibrial pH of bath and ash of thoroughly rinsed fiber. In this time the desorption of Cr_2O_3 amounted to 15.6, 22.3, and 48.0 per cent, respectively, for cellulose-acetate rayon, nylon, and silk; in the same order the migration of Cr_2O_3 was 3.3, 13, and 10 per cent. Rose (115) had stated that speed of equalization during dyeing was more rapid with nylon than with cellulose-acetate rayon.

An exploration of distribution during mordanting of cellulose-acetate rayon at 40° C. and 100° C. is shown in Table XII. A sample of cellulose-acetate rayon was immersed in each of three identical mordanting baths at each temperature; after thirteen hours at 40 or one hour at 100° C. the fiber from the first baths and after 26 hours at 40 or two hours at 100° C. the fiber from the second baths were removed, the equilibrial pH of the baths determined, and the mordanted fibers rinsed and ashed. A second sample of fiber was added to the third bath after thirteen hours at 40 or one hour at 100° C. and mordanting was continued thirteen hours at 40 or one hour at 100° C. before removal of samples for analysis of bath and fiber. At 40° C. the ratio of the sum of the percental fixations in the same bath to that in separate baths was 0.84; at 100° C. this ratio became 0.96.

Table XIII presents a numerical picture of distribution during mordanting of nylon at 40° C. The same weight of nylon

was immersed in each of seven identical mordanting baths at constant temperature. At 74 hours the mordanted nylon was removed from one mordanting bath and the equilibrial pH of the bath and the ash of the fiber determined. At 74 hours a second marked nylon of the same weight was immersed in each of five other baths for 48, 96, 120, 168, or 453 hours before analysis of equilibrial baths and mordanted fibers; the seventh bath and fiber were analyzed after 527 hours. Fixation during same-bath mordanting on both the first-immersed and the second-immersed nylon was an increasing logarithmic function of time of mordanting with rate of fixation higher for the second-immersed nylon. This seems to illustrate a statement by Fajans and Wüst (37),

> "If the concentration of a solution with which a solid body is in equilibrium is lowered then the adsorbed substance is given up until equilibrium under the new concentration is established in accordance with the adsorption isotherm."

Effect of volume of mordanting bath

Fixation of Cr_2O_3 on each fiber,

$$x/m = kv^n$$

and the exhaustion of aqueous potassium dichromate during one hour at boiling have been shown to be decreasing logarithmic functions of initial volume of mordanting bath, 2.0000 g. solute per gram of cellulose-acetate rayon or 0.5000 g. solute per gram of nylon or silk, with initial pH of shortest bath rising upon dilution (Table 9 and Figs. 16 and 17).

The distribution coefficient, until it became constant, was also a logarithmic function of volume, decreasing for cellulose-acetate rayon and nylon but increasing for silk.

Data for fixation on cellulose-acetate rayon of Cellitechtviolett E R published by Brandenburger (9, 10) and of Malachite green given by Bernouilli (4) plot as decreasing logarithmic functions of volume of dyebath. Rabinerson (108) has stressed anomalous adsorption at low volumes.

When cellulose-acetate rayon and nylon were mordanted in another set of mordanting baths, like the first except for constant initial pH, fixation and exhaustion decreased, but not logarithmically, with volume of mordanting bath and distribution coefficient increased to a constant value.

Effect of weight of fiber

Fixation of Cr_2O_3 on each fiber during one hour at 100° C. from a constant volume, 600 ml., of aqueous potassium dichromate (2.0000 g. solute per gram of cellulose-acetate rayon, 1.5000 g. solute per gram of nylon, or 0.5000 g. solute per gram of silk fibroin) was a decreasing logarithmic function of initial weight of fiber between 4 and 13 grams,

$$x/m = km^n$$

This relationship probably holds for lesser weight of nylon or silk as it has been shown to hold for one gram of cellulose-acetate rayon and the discrepancy is likely due to slight error

in estimation of initial pH in the region where striking change in fixation accompanies extremely slight change in pH (Table 10 and Figs. 18, 19, and 20).

Sachs' data (118) for fixation of dye on cellulose-acetate rayon plot as an increasing logarithmic function of initial weight of fiber between 2 and 8 g. and Bernouilli's data (4) for Malachite green on cellulose-acetate rayon follow this exponential between 1.5 and 2.5 g. of fiber. However, anomalous adsorption by small weight of fiber has been emphasized (39, 99, 107, 101, 109, 15).

Exhaustion was an increasing logarithmic function of initial weight of each fiber. For nylon the distribution coefficient was an increasing, but for cellulose-acetate rayon and silk, a decreasing logarithmic function of initial weight of fiber.

SUMMARY

1. Fixation of chromium sesquioxide on cellulose-acetate rayon from fifty volumes of potassium dichromate during one hour at 100° C. has been shown to be an increasing rectilinear function of initial pH of mordanting bath, 2.0000 g. solute per gram of fiber, between pH 1.17 and 1.29 and a decreasing rectilinear function between this maximum, 4.03±0.05 per cent, and 0.96±0.01 per cent Cr_2O_3 at pH 1.67. Loss of acetyl between pH 0.95 and 2.27 was less than 3.8 per cent of its original 38.57 per cent. No change in wet strength occurred when cellulose-acetate rayon was mordanted at the threshold of fixation, pH 2.27; its strength increased upon mordanting at greater pH, approximately 10 per cent at pH 6.47, and decreased by half its first value at pH 0.91.

Fixation on nylon at variable pH and constant concentration, 0.5000 g. solute per gram of fiber, was a decreasing rectilinear function of initial pH of mordanting bath between 10.30±0.02 per cent Cr_2O_3 at pH 0.93 and 2.64±0.03 per cent at pH 1.70.

Fixation on silk fibroin from a like bath proved to be an increasing rectilinear function of initial pH from 0.93 to 1.15 and a decreasing rectilinear function between this maximum, 8.59±0.10 per cent, and 1.30 ± 0.03 per cent

Cr_2O_3 at pH 2.30. The silk lost strength upon mordanting at pH 2.32 or less and retained but 17 per cent of its original wet strength after mordanting at pH 1.21.

Fixation, exhaustion, and distribution coefficient for each fiber were logarithmic functions of equilibrial concentration, decreasing for nylon but passing through a maximum for cellulose-acetate rayon and silk.

2. For each fiber, and during 48 hours at 40° C. as well as during one hour at 100° C., fixation of Cr_2O_3 from fifty volumes of aqueous potassium dichromate at constant initial pH was an increasing logarithmic function of equilibrial concentration,

$$x/m = kc^n$$

Exhaustion and distribution coefficients at both temperatures were decreasing logarithmic functions of equilibrial concentration. Increase in conditioned weight of each fiber upon mordanting at 40° C., within experimental error of chromic-acid equivalent of fixed Cr_2O_3, and increased absorption of light by mordanted fiber were increasing logarithmic functions of equilibrial concentration.

3. Fixation of Cr_2O_3 on each fiber during one hour from fifty volumes of aqueous potassium dichromate (2.0000 g. solute per gram of cellulose-acetate rayon at pH 1.15 or 0.5000 g. solute per gram of silk at pH 1.70) has been shown to be, between 25 and 100° C., an increasing logarithmic function of temperature of mordanting,

$$x/m = kT^n$$

Exhaustion and distribution coefficient also increased logarithmically with temperature of mordanting.

4. Fixation of Cr_2O_3 on cellulose-acetate rayon from fifty volumes of potassium dichromate, 2.0000 g. solute per gram of fiber at pH 1.29, was an increasing logarithmic function of time of mordanting,

$$x/m = kt^n$$

between one and 211 hours at 40° C. and between fifteen minutes and four hours at 100° C. At 40° C. the slope of the logarithmic graph of fixation decreased after 49 hours; at 100° C. this change in slope came at 45 minutes. Exhaustion and distribution coefficient were increasing logarithmic functions of time of mordanting at both temperatures and their graphs changed slope like that of fixation. The mean velocity coefficients for the second discontinuous isothermals were less than those for the first. The diffusion coefficients for the first discontinuous isothermal at 40° C. increased to a constant value; at 100° C. the diffusion coefficients passed through a maximum. Until equilibrial pH at 40° C. became constant, in 100 hours at pH 2.00, it increased semilogarithmically as equilibrial concentration of potassium dichromate decreased. No greater loss than 11 per cent occurred during the first hundred hours' mordanting of cellulose-acetate rayon at 40° C.

Fixation of Cr_2O_3 on nylon from fifty volumes of aqueous potassium dichromate, 0.5000 g. solute per gram of

fiber at pH 1.15, was a similar increasing logarithmic function of time of mordanting between one and 100 hours at 40° C. and between fifteen minutes and 1.5 hours at 100° C. Exhaustion and distribution coefficient were increasing logarithmic functions of time of mordanting at both temperatures. The velocity coefficient decreased with time at each temperature. At 40° C. the diffusion coefficient remained constant for 64 hours but at 100° C. it rose rapidly. After 49 hours' mordanting at 40° C. and at an equilibrial pH of 1.43 nylon retained but 6 per cent of its original wet strength. Equilibrial pH increased semi-logarithmically as equilibrial concentration decreased.

Fixation of Cr_2O_3 on silk fibroin from fifty volumes of aqueous potassium dichromate, 0.5000 g. solute per gram of fiber at pH 1.70, progressed as an increasing logarithmic function of time of mordanting between one and 229 hours at 40°C. and between fifteen minutes and one hour at 100° C. Exhaustion and distribution coefficient were increasing logarithmic functions of time of mordanting at each temperature. The velocity coefficient decreased with time. At 40° C. the diffusion coefficient kept constant from four to 169 hours but at 100° C. it continuously increased. Wet strength of silk fibroin upon mordanting 100 hours at 40° C. fell to 39 per cent of its first value while the pH of its mordanting bath rose from 1.70 to 3.40. Computation of energy of activation in calorie/mole from either velocity coefficients or distribution coefficients gave the same values, 13820 for cellulose-acetate rayon, 7655

for nylon, and 9707 for silk.

5. Fixation of Cr_2O_3 on each fiber,

$$x/m = kv^n$$

and the exhaustion of mordanting bath during one hour at boiling have been shown to be decreasing logarithmic functions of initial volume of mordanting bath, 2.0000 g. solute per gram of cellulose-acetate rayon or 0.5000 g. solute per gram of nylon or silk, with initial pH of the shortest bath rising upon dilution. The distribution coefficient, until it became constant, was also a logarithmic function of initial volume, decreasing for cellulose-acetate rayon and nylon but increasing for silk. When cellulose-acetate rayon and nylon were mordanted in another set of mordanting baths, like the first except for constant initial pH, fixation and exhaustion decreased, but not logarithmically, with volume of mordanting bath and distribution coefficient increased to a constant value.

6. Fixation of Cr_2O_3 on each fiber during one hour at 100° C. from a constant volume of aqueous potassium dichromate (2.0000 g. solute per gram of cellulose-acetate rayon, 1.5000 g. solute per gram of nylon, or 0.5000 g. solute per gram of silk fibroin) was a decreasing logarithmic function of initial weight of fiber between one and thirteen grams,

$$x/m = km^n$$

Exhaustion was an increasing logarithmic function of weight of fiber. For nylon the distribution coefficient was an increasing, but for cellulose-acetate rayon and silk a decreasing, logarithmic function of weight of fiber.

LITERATURE CITED*

1. American Society for Testing Materials.
A. S. T. M. Standards on Textile Materials. p. 39.
Philadelphia: American Society for Testing Materials, 1942.

2. Astbury, W. T.
X-ray studies of the structure of plastics.
J. Soc. Dyers Colourists 62,3(1946).

3. Barr, F., Marshall, A. J., and Edgar, R.
A comparison of carbon tetrachloride, naphtha, and water for the cleaning of cellulose-acetate rayon, regenerated-cellulose rayon, wool, wild silk, silk, and weighted silks.
Am. Dyestuff Reptr. 29,599-603(1940).

4. Bernouilli, P. F.
Quantitative Untersuchungen über die Wirkungsweise von Zusätzen beim Färben von Acetatseide mit basischen Farbstoffen.
Helv. Chim. Acta 16,1226-40(1933).

5. Bhatnagar, S. S., Kapur, P. L., and Kapur, A. N.
The influence of a magnetic field on adsorption.
Phil. Mag. (7) 23,256-64(1937).

6. Bloch, L.
Etude du mordançage en étain, fer, et alumine sur soie par M. le Dr. Paul Heermann.
Bull. soc. ind. Mulhouse 74,159-66(1904).

7. Boedecker, C.
Ueber das Verhältniss zwischen Masse und Wirkung beim Contact ammoniakalischer Flüssigkeiten mit Ackererde und mit kohlensaurem Kalk.
J. Landw. 7,48-58(1859).

8. Boutaric, A.
Remarques sur les formules représentant les isothermes d'adsorption.
Compt. rend. 188,450-2(1929).

9. Brandenburger, H.
Die Färberei der Acetatseide.
Kunstseide 11,338-45(1929).

---

* Abbreviations for periodicals follow the usage of Chemical Abstracts, (C. A.).

10. Brandenburger, H.
Neuere Untersuchungen zur Theorie der Azetatseidenfärberei.
Melliand Textilber. 10,215-7(1929).

11. Brintzinger, H., Schall, A., and Beier, H. G.
Die maximale Adsorption. I. Mitteilung. Die maximale Adsorption schwerlöslicher Säuren und Basen an verschiedene Aktivkohlen.
Kolloid-Z. 74,29-32(1936).

12. British Celanese Ltd.
Coloration of textile materials.
British Patent 561,249, May 11, 1944; Original not seen; abstracted in C. A. 39,5086(1945).

13. British Celanese Ltd.
Dyeing cellulose acetate textile materials.
British Patent 563,181, Aug. 2, 1944; Original not seen; abstracted in C. A. 40,2314(1946).

14. British Celanese Ltd.
Dyeing textiles.
British Patent 440,594, Jan. 2, 1936; Original not seen; abstracted in C. A. 30,4018(1936).

15. Burgers, W. G.
Sur la dépendance de l(isotherme d'adsorption de la quantité d'adsorbant.
Rec. trav. chim. 63,46-52(1944).

16. Burns, H. M., and Wood, J. K.
The behaviour of cellulose acetate towards amino-derivatives of anthraquinone.
J. Soc. Dyers Colourists 45,13-5(1929).

17. Burr, A. H., and Burr, M. S.
The nature of the dyeing process on cellulose acetate rayon and the hydrolytic constant of chrysoidine G.
J. Soc. Dyers Colourists 50,42-7(1934).

18. Busse, W. F., Lessig, E. T., Loughborough, D. L., and Larrick, L.
Erratum: Fatigue of fabrics.
J. Applied Phys. 16,120(1945).

19. Busse, W. F., Lessig, E. T., Loughborough, D. L.,and Larrick, L.
Fatigue of fabrics.
J. Applied Phys. 13,715-25(1942).

20. Clavel, R., and Stanisz, T.
Considérations sur la teinture de la soie artificielle, dite à "l'acétate" (cellulose acétylée).
Rev. gen. mat. color. 28,145-7,167-9(1923)., 29,94-6, 158-60,222-4(1924).

21. Clayton, E.
Theory of the dyeing of cellulose acetate silk.
J. Soc. Dyers Colourists 46,367-8(1930).

22. Croft, C. M., and Hindle, W. H.
Dyeing.
U. S. Patent 2,380,503, July 31, 1945; Original not seen; abstracted in Off. Gaz. U. S. Pat. Office 576,463-4(1945).

23. Dean, R. B.
The diffusion of ions in supporting electrolytes.
J. Am. Chem. Soc. 67,31-5(1945).

24. Denham, W. S., and Brash, W.
The isoelectric point of silk-fibroin.
J. Textile Inst. 18,T520-5(1927).

25. Denham, W. S., and Dickinson, E.
The swelling of silk.
Trans. Faraday Soc. 29,300-5(1933).

26. Denham, W. S., Hutton, E. A., and Lonsdale, T.
Measurement of the electrical resistance of yarns and cloths. Variation in the resistance of silk with pH.
Trans. Faraday Soc. 31,511-9(1935).

27. Dietl, A.
Ueber die Kinetik der Sorption.
Kolloid-Beihefte 6,127-46(1914).

28. Donohue, R. O.
The chemical resistance of polyhexamethylene adipamide.
Unpublished Ph. D. Thesis, Ames, Iowa, Iowa State College Library, 1942.

29. Ellis, G. H., and Wesson, A. J.
Mordant dyeing of cellulose derivatives.
U. S. Patent 2,365,809, Dec. 26, 1944; Original not seen; abstracted in Off. Gaz. U. S. Pat. Office 569,602(1944).

30. Elöd, E., and Balla, N.
The reaction between protein fibers and substantive dyestuffs. (XXII Communication concerning mordanting and dyeing processes.)
Trans. Faraday Soc. 31,305-17(1935).

31. Elöd, E., and Balla, N.
Über das Färben von Naturseide.
Melliand Textilber. 16,201-4(1935).

32. Elöd, E., and Silva, E.
Studien über Beiz- und Färbevorgänge. Zur Theorie der Färbung tierischer Fasern mit sauren Farbstoffen.
Melliand Textilber. 10,707-10(1929).

33. Elöd, E., Teichmann, L., and Pieper, E.
Studien über Beiz- und Färbevorgänge, V.
Angew. Chem. 40,262-4(1927).

34. Ephriam, F.
A Text-book of Inorganic Chemistry, p. 416.
New York: D. Van Nostrand Company, Inc., 1934.

35. Estrup, K.
Ueber negative Adsorptionsisothermen.
Kolloid-Z. 11,8-12(1913).

36. Etard.
Recherches experimentales sur les solutions saturees.
Ann. chim. (7) 2,503-74(1894).

37. Fajans, K., and Wüst, J.
A Textbook of Practical Physical Chemistry, p. 55.
New York: E. P. Dutton and Company, Inc., 1930.

38. Fick, A.
Ueber Diffusion.
Ann. Physik 94,59-86(1855).

39. Fodor, A., and Schönfeld, R.
Die Abhängigkeit der Adsorption durch Kohle von der Kohlemenge, ferner über das Wesen der Adsorptionsisotherme.
Kolloid-Z. 31,75-80(1922).

40. Freundlich, H.
Bemerkungen zu der Abhandlung von M. W. Travers "Über Adsorption und Okklusion".
Z. physik. Chem. 61,249-54(1907).

41. Freundlich, H.
Über die Adsorption in Lösungen.
Z. physik. Chem. 57,385-470(1907).

42. Freundlich, H., and Losev, G.
Über die Adsorption der Farbstoffe durch Kohle und Fasern. (Ein Beitrag zur Theorie des Färbens.).
Z. physik. Chem. 59,284-312(1907).

43. Freundlich, H., and Neumann, W.
Über die Adsorption von Farbstoffen.
Z. physik. Chem. 67,538-50(1909).

44. Frey-Wyssling, A.
Röntgenographische Vermessung der submikroskopischen Räume in Gerüstusbstanzen. Ultramikroskopische Untersuchung der submikroskopischen Räume in Gerüstsubstanzen.
Protoplasma 27,372-41,563-71(1937).

45. Galatioto, L. C.
Method of dyeing cellulose acetate and dye bath compositions.
U. S. Patent 2,249,607, July 15, 1941; Original not seen; abstracted in Off. Gaz. U. S. Pat. Office 528,723-4(1941).

46. Genung, L, B., and Mallatt, R. C.
Analysis of cellulose derivatives. Determination of total combined acyl in cellulose organic esters.
Ind. Eng. Chem., Anal. Ed. 13,369-74(1941).

47. Georgievics, G. von.
Ein Beitrag zur Kenntnis des Tannierens der Baumwolle.
Mitt. tech. Gewerbe Museums Wien (2) 8,362-4(1898); Original not seen; abstracted in Chem. Zentr. 1899, I, 313.

48. Georgievics, G. von.
Nature of the dyeing process.
Mitt. tech. Gewerbe Museums Wien 4,349-61; Original not seen; abstracted in J. Soc. Chem. Ind. 14,652-3(1895).

49. Georgievics, G. von.
Studien über Adsorption in Lösungen. II Abhandlung: Die dualistische Natur der Adsorptionsverscheinungen.
Montsh. 32,1075-87(1911).

50. Georgievics, G. von.
Studien über Adsorption in Lösungen. IV Abhandlung: Über die Bedeutung der X der Verteilungsformel und die Ursachen der Sorption. V Abhandlung: Lösung, Adsorption, chemische Verbindung, Adhäsion.
Monatsh. 34,733-50,751-7(1913).

51. Georgievics, G. von.
The nature of the dyeing process.
Mitt. tech. Gewerbe Museums Wien 4,205-20(1894); J. Soc. Chem. Ind. 14,149-51(1895).

52. Georgievics, G. von.
Ueber Adsorption in Lösungen, II. Eigenheudt der studien über Adsorption.
Kolloid-Z. 14,69-74(1914).

53. Georgievics, G. von.
Über das Wesen des Färbeprocesses.
Monatsh. 15,705-17(1894).

54. Georgievics, G. von.
Uber das Wesen des Färbeprocesses.
Sitzber. Akad. Wiss. Wien, Math. naturw. Klasse Abt. IIb, 103,589-601(1894).

55. Georgievics, G. von.
Über das Wesen und die Ursachen der Sorption aus wässerigen Lösungen.
Z. physik. Chem. 83,269-80(1914).

56. Georgievics, G. von.
Ueber den Einfluss der Structur der Gespinnstfasern auf die Aufnahme von Farbstoffen.
Chem.-Ztg. 18, Repertorium 170(1894).

57. Georgievics, G. von.
Zur Kenntnis der Färbungen von Säurefarbstoffen und Salzfarben.
Z. Farbenind. 2,253-7(1903).

58. Georgievics, G. von, and Löwy, E.
Über das Wesen des Färbeprocesses. Vertheilung von Methylenblau zwischen Wasser und mercerisierter Cellulose.
Monatsh. 16,345-50(1895).

59. Getman, F. H., and Daniels, F.
Outlines of Physical Chemistry, p. 406.
New York: John Wiley and Sons, Inc., 1944.

60. Gyani, B. P.
Distribution law, adsorption, and chemical reaction.
J. Phys. Chem. 49,442-53(1945).

61. Harris, M.
The combination of silk and wool with positive and negative ions.
J. Research Natl. Bur. Standards 10,475-8(1933).

62. Harris, M.
The isoelectric point of silk.
J. Research Natl. Bur. Standards 9,557-60(1932).

63. Harris, M., and Johnson, T. B.
Study of the fibroin from silk in the isoelectric region.
Ind. Eng. Chem. 22,539-42(1930).

64. Harris, M., and Sookne, A. M.
Electrophoretic studies of nylon.
J. Research Natl. Bur. Standards 26,289-92(1941).

65. Hawley, Jr., T. G., and Johnson, T. B.
The isoelectric point of silk fibroin.
Ind. Eng. Chem. 22,297-9(1930).

66. Heermann, P.
Beiträge zur Kenntnis der Färbereiprozesse. I.
Beizdauer und Beizenaufnahme bei der primären Metallbeizung.
Farber-Ztg. 14,37-43(1903).

67. Heermann, P.
Beiträge zur Kenntnis der Färbereiprozesse. II. Beiztemperatur und Beizenaufnahme bei der primären Metallbeizung.
Farber-Ztg. 14,142-5(1903).

68. Herrmann, P.
Beiträge zur Kenntnis der Färbereiprozesse. III. Beizen-Konzentration und Beizenaufnahme bei der primären Metallbeizung.
Färber-Ztg. 14,350-2(1903).

69. Hill, A. V.
The diffusion of oxygen and lactic acid through tissues.
Proc. Roy. Soc. (London) 104B,39-96(1908).

70. Hishiyama, K.
Studies on the mordanting of silk with chromium salts, VI.
J. Soc. Chem. Ind., Japan 39,136-8B(1936).

71. Hishiyama, K., and Sekiguchi, H.
Studies on the mordanting of silk with chrome alum. I.
J. Soc. Chem. Ind., Japan 35,113-6B(1932).

72. Imperial Chemical Industries, Ltd.
Dyeing rayon.
French Patent 799,912, June 23, 1936; Original not seen; abstracted in C. A. 30,8643(1936).

73. Imperial Chemical Industries, Ltd., Rendell, L. P. and Thomas, H. A.
Dyeing cellulose derivatives.
Brit. Patent 437,274, Oct. 21, 1935; Original not seen; abstracted in C. A. 30,2402(1936).

74. Ishizaka, N.
Ueber die Beziehung zwischen Kolloidfällung und Adsorption und über Fallungsgeschwindigkeit.
Z. physik. chem. 83,97-128(1913).

75. Jacquemin, E.
De la combinaison directe de l'acide chromique avec la laine et la soie, et de ses applications à la teinture et a l'analyse des vins.
Compt. rend. 79,523-5(1874).

76. Kaneko, B., and Yamamoto, K.
Behavior of aqueous solution of the domestic cocoon. XXI. Isoelectric points of sericin and fibroin.
J. Agr. Chem. Soc. Japan 10,1291-4(1935).

77. Kartaschoff, V.
Le phénomène de la teinture de la soie à l'acétate de cellulose. II.
Helv. Chim. Acta 9,152-73(1926).

78. Kartaschoff, V., and Farine, G.
Complément à l'étude du phénomène de teinture de la soie a l'acétate.
Helv. Chim. Acta 11,813-36(1928).

79. Kitson, R. E., and Mellon, M. G.
Color of aqueous potassium dichromate solutions.
Ind. Eng. Chem., Anal. Ed. 16,42-4(1944).

80. Knoevenagel, E.
Ueber die Natur der Quellungsvorgänge. 2. Mitteilung.
Kolloid-Beihefte 13,233-41(1921).

81. Koechlin, C.
Memoire sur l'historique des applications du chrome dans l'impression et dans la teinture.
Bull. soc. ind. Mulhouse 25,399-448(1853).

82. Kolthoff, I. M., and Goot, E. van der.
The adsorption of hydroxybenzenes and other aromatic compounds and their replacing action upon each other at the interface water-charcoal.
Rec. trav. chim. 48,265-87(1929).

83. Kroeker, K.
Ueber die Adsorption gelöster Stoffe durch Kohle.
Dissertation, Berlin, 1892; Original not seen; abstracted in Z. physik. Chem. 74,689-737(1910).

84. Lachs, H., and Michaelis, L.
Über die Adsorption der Neutralsalze.
Z. Elektrochem. 17,1-5(1911).

85. Leunig, H.
Adsorptions - und Reduktionsvorgänge an aktiver Kohle.
Kolloid-Z. 64,143-53(1933).

86. Lewis, W. C. M.
An experimental examination of Gibbs' theory of surface-concentration, regarded as the basis of adsorption, with an application to the theory of dyeing.
Phil. Mag. (6) 15,499-526(1908).

87. Mehl, P.
Uber "anomale" Kroeker-Kurven.
Kolloid-Z. 56,299-305(1931).

88. Meunier, L., and Rey, G.
Détermination du point isoélectrique de la laine et de la fibroine de soie. Applications. Note (7).
Compt. rend. 184,285-7(1927).

89. Meyer, K. H.
Natural and Synthetic High Polymers.
New York: Interscience Publishers, Inc., 1942.

90. Meyer, K. H.
Zur Physik und Chemie der Färbevorgänge.
Naturwissenschaften 15,129-34(1927).

91. Meyer, K. H., and Fikentscher.
Zur Physik und Chemie der Färbevorgänge. IV. Ueber die Vorgänge beim Färben der Seide und Wolle.
Melliand Textilber. 8,781-5(1927).

92. Meyer, K. H., Schuster, C., and Bülow, W.
Zur Physik und Chemie der Färbevorgänge I. Ueber das Färben von Azetatseide.
Melliand Textilber. 6,737-9(1925).

93. Michaelis, L., and Perlzweig, W. A.
Studies on permeabilities of membranes. I. Introduction and the diffusion of ions across the dried collodion membrane.
J. Gen. Physiol. 10,575-98(1927).

94. Michel, P.
Absorption des sels de chrome par la soie naturelle.
Tiba 12,89,91,93(1934).

95. Michels, M.
Studies on mordants for textile dyes, and a new process for color photography on textile fabrics.
Tiba 6,39-45,153-7(1928); Original not seen; abstracted in C. A. 22,1477(1928).

96. Neville, H. A.
Surface chemistry and dyeing.
Am. Dyestuff Reptr. 25,P267-78(1936).

97. Oryng, T.
Ueber die Adsorption in Lösungen und die dabei vorkommenden chemischen Vorgänge. Blutkohleadsorption in wässerigen Lösungen von $K_2Cr_2O_7$ und K_2CrO_4.
Kolloid-Z. 13,9-14(1913).

98. Oryng, T.
Zur Adsorption.
Elektrochem. Z. 22,176-7(1915).

99. Ostwald, W.
Ueber einige Adsorptions - Anomalien und ihre Deutung.
Kolloid-Z. 43,268-76(1927).

100. Ostwald, W., and Izaguirre, R. de.
Ueber eine allgemeinere Theorie der Adsorption von Lösungen.
Kolloid-Z. 30,279-306(1922).

101. Papkova - Kwitzel, T. P.
Adsorption und Adsorbensmenge, II. Adsorption von Farbstoffen an hydrophilen Adsorbentien.
Kolloid-Z. 66,148-55(1934).

102. Pelet-Jolivet, L., and Siegrist, H.
The adsorption of methylene blue and crystal ponceau by carbon in its dependence on the temperature.
van Bemmelen Gedenkboek 1910,158-62; Original not seen; abstracted in C. A. 5,3190-1(1911).

103. Peters, R. H.
Nylon fibre: A study of the mechanism of the dyeing process with acid dyes.
J. Soc. Dyers Colourists 61,95-100(1945).

104. Philadelphia Section /A. A. T. C. C./
Some effects of dry heat upon the properties of nylon fabrics.
Am. Dyestuff Reptr. 36,P38-42(1946).

105. Pickles, A.
Velocity of sorption.
Chem. News 121,25-7(1920).

106. Platt, H.
Coloration of materials.
U. S. Patent 2,042,802, June 2, 1936; Original not seen; abstracted in Off. Gaz. U. S. Pat. Office 467,129(1936).

107. Rabinerson, A.
Adsorption und Adsorbensmenge, I.
Kolloid-Z. 62,157-62(1933).

108. Rabinerson, A.
Adsorption und Lösungsvolum.
Kolloid-Z. 48,231-7(1929).

109. Rabinerson, A., Papkova-Kwitzel, T. and Pittel, A.
Adsorption und Adsorbensmenge, III.
Kolloid-Z. 67,154-61(1934).

110. Race, E., Rowe, F. M., and Speakman, J. B.
The dyeing of cotton with mineral khaki. Part I. The constitution and properties of the pigments produced in chromate development.
J. Soc. Dyers Colourists 57,213-23(1941).

111. Race, E., Rowe, F. M., and Speakman, J. B.
The dyeing of cotton with mineral khaki. Part III. The chemical changes accompanying the use of a standing bath in development by the chromate process.
J. Soc. Dyers Colourists 58,32-6(1942).

112. Race, E., Rowe, F. M., Speakman, J. B., and Vickerstaff, T.
The unlevel dyeing of wool with acid and chrome dyes. Part I - The reasons for the uneven dyeing properties of wool staples and of cloth damaged by exposure.
J. Soc. Dyers Colourists 54,141-58(1938).

113. Rastelli, G.
Untersuchungen über Seidenfibroin.
Kolloid-Z. 67,55-9(1934).

114. Rona, P., and Michaelis, L.
Über Adsorption von Elektrolyten durch Kohle.
Biochem. Z. 94,240-60(1919).

115. Rose, R. E.
The mechanism of dyeing.
Am. Dyestuff Reptr. 31,P204-8(1942).

116. Roseveare, W. E.
Methods of calculating and averaging rate constants.
J. Am. Chem. Soc. 53,1651-61(1931).

117. Sabalitschka, T., and Kubisch, G.
Ueber die Umsetzung des Kaliumdichromates in wässerigen Lösung.
Pharm. Zentralh. 65,272-4(1924).

118. Sachs, A. P.
The theory of dyeing acetate silk.
Textile Colorist 51,22-3(1929).

119. Schellens, W.
Ueber das Verhalten von pflanzlichen und tierischen Textilstoffen zu Metallsalzlösungen.
Arch. Pharm. 243,617-27(1905).

120. Schmidt, G. C.
Über Adsorption.
Z. physik. chem. 15,56-64(1894).

121. Schmidt, G. C.
Über Adsorption. Dritte Abhandlung.
Z. physik. Chem. 78,667-81(1912).

122. Schmidt, G. C.
Über Adsorption von Losungen.
Z. physik. Chem. 74,689-737(1910).

123. Schmidt, G. C.
Über Adsorption von Losungen. Zweite Abhandlung.
Z. physik. Chem. 77,641-60(1911).

124. Seitz, F.
The Modern Theory of Solids.
New York: McGraw-Hill Book Company, Inc., 1940.

125. Sisley, P.
Augenblicklicher Stand unserer Kentnisse über die Theorie der Färbung.
Chem.-Ztg. 37,1357-8,1379-80(1913).

126. Sokolov, A. I., and Tumanskii, S. S.
Influence du champ ultrasonique sur le processus de teinture des tissus de coton.
J. Applied Chem. (U. S. S. R.) 14,843-8(1941).

127. Sookne, A. M., and Harris, M.
Electrophoretic studies of silk.
J. Research Natl. Bur. Standards 23,299-308(1939).

128. Stamm, A. J., and Millett, M. A.
The internal surface of cellulosic materials.
J. Phys. Chem. 45,43-54(1941).

129. Svedberg, T.
Colloid Chemistry. 2nd ed. p. 203.
New York: Chemical Catalog Company, Inc., 1928.

130. Theis, E. R., and Jacoby, T. F.
Studies in animal skin proteins. III. The combination of acid or base with the protein of silk, fibroin, hair, and collagen.
J. Am. Leather Chem. Assoc. 36,545-66(1941).

131. Trümpler, G.
Die Adsorptionsisotherme in Bereich sehr tiefe Konzentrationen.
Kolloid-Z. 15,10-8(1914).

132. Vauquelin.
Sur une nouvelle substance métallique contenue dans le plomb rouge de Sibérie, et qu' on propose d'appeler chrôme, à cause de la propriété qu'il a de colorer les combinaisons ou il entre. Second mémoire sur le métal contenu dans le plomb rouge de Sibérie.
Ann. chim. (1) 25,21-31,194-204(1798).

133. Vickerstaff, T.
The dyeing of nylon with dispersed dyes.
J. Soc. Dyers Colourists 59,92-101(1943).

134. Vickerstaff, T., and Waters, E.
The dyeing of cellulose acetate rayon with dispersed dyes.
J. Soc. Dyers Colourists 58,116-25(1942).

135. Walker, J., and Appleyard, J. R.
Absorption of dilute acids by silk.
J. Chem. Soc. 69,1334-49(1896).

136. Wang, C., and Woo, T. T.
The isoelectric point of the fibroin of Chinese silk.
J. Chinese Chem. Soc. 5,170-3(1937).

137. Weiser, H. B., and Middleton, E. B.
Adsorption by precipitates. III.
J. Phys. Chem. 24,630-63(1920).

138. Whittaker, C. M.
The dyeing of the newer rayons.
Chemistry and Industry 1944,269-71.

139. Willard, H. H., and Diehl, H.
Advanced Quantitative Analysis, p. 234.
New York: D. Van Nostrand Company, Inc., 1943.

140. Wöhler, L., and Wenzel, W.
Beiträge zur Deutung der Boedeker'schen Adsorptionsgleichung.
Kolloid-Z. 53,273-88(1930).

APPENDIX - EXPERIMENTAL DATA

TABLE 1. ACETYL OF NEW CELLULOSE-ACETATE RAYON

Determination number	Cellulose-acetate rayon gram	Sodium hydroxide milliliter of 0.2927N	Hydrochloric acid milliliter of 0.2514N	Acetyl percentage
1	0.9472	40.55	13.39	38.53
2	0.9476	48.60	22.64	38.63
3	0.9425	41.60	14.68	38.64
4	0.9379	41.00	14.29	38.48
Mean				38.57
Deviation				0.06

TABLE 2. ASH OF NEW FABRICS

Determination number	Fabric		Ash	
		gram	gram	percentage
1	Cellulose-acetate rayon	2.5262	0.0029	0.11x
2		2.5004	0.0035	0.14
3		2.5243	0.0035	0.14
4		2.5031	0.0034	0.14
Mean				0.14
Deviation				0.00
1	Silk	2.2585	0.0039	0.17
2		2.2756	0.0042	0.18
3		2.2133	0.0042	0.19
4		2.1903	0.0039	0.18
Mean				0.18
Deviation				0.00

x Rejected observation

TABLE 3. BREAKING STRENGTH AND ELONGATION AT BREAKING LOAD OF NEW FABRICS

Determination number	Breaking strength of fabric				Elongation at breaking load of fabric			
	Conditioned		Wet		Conditioned		Wet	
	Warp pound/ inch	Filling pound/ inch	Warp pound/ inch	Filling pound/ inch	Warp inch	Filling inch	Warp inch	Filling inch
A. Cellulose-acetate rayon								
1	60	18	30	10	0.78	-	1.00	1.33
2	58	18	22x	10	0.72	0.89	0.83	1.33
3	60	18	30	8	0.72	0.94	0.94	1.22
4	58	18	32	8	0.78	0.94	1.00	1.17
5	55	18	34	8	0.67	1.00	1.11	1.22
6	60	18	34	8	0.72	0.94	1.11	1.39
7	51x	18	28	8	0.67	1.00	0.83	1.22
8	-	18	30	8	-	1.00	-	1.33
9	56	18	32	8	0.67	0.94	1.11	1.33
10	58	18	34	8	0.78	0.89	1.11	1.33
11	58	18	32	8	0.78	1.11	1.00	1.33
12	55	18	30	8	0.67	1.00	1.00	1.33
13	58	18	30	8	0.67	1.00	1.00	1.33
14	60	18	34	8	0.67	1.00	1.00	1.44
15	62	18	34	8	0.83	1.00	1.22	1.22
16	61	18	30	8	0.72	1.00	1.00	1.33
17	61	18	34	8	0.72	1.00	1.00	1.33
18	62	18	32	9	0.67	0.83	1.17	1.39

x Rejected observation

TABLE 3 (Continued)

Determination number	Breaking strength of fabric Conditioned Warp pound/inch	Filling pound/inch	Wet Warp pound/inch	Filling pound/inch	Elongation at breaking load of fabric Conditioned Warp inch	Filling inch	Wet Warp inch	Filling inch
19	62	18	34	8	0.78	1.00	1.22	1.44
20	60	18	31	8	0.72	-	-	1.33
Mean	59	18	32	8	0.72	0.97	1.04	1.32
Deviation	2	0	2	0	0.04	0.05	0.09	0.05
Percentage					.24	32	35	44
Percentage of conditioned			54	44			144	136
B. Silk								
1	16x	22	17	7x	0.56x	0.50	0.83	0.33x
2	19	22	15	14	0.67	0.56	0.83	0.67
3	23	22	18	12	0.78	0.67	1.00	0.78
4	20	21	14	16	0.72	0.67	0.78	0.72
5	24	23	18	16	0.67	0.61	1.06	0.78
6	24	17	20	16	0.78	0.56	1.11	0.89
7	25	17	18	16	0.83	0.67	1.00	0.83
8	21	18	20	10x	0.67	0.44	1.06	0.44x
9	29	19	21	17	0.78	0.67	1.00	0.83
10	26	20	16	15	0.67	0.67	1.00	0.83
11	25	21	16	16	0.67	0.61	1.00	0.89
12	25	21	20	16	0.78	0.67	1.06	0.89
13	26	22	20	15	0.72	0.56	1.00	0.89
14	20	22	20	15	0.67	0.67	1.11	0.72
15	21	19	18	15	0.67	0.67	0.89	0.72

x Rejected observation

TABLE 3 (Continued)

Determination number	Breaking strength of fabric Conditioned Warp pound/inch	Breaking strength of fabric Conditioned Filling pound/inch	Breaking strength of fabric Wet Warp pound/inch	Breaking strength of fabric Wet Filling pound/inch	Elongation at breaking load of fabric Conditioned Warp inch	Elongation at breaking load of fabric Conditioned Filling inch	Elongation at breaking load of fabric Wet Warp inch	Elongation at breaking load of fabric Wet Filling inch
16	23	19	19	12	0.78	0.61	0.89	0.67
17	19	17	16	13	0.78	0.56	0.94	0.67
18	25	21	21	16	0.67	0.67	1.06	0.78
19	27	21	20	17	0.67	0.67	1.00	0.67
20	28	20	19	12	0.72	0.61	0.89	0.67
Mean	24	20	18	15	0.72	0.62	0.98	0.77
Deviation	2	2	2	1	0.05	0.05	0.08	0.07
Percentage					24	21	33	26
Percentage of conditioned			75	75			136	124

TABLE 4. DIAMETER OF FIBER

Determination number	Diameter of fiber: Cellulose-acetate rayon Warp inch x 10^3	Cellulose-acetate rayon Filling inch x 10^3	Silk Warp inch x 10^3	Silk Filling inch x 10^3
1	1.732	4.866	1.291	0.961
2	1.811	4.819	0.787	1.339
3	1.890	4.488	1.134	1.559
4	3.087	4.126	1.559	1.260
5	2.551	3.654	1.449	1.039
6	3.102	4.047	1.339	1.228
7	2.961	4.220	0.961	1.433
8	2.709	4.724	1.102	1.181
9	3.118	4.220	1.433	1.024
10	2.220	5.102	1.024	1.386
Mean	2.518	4.427	1.208	1.241
Deviation	0.484	0.373	0.206	0.154

TABLE 5. DISTRIBUTION OF YARNS BY NUMBER IN NEW FABRICS

Determination number	Cellulose-acetate rayon		Silk	
	Warp number/inch	Filling number/inch	Warp number/inch	Filling number/inch
1	236	68	172	128
2	232	70	168	136
3	232	70	178	128
4	230	69	172	134
5	228	69	178	126
6	240x	69	172	134
7	230	68	176	128
8	228	69	174	130
9	234	69	178	132
10	232	69	172	128
Mean	231	69	174	130
Deviation	2	0	3	3

x Rejected observation

TABLE 6. DISTRIBUTION OF YARNS BY WEIGHT IN NEW FABRICS

Determination number	Fabric gram	Yarn: Warp gram	Warp percentage	Yarn: Filling gram	Filling percentage
A. Cellulose-acetate rayon					
1	0.3276	0.2482	75.8	0.0799	24.4
2	0.3350	0.2541	75.8	0.0817	24.4
3	0.3280	0.2597	79.2x	0.0796	24.3
4	0.3285	0.2510	76.4	0.0796	24.2
Mean			76.0		24.3
Deviation			0.3		0.1
B. Silk					
1	0.1507	0.0992	65.8x	0.0543	36.0
2	0.1564	0.1007	64.4	0.0590	37.7
3	0.1586	0.1028	64.8	0.0615	38.8
4	0.1550	0.1002	64.6	0.0578	37.3
Mean			64.6		37.4
Deviation			0.1		0.8

x Rejected observation

TABLE 7. MOISTURE OF NEW FABRICS

Determination number	Fabric: Conditioned weight gram	Fabric: Oven-dried weight gram	Moisture: percentage of conditioned weight
A. Cellulose-acetate rayon			
1	2.7242	2.6098	4.20
2	2.7077	2.5955	4.14
3	2.6958	2.5820	4.22
4	2.7084	2.5901	4.36x
5	2.7212	2.6093	4.11
Mean			4.17
Deviation			0.04
B. Silk			
1	2.4608	2.2585	8.22
2	2.4800	2.2756	8.24
3	2.4129	2.2133	8.27
4	2.3872	2.1903	8.25
Mean			8.24
Deviation			0.02

x Rejected observation

TABLE 8. THICKNESS OF NEW FABRICS

Determination number	Thickness of fabric: Cellulose-acetate rayon inch	Silk inch
1	0.00350x	0.00750
2	0.00283	0.00650
3	0.00283	0.00625
4	0.00267	0.00700
5	0.00283	0.00725
6	0.00267	0.00650
7	0.00283	0.00700
8	0.00275	0.00700
9	0.00283	0.00650
10	0.00300	0.00750
Mean	0.00280	0.00690
Deviation	0.00007	0.00037

x Rejected observation

TABLE 9. TWIST OF NEW FABRICS

Determination number	Twist of yarn			
	Warp number/ 10 inch		Filling number/ 10 inch	
A. Cellulose-acetate rayon				
1	25 S		20 S	
2	28		18x	
3	25		25	
4	29		26	
5	27		21	
6	23x		20	
7	31		29	
8	31		24	
9	27		27	
10	27		24	
Mean twist/ inch	2.8		2.4	
Deviation	0.2		0.2	
B. Silk				
1	765 Z	770 S	721 Z	741 S
2	743	758x	784x	716
3	752	768	740	738
4	750	773	743	769
5	730	768	-	746
6	-	-	-	736
Mean twist/ inch	74.8	77.0	73.5	74.1
Deviation	0.9	0.2	0.9	1.1

x Rejected observation

TABLE 10. WEIGHT OF NEW FABRICS

Determination number	Length inch	Width inch	Weight of fabric gram	Weight of fabric ounce/square yard
A. Cellulose-acetate rayon				
1	4.03	31.59	10.3452	3.71
2	4.03	31.62	10.3221	3.70
3	4.08	31.64	10.4507	3.70
4	4.05	31.59	10.4212	3.73
Mean				3.71
Deviation				0.01
B. Silk				
1	4.05	32.31	5.1694	1.81
2	4.00	32.12	5.1046	1.82
3	4.06	32.52	5.1992	1.80
4	4.00	32.56	5.2401	1.84
Mean				1.82
Deviation				0.01

TABLE 11. YARN NUMBER

Determination number	Warp Length yard	Warp Weight gram	Warp Weight typp	Filling Length yard	Filling Weight gram	Filling Weight typp
A. Cellulose-acetate rayon						
1	10	0.0965	47.00	10	0.1067	42.51x
2	10	0.0940	48.26	10	0.1018	44.56
3	10	0.0940	48.26	10	0.1024	44.30
4	10	0.0954	47.55	10	0.1028	44.12
Mean			47.77			44.33
Deviation			0.49			0.16
B. Silk						
1	10.14	0.0514	89.5	10.01	0.0406	112
2	10.14	0.0521	88.3	10.01	0.0410	111
3	10.14	0.0550	83.6	10.01	0.0377	120x
4	10.14	0.0546	84.2	10.01	0.0410	111
Mean			86.4			111
Deviation			2.5			0

x Rejected observation

TABLE 12. EFFECT OF INITIAL pH OF MORDANTING BATH ON FIXATION OF MORDANT FROM FIFTY-VOLUME BATH OF POTASSIUM DICHROMATE IN ONE HOUR AT BOILING

Determination number	Initial pH of bath	Fabric	Ash		Cr_2O_3	Barometric pressure
		gram	gram	percentage	percentage	millimeter of mercury
A. Cellulose-acetate rayon, 2.0000 g. $K_2Cr_2O_7$/ gram fiber						
1	0.95	2.2944	0.0294	1.28		741.0
2		2.2952	0.0325	1.42		
3		2.2955	0.0309	1.35		
4		2.2997	0.0313	1.36		
Mean				1.35	1.29	
Deviation				0.04		
1	1.00	2.3059	0.0298	1.29x		
2		2.3068	0.0327	1.42		
3		2.3132	0.0321	1.39		
4		2.3241	0.0319	1.37		
Mean				1.39	1.33	
Deviation				0.02		
1	1.10	2.3288	0.0361	1.55		742.9
2		2.3336	0.0352	1.51		
3		2.3412	0.0356	1.52		
4		2.3757	0.0370	1.56		
Mean				1.54	1.48	
Deviation				0.02		
1	1.17	2.3774	0.0502	2.11x		
2		2.3839	0.0458	1.92		
3		2.3905	0.0460	1.92		
4		2.3937	0.0477	1.99		
Mean				1.94	1.88	
Deviation				0.03		

* Blank determination for ash of cellulose-acetate rayon: 0.06 per cent

x Rejected observation

TABLE 12. (Continued)

Determination number	Initial pH of bath	Fabric	Ash		Cr_2O_3	Barometric pressure
		gram	gram	percentage	percentage	millimeter of mercury
1	1.22	2.3958	0.0869	3.63x		742.7
2		2.3986	0.0760	3.17		
3		2.3999	0.0776	3.23		
4		2.4051	0.0764	3.18		
Mean				3.19	3.13	
Deviation				0.02		
1	1.29	2.5689	0.0994	3.87x		732.5
2		2.5360	0.1017	4.01		
3		2.6339	0.1086	4.12		
4		2.6158	0.1075	4.11		
Mean				4.08	4.03	
Deviation				0.05		
1	1.32	2.3840	0.0957	4.01		750.0
2		2.3854	0.0943	3.95		
3		2.3897	0.0939	3.93		
4		2.4246	0.0933	3.85x		
Mean				3.96	3.90	
Deviation				0.03		
1	1.43	2.5522	0.0813	3.19		731.9
2		2.5587	0.0819	3.20		
3		2.5622	0.0761	2.97		
4		2.5705	0.0700	2.72x		
5		2.4972	0.0759	3.04		
Mean				3.10	3.04	
Deviation				0.10		
1	1.50	2.4321	0.0638	2.62		750.0
2		2.4535	0.0658	2.68		
3		2.4603	0.0659	2.68		
4		2.4671	0.0680	2.76		
Mean				2.68	2.62	
Deviation				0.04		

x Rejected observation

TABLE 12. (Continued)

Determination number	Initial pH of bath	Fabric	Ash		Cr_2O_3	Barometric pressure
		gram	gram	percentage	percentage	millimeter of mercury
1	1.57	2.4052	0.0454	1.89		742.7
2		2.4060	0.0443	1.84		
3		2.4084	0.0445	1.85		
4		2.4138	0.0437	1.81		
Mean				1.85	1.79	
Deviation				0.02		
1	1.62	2.4150	0.0329	1.36		
2		2.4214	0.0329	1.36		
3		2.4218	0.0339	1.40		
4		2.4397	0.0353	1.45		
Mean				1.39	1.33	
Deviation				0.03		
1	1.67	2.4417	0.0251	1.03		
2		2.4424	0.0250	1.02		
3		2.4505	0.0245	1.00		
4		2.4612	0.0251	1.02		
Mean				1.02	0.96	
Deviation				0.01		
1	1.96	2.4972	0.0174	0.70		750.0
2		2.4973	0.0172	0.69		
3		2.4997	0.0177	0.71		
4		2.5024	0.0174	0.70		
Mean				0.70	0.64	
Deviation				0.00		
1	1.99	2.4640	0.0136	0.55		750.0
2		2.4718	0.0156	0.63		
3		2.4847	0.0144	0.58		
4		2.3804	0.0156	0.56		
Mean				0.61	0.55	
Deviation				0.04		

TABLE 12. (Continued)

Determination number	Initial pH of bath	Fabric	Ash		Cr_2O_3	Barometric pressure
		gram	gram	percentage	percentage	millimeter of mercury
1	2.27	2.5081	0.0087	0.35		747.7
2		2.5085	0.0084	0.33		
3		2.5110	0.0082	0.33		
4		2.5119	0.0096	0.38		
Mean				0.35	0.29	
Deviation				0.02		
B. Nylon*, 0.5000 g. $K_2Cr_2O_7$/ gram fiber						
1	0.93	1.3862	0.1466	10.58		735.0
2		1.3702	0.1457	10.63		
3		1.3983	0.1488	10.64		
4		1.3702	0.1456	10.63		
5		1.3602	0.1458	10.72x		
Mean				10.62	10.30	
Deviation				0.02		
1	1.05	1.3045	0.1280	9.81		730.0
2		1.3389	0.1312	9.80		
3		1.3245	0.1293	9.76x		
4		1.3333	0.1309	9.82		
5		1.3480	0.1324	9.82		
Mean				9.81	9.49	
Deviation				0.01		
1	1.10	1.3079	0.1068	8.17x		735.0
2		1.2808	0.1102	8.60		
3		1.2226	0.1060	8.67		
4		1.3934	0.1200	8.61		
5		1.3865	0.1211	8.73		
Mean				8.65	8.33	
Deviation				0.05		

* Blank determination for ash of nylon: 0.32 per cent
x Rejected observation

TABLE 12. (Continued)

Determination number	Initial pH of bath	Fabric	Ash		Cr_2O_3	Barometric pressure
		gram	gram	percentage	percentage	millimeter of mercury
1	1.15	1.2751	0.1014	7.95		744.5
2		1.2417	0.0999	8.05		
3		1.3865	0.1112	8.02		
4		1.5278	0.1238	8.10		
5		1.2271	0.1009	8.22x		
Mean				8.03	7.71	
Deviation				0.04		
1	1.36	1.1862	0.0713	6.01		733.5
2		1.1933	0.0732	6.13		
3		1.2023	0.0761	6.33x		
4		1.2026	0.0739	6.15		
5		1.2401	0.0761	6.14		
Mean				6.11	5.79	
Deviation				0.05		
1	1.70	1.2484	0.0350	2.80x		733.5
2		1.4340	0.0417	2.91		
3		1.4089	0.0419	2.97		
4		1.4083	0.0415	2.95		
5		1.3834	0.0415	3.00		
Mean				2.96	2.64	
Deviation				0.03		
1	2.08	1.2825	0.0156	1.22		730.0
2		1.3891	0.0160	1.15		
3		1.2688	0.0139	1.10		
4		1.4041	0.0165	1.18		
5		1.4901	0.0186	1.25		
Mean				1.18	0.86	
Deviation				0.04		
1	3.74	1.3437	0.0079	0.59		727.0
2		1.3349	0.0079	0.59		
3		1.3371	0.0079	0.59		
4		1.3699	0.0081	0.59		
Mean				0.59	0.27	
Deviation				0.00		

x Rejected observation

TABLE 12. (Continued)

Determination number	Initial pH of bath	Fabric	Ash		Cr_2O_3	Barometric pressure
		gram	gram	percentage	percentage	millimeter of mercury
C. Silk*, 0.5000 g. $K_2Cr_2O_7$/ gram fiber						
1	0.93	1.3091	0.0880	6.72		738.8
2		1.2907	0.0874	6.77		
3		1.3023	0.0874	6.71		
4		1.3249	0.0896	6.76		
5		1.2989	0.0890	6.85x		
Mean				6.74	6.61	
Deviation				0.02		
1	1.05	1.5741	0.1205	7.66		
2		1.5887	0.1236	7.79		
3		1.3278	0.1046	7.88		
4		1.2903	0.1006	7.80		
5		1.2805	0.0994	7.76		
Mean				7.78	7.65	
Deviation				0.05		
1	1.15	1.2894	0.1040	8.07x		737.1
2		1.2270	0.1048	8.54		
3		1.2682	0.1108	8.74		
4		1.1471	0.1003	8.74		
5		1.2321	0.1094	8.88		
Mean				8.72	8.59	
Deviation				0.10		
1	1.21	1.3972	0.1182	8.46		730.0
2		1.0975	0.0930	8.47		
3		1.1655	0.0991	8.50		
4		1.2443	0.1063	8.54		
Mean				8.49	8.36	
Deviation				0.03		
1	1.36	1.2147	0.1017	8.37		737.1
2		1.2116	0.1004	8.29		
3		1.2391	0.1060	8.55x		
4		1.3092	0.1093	8.35		
5		1.2292	0.1004	8.17		
Mean				8.30	8.17	
Deviation				0.06		

* Blank determination for ash of silk: 0.13 per cent
x Rejected observation

TABLE 12. (Continued)

Determination number	Initial pH of bath	Fabric	Ash		Cr_2O_3	Barometric pressure
		gram	gram	percentage	percentage	millimeter of mercury
1	1.70	1.2230	0.0679	5.55x		722.6
2		1.2679	0.0797	6.29		
3		1.2251	0.0780	6.37		
4		1.2192	0.0777	6.37		
5		1.2194	0.0792	6.49		
Mean				6.38	6.25	
Deviation				0.06		
1	2.03	1.2146	0.0379	3.12		
2		1.2303	0.0375	3.05		
3		1.2980	0.0397	3.06		
4		1.3197	0.0402	3.05		
5		1.3252	0.0395	2.98		
Mean				3.05	2.92	
Deviation				0.03		
1	2.32	1.2836	0.0194	1.51		738.8
2		1.5419	0.0243	1.58		
3		1.2955	0.0198	1.53		
4		1.3212	0.0199	1.51		
5		1.2901	0.0190	1.47		
Mean				1.52	1.39	
Deviation				0.03		
1	3.72	1.2770	0.0039	0.31		738.8
2		1.3149	0.0040	0.30		
3		1.2370	0.0036	0.29		
4		1.3351	0.0040	0.30		
Mean				0.30	0.17	
Deviation				0.00		
1	6.47	1.2609	0.0079	0.63		731.8
2		1.2925	0.0079	0.61		
3		1.4227	0.0096	0.67		
Mean				0.64	0.51	
Deviation				0.02		

x Rejected observation

TABLE 12. (Continued)

Determination number	Initial pH of bath	Fabric gram	Ash gram	Ash percentage	Cr_2O_3 percentage	Barometric pressure millimeter of mercury
D. Silk*, 0.5000 g. $K_2Cr_2O_7$/ gram fiber						
1	0.93	1.3483	0.0923	6.85		737.4
2		1.3574	0.0937	6.90		
3		1.2553	0.0867	6.91		
4		1.2618	0.0878	6.96		
5		1.2391	0.0864	6.97		
Mean				6.92	6.79	
Deviation				0.04		
1	1.05	1.2977	0.0999	7.70x		
2		1.2794	0.1023	8.00		
3		1.1699	0.0938	8.02		
4		1.2584	0.0987	7.84		
5		1.2756	0.1030	8.07		
Mean				7.98	7.86	
Deviation				0.07		
1A**	1.15	1.3354	0.1124	8.42		737.4
2A		1.2212	0.1052	8.61		
3A		1.3269	0.1183	8.92		
4A		1.3252	0.1231	9.28		
5A		1.1918	0.1075	9.02		
6B		1.3254	0.1062	8.01		731.8
7B		1.3282	0.1123	9.46		
8B		1.3306	0.1138	8.55		
9B		1.4664	0.1282	8.74		
10B		1.3449	0.1186	8.82		
Mean				8.68	8.55	
Deviation				0.27		

* Blank determination for ash of silk (not extracted with benzene): 0.13 per cent

** Parallel determinations lettered alike

x Rejected observation

TABLE 12. (Continued)

Determination number	Initial pH of bath	Fabric	Ash		Cr_2O_3	Barometric pressure
		gram	gram	percentage	percentage	millimeter of mercury
1	1.21	1.3182	0.1118	8.48		731.8
2		1.3186	0.1127	8.55		
3		1.3410	0.1137	8.48		
4		1.3318	0.1089	8.18x		
5		1.3116	0.1099	8.38		
Mean				8.47	8.34	
Deviation				0.05		
1A*	1.36	1.1656	0.1166	10.00		737.4
2A		1.3229	0.1015	7.67		
3A		1.2889	0.1193	9.26		
4A		1.3601	0.1127	8.29		
5A		1.3087	0.1189	9.09		
6B		1.2033	0.0969	8.05		731.8
7B		1.1853	0.0999	8.43		
8B		1.0925	0.0963	8.81		
9B		1.2355	0.1098	8.89		
10B		1.2790	0.1096	8.57		
Mean				8.71	8.58	
Deviation				0.50		
1	1.70	1.3561	0.0767	5.66x		739.8
2		1.2827	0.0805	6.28		
3		1.3446	0.0877	6.52		
4		1.2348	0.0815	6.60		
5		1.2452	0.0836	6.71		
Mean				6.53	6.40	
Deviation				0.13		
1	2.03	1.2491	0.0370	2.96		739.8
2		1.1630	0.0349	3.00		
3		1.2113	0.0372	3.07		
4		1.3419	0.0414	3.09		
5		1.4610	0.0454	3.11		
Mean				3.05	2.92	
Deviation				0.05		

* Parallel determinations lettered alike
x Rejected observation

TABLE 12. (Continued)

Determination number	Initial pH of bath	Fabric	Ash		Cr_2O_3	Barometric pressure
		gram	gram	percentage	percentage	millimeter of mercury
1	2.32	1.3805	0.0211	1.53		731.8
2		1.3920	0.0209	1.50		
3		1.3364	0.0200	1.50		
4		1.3966	0.0198	1.42x		
5		1.3351	0.0207	1.55		
Mean				1.52	1.39	
Deviation				0.02		
1	3.72	1.2790	0.0038	0.30		
2		1.2273	0.0037	0.30		
3		1.3361	0.0040	0.30		
4		1.3259	0.0038	0.29		
Mean				0.30	0.17	
Deviation				0.00		

x Rejected observation

TABLE 13. EFFECT OF INITIAL pH OF MORDANTING BATH ON ACETYL OF CELLULOSE-ACETATE RAYON IN FIFTY-VOLUME BATH, 2.0000 g. POTASSIUM DICHROMATE / GRAM FIBER, IN ONE HOUR AT BOILING

Determination number	Initial pH of bath	Cellulose-acetate rayon	Sodium hydroxide		Hydrochloric acid		Acetyl*	Barometric pressure
		gram	normality	milliliter	normality	milliliter	percentage	millimeter of mercury
1	0.95	1.0830	0.2576	40.32	0.2514	3.22	37.61	725.0
2		1.1106		40.50		2.81	37.24	
3		1.1018		40.62		3.48	37.01	
4		1.0842		40.55		3.46	37.56	
Mean							37.36	
Deviation							0.23	
1	1.00	1.0838	0.2576	40.80	0.2514	3.79	37.49	
2		1.0904		40.72		3.22	37.74	
3		1.1062		40.44		2.47	37.65	
4		1.1058		46.54		7.91	38.46x	
Mean							37.63	
Deviation							0.09	
1	1.10	1.0845	0.2576	41.67	0.2514	4.25	37.75	725.0
2		1.0764		40.88		3.64	37.84	
3		1.0653		40.86		3.88	37.97	
4		1.0702		41.16		4.63	37.35x	
Mean							37.85	
Deviation							0.08	

* Correction factor for potassium dichromate in Table 13a.
x Rejected observation

TABLE 13. (Continued)

Determination number	Initial pH of bath	Cellulose-acetate rayon gram	Sodium hydroxide normality	Sodium hydroxide milliliter	Hydrochloric acid normality	Hydrochloric acid milliliter	Acetyl percentage	Barometric pressure millimeter of mercury
1	1.17	1.0690	0.2576	40.82	0.2514	3.49	38.03	
2		1.0852		40.79		3.12	37.78	
3		1.0981		40.57		2.62	37.61	
4		1.0730		40.38		2.98	37.94	
Mean							37.84	
Deviation							0.14	
1	1.22	1.0883	0.2579	40.67	0.2514	2.07	38.01	736.0
2		1.0634		40.42		2.03	38.71	
3		1.0934		40.39		1.58	38.02	
4		1.0970		40.47		2.21	37.36	
5		1.1217		40.61		1.51	37.31	
Mean							37.88	
Deviation							0.44	
1	1.29	1.0922	0.2579	40.60	0.2514	1.92	37.38	
2		1.1132		42.10		3.00	37.08x	
3		1.0832		40.40		1.79	37.63	
4		1.0912		40.55		1.78	37.50	
5		1.0897		40.58		2.08	37.26	
Mean							37.37	
Deviation							0.16	

TABLE 13. (Continued)

Determination number	Initial pH of bath	Cellulose-acetate rayon gram	Sodium hydroxide normality	Sodium hydroxide milliliter	Hydrochloric acid normality	Hydrochloric acid milliliter	Acetyl percentage	Barometric pressure millimeter of mercury
1A**	1.32	1.0863	0.2579	40.47	0.2514	2.25	37.22	736.0
2A		1.0910		40.40		1.67	37.55	
3A		1.1072		40.34		1.36	37.23	
4A		1.1267		40.39		1.78	36.20x	
5B		0.9926	0.2457	40.41	0.2267	3.71	37.51	738.8
6B		0.9949		40.32		5.35	35.70x	
7B		1.0001		40.61		3.74	37.39	
8B		0.9965		40.68		4.25	37.11	
9C		1.0794	0.2572	40.31	0.2514	2.01	37.43	
10C		1.0965		40.57		1.82	37.26	
Mean							37.34	
Deviation							0.13	
1	1.43	1.0910	0.2574	40.68	0.2514	2.50	37.46	740.5
2		1.0950		40.70		2.49	37.32	
3		1.1422		40.87		2.87	36.49x	
4		1.0898		40.40		2.44	37.27	
Mean							37.35	
Deviation							0.07	

** Parallel determinations lettered alike

TABLE 13. (Continued)

Determination number	Initial pH of bath	Cellulose-acetate rayon gram	Sodium hydroxide normality	Sodium hydroxide milliliter	Hydrochloric acid normality	Hydrochloric acid milliliter	Acetyl percentage	Barometric pressure millimeter of mercury
1A	1.50	1.0906	0.2574	40.13	0.2514	2.26	37.41	740.5
2A		1.0841		40.51		2.19	38.11	
3A		1.1107		40.43		1.95	37.31	
4A		1.0914		40.52		2.05	37.98	
5B		1.0820	0.2574	40.63	0.2267	3.42	37.40	735.8
6B		1.0864		40.72		3.12	37.61	
7B		1.0821		40.62		2.91	37.85	
8B		1.0748		40.57		2.91	38.06	
Mean							37.72	
Deviation							0.28	
1	1.57	1.0103	0.2506	41.86	0.2267	5.97	38.19	747.7
2		1.0098		40.37		4.44	38.09	
3		1.0089		40.39		4.20	38.38	
4		1.0103		40.49		4.29	38.35	
Mean							38.25	
Deviation							0.11	
1	1.62	1.0872	0.2574	41.39	0.2514	3.40	38.33	740.5
2		1.0888		40.77		2.85	38.19	
3		1.0938		40.66		2.67	38.08	
4		1.0642		40.39		2.99	38.54	
Mean							38.28	
Deviation							0.15	

TABLE 13. (Continued)

Determination number	Initial pH of bath	Cellulose-acetate rayon gram	Sodium hydroxide normality	Sodium hydroxide milliliter	Hydrochloric acid normality	Hydrochloric acid milliliter	Acetyl percentage	Barometric pressure millimeter of mercury
1A	1.67	1.0149	0.2506	40.51	0.2267	4.57	38.27	747.7
2A		1.0134		40.40		4.46	38.32	
3A		1.0171		40.39		4.69	37.95	
4A		1.0191		40.43		4.96	37.67	
5B		1.0938	0.2574	40.50	0.2514	2.51	38.15	740.5
6B		1.0685		41.30		4.48	37.90	
7B		1.0749		40.35		3.10	38.08	
8B		1.0436		40.59		4.06	38.49x	
Mean							38.05	
Deviation							0.18	
1	1.99	1.0211	0.2467	40.77	0.2267	4.80	37.60	739.5
2		1.0237		40.93		4.54	37.91	
3		1.0244		40.90		4.45	37.94	
4		1.0231		40.72		4.04	38.19	
Mean							37.91	
Deviation							0.16	
1	2.27	1.0302	0.2506	40.55	0.2267	5.41	37.20	747.7
2		1.0290		40.97		6.19	36.94	
3		1.0287		41.19		5.91	37.45	
4		1.0308		40.93		6.15	36.88	
Mean							37.12	
Deviation							0.21	

TABLE 13a. DETERMINATION OF CORRECTION FACTOR FOR ACETYL

Determination number	Potassium dichromate gram	Sodium hydroxide normality	Sodium hydroxide milliliter	Hydrochloric acid normality	Hydrochloric acid milliliter	Observed NaOH/ Calculated/NaOH
1	0.0858	0.2438	41.01	0.2268	41.70	0.93
2	0.0856		41.08		41.95	0.86
3	0.0857		41.53		42.57	0.81
Mean						0.87
Deviation						0.04
1	0.0781	0.2446	41.12	0.2273	42.32	0.83
2	0.0780		40.84		41.94	0.86
3	0.0784		40.76		41.77	0.89
Mean						0.86
Deviation						0.02
1	0.0662	0.2438	41.16	0.2268	42.62	0.82
2	0.0661		41.35		42.86	0.80
3	0.0664		41.10		42.61	0.78
Mean						0.80
Deviation						0.01
1	0.0631	0.2440	40.78	0.2268	42.34	0.81
2	0.0635		41.12		42.74	0.79
3	0.0634		40.96		42.55	0.80
Mean						0.80
Deviation						0.01

TABLE 13a. (Continued)

Determination number	Potassium dichromate gram	Sodium hydroxide normality	Sodium hydroxide milliliter	Hydrochloric acid normality	Hydrochloric acid milliliter	Observed NaOH/ Calculated NaOH
1	0.0550	0.2438	41.14	0.2268	43.00	0.74
2	0.0551		40.89		42.61	0.81
3	0.0552		41.07		43.01	0.69
Mean						0.75
Deviation						0.04
1	0.0394	0.2438	41.38	0.2268	43.57	0.78
2	0.0390		40.85		43.07	0.72
3	0.0394		40.82		43.05	0.70
Mean						0.73
Deviation						0.03
1	0.0353	0.2440	40.75	0.2268	43.09	0.71
2	0.0350		40.94		43.30	0.72
3	0.0354		40.79		43.09	0.75
Mean						0.73
Deviation						0.02
1	0.0305	0.2438	41.21	0.2268	43.76	0.59x
2	0.0306		40.63		42.99	0.75
3	0.0308		41.18		43.61	0.71
Mean						0.73
Deviation						0.02

x Rejected observation

TABLE 13a. (Continued)

Determination number	Potassium dichromate gram	Sodium hydroxide normality	Sodium hydroxide milliliter	Hydrochloric acid normality	Hydrochloric acid milliliter	Observed NaOH/ Calculated NaOH
1	0.0282	0.2440	40.90	0.2268	43.49	0.60
2	0.0279		40.82		43.40	0.62
3	0.0275		40.88		43.45	0.64
4	0.0283		41.15		43.72	0.65
5	0.0289		41.30		43.91	0.59
6	0.0284		40.82		43.39	0.62
Mean						0.62
Deviation						0.02
1	0.0193	0.2440	40.88	0.2268	43.58	0.69
2	0.0194		41.16		43.86	0.72
3	0.0193		41.05		43.75	0.71
Mean						0.71
Deviation						0.01
1	0.0104	0.2452	41.06	0.2273	44.07	0.71
2	0.0109		41.00		44.00	0.70
3	0.0108		41.00		44.01	0.69
Mean						0.70
Deviation						0.01
1	0.0065	0.2440	40.94	0.2268	43.89	0.78
2	0.0058		41.01		43.98	0.81
3	0.0059		41.10		44.07	0.81
Mean						0.80
Deviation						0.01

TABLE 14. EFFECT OF INITIAL pH OF MORDANTING ON WET STRENGTH OF FABRIC IN FIFTY-VOLUME BATH OF POTASSIUM DICHROMATE IN ONE HOUR AT BOILING

Determination number	Breaking strength of wet warp of fabric pound/inch					
A. Cellulose-acetate rayon, 2.0000 g. $K_2Cr_2O_7$/ gram fiber						
Initial pH of bath	0.91	0.95	1.00	1.10	1.17	1.22
1A*	16	18	18	21	17	22
2A	12x	18	18	21	18	22
3A	16	16	18	16	21	24
4A	14	18	18	20	22	23
5A	16	17	18	19	21	22
6B	15	17	18	19	19	23
7B	13x	18	18	20	20	22
8B	15	17	18	20	21	20
9B	16	18	19	19	21	24
10B	16	17	18	20	21	21
Mean	16	17	18	20	20	22
Deviation	1	1	0	1	1	1
Percentage of original wet strength	50	53	56	62	62	69
Barometric pressure in millimeter of mercury	744.8	744.8	741.0	741.0	741.0	741.0

* Parallel determinations lettered alike
x Rejected observation

TABLE 14. (Continued)

Determination number	Breaking strength of wet warp of fabric					
	pound/ inch	pound/ inch	pound/ inch	pound/ inch	pound/ inch	pound/ inch
Initial pH of bath	1.29	1.32	1.43	1.50	1.57	1.62
1A	23	23	24	30	28	31
2A	23	26	28	27	30	30
3A	21	27	30	30	28	26
4A	24	23	27	28	27	28
5A	21	24	27	30	28	31
6B	21	26	27	26	30	29
7B	23	28	27	29	26	30
8B	23	24	28	28	31	31
9B	23	25	24	28	29	27
10B	23	26	28	29	31	30
11C	-	-	-	29	-	-
12C	-	-	-	29	-	-
13C	-	-	-	29	-	-
14C	-	-	-	26	-	-
15C	-	-	-	31	-	-
Mean	22	25	27	29	29	29
Deviation	1	1	1	1	1	2
Percentage of original wet strength	69	78	84	91	91	91
Barometric pressure in millimeter of mercury	750.1	741.0	741.0	750.1	741.0	750.1

TABLE 14. (Continued)

Determination number	Breaking strength of wet warp of fabric					
	pound/ inch	pound/ inch	pound/ inch	pound/ inch	pound/ inch	pound/ inch
Initial pH of bath	1.67	1.99	2.27	3.72	5.33	5.68
1A	19x	29	30	35	35	34
2A	31	31	32	30	36	36
3A	31	30	32	34	34	36
4A	32	31	30	34	36	35
5A	30	31	32	31	31	34
6B	33	32	33	32	31	30
7B	32	33	33	35	35	34
8B	28	34	32	35	30	33
9B	33	31	33	34	36	32
10B	32	32	32	32	34	35
Mean	31	31	32	33	34	34
Deviation	1	1	1	2	2	1
Percentage of original wet strength	97	97	100	103	106	106
Barometric pressure in millimeter of mercury	747.7	750.1	751.2	751.2	751.2	751.2

TABLE 14. (Continued)

Determination number	Breaking strength of wet warp of fabric pound/inch	pound/inch	pound/inch	pound/inch
Initial pH of bath	6.10	6.47	6.68	6.88
1A	35	36	30	35
2A	37	34	30	35
3A	32	35	36	34
4A	36	35	34	35
5A	31	36	36	35
6B	36	36	36	35
7B	36	34	36	32
8B	35	36	32	35
9B	35	36	30	36
10B	31x	35	30	30
Mean	35	35	33	34
Deviation	1	1	3	1
Percentage of original wet strength	109	109	103	106
Barometric pressure in millimeter of mercury	751.2	751.2	751.2	751.2

TABLE 14. (Continued)

Determination number	Breaking strength of wet warp of fabric pound/inch	pound/inch	pound/inch	pound/inch
B. Silk, 0.5000 g. $K_2Cr_2O_7$/ gram fiber.				
Initial pH of bath	0.95	1.05	1.15	1.21
1A			1	3
2A			0	3
3A			0	4
4A			1	4
5A			0	2
6B			0	3
7B			1	4
8B			0	2
9B			0	4
10B			0	3
Mean	<1	<1	<1	3
Deviation				1
Percentage of original wet strength				17
Barometric pressure in millimeter of mercury	737.1	737.1	737.1	737.1

TABLE 14. (Continued)

Determination number	Breaking strength of wet warp of fabric pound/inch	pound/inch	pound/inch	pound/inch
Initial pH of bath	1.36	1.70	2.03	2.32
1A	5	7	15	14
2A	5	7	10	16
3A	3	6	12	19
4A	4	6	16	15
5A	5	5	11	12
6B	5	11	10	17
7B	4	8	9	19
8B	4	6	12	21
9B	6	9	15	20
10B	4	5	17	19
Mean	4	7	13	17
Deviation	1	1	2	2
Percentage of original wet strength	22	39	72	94
Barometric pressure in millimeter of mercury	737.1	737.1	737.1	737.1

TABLE 15. EFFECT OF CONCENTRATION OF FIFTY-VOLUME MORDANTING BATH OF POTASSIUM DICHROMATE ON FIXATION OF MORDANT IN 48 HOURS AT 40° C.

Determination number	Mordanting bath: gram Cr_2O_3/gram fiber	pH	Fiber: gram	Ash: gram	Ash: percentage	Cr_2O_3: percentage
A. Cellulose-acetate rayon*						
1	0.05167	1.22	2.5639	0.0243	0.95	
2			2.6075	0.0245	0.94	
3			2.5493	0.0238	0.93	
4			2.5148	0.0259	1.03x	
Mean					0.94	0.88
Deviation					0.01	
1	0.2584	1.27	2.5138	0.0839	3.34x	
2			2.5016	0.0823	3.29	
3			2.4577	0.0799	3.25	
4			2.5003	0.0810	3.24	
Mean					3.26	3.20
Deviation					0.02	
1	0.5167	1.28	2.5600	0.1180	4.61	
2			2.6064	0.1195	4.58	
3			2.5995	0.1192	4.59	
4			2.5657	0.1153	4.49x	
Mean					4.59	4.53
Deviation					0.01	
1	1.0334	1.29	2.5873	0.1545	5.97	
2			2.5315	0.1530	6.04	
3			2.5674	0.1523	5.93	
4			2.5625	0.1504	5.87	
Mean					5.95	5.89
Deviation					0.05	

* Blank determination for ash of cellulose-acetate rayon: 0.06 per cent

x Rejected observation

TABLE 15. (Continued)

Determination number	Mordanting bath: gram Cr_2O_3/gram fiber	pH	Fiber: gram	Ash: gram	Ash: percentage	Cr_2O_3 percentage
1	2.0668	1.30	2.5591	0.1734	6.78	
2			2.6308	0.1805	6.86	
3			2.5068	0.1724	6.88	
4			2.6116	0.1830	7.01x	
Mean					6.84	6.78
Deviation					0.04	
1	2.5835	1.30	2.4762	0.2024	8.17	
2			2.4529	0.2012	8.20	
3			2.3856	0.1935	8.11	
4			2.4129	0.1962	8.13	
Mean					8.15	8.09
Deviation					0.03	
B. Nylon*						
1	0.005167	1.12	1.2369	0.0085	0.69	
2			1.2481	0.0081	0.65	
3			1.2586	0.0077	0.61	
4			1.2647	0.0079	0.62	
Mean					0.64	0.32
Deviation					0.03	
1	0.05167	1.13	1.2176	0.0424	3.48	
2			1.2142	0.0428	3.52	
3			1.2309	0.0429	3.49	
4			1.2271	0.0430	3.50	
Mean					3.50	3.18
Deviation					0.01	
1	0.2584	1.15	1.2196	0.0855	7.01	
2			1.2186	0.0858	7.04	
3			1.1952	0.0824	6.89	
4			1.2121	0.0837	6.91	
Mean					6.96	6.64
Deviation					0.06	

* Blank determination for ash of nylon: 0.32 per cent

TABLE 15. (Continued)

Determination number	Mordanting bath: gram Cr_2O_3/gram fiber	pH	Fiber: gram	Ash: gram	Ash: percentage	Cr_2O_3: percentage
1	0.5167	1.15	1.2002	0.0875	7.29	
2			1.2262	0.0890	7.26	
3			1.2115	0.0880	7.26	
4			1.2061	0.0872	7.23	
Mean					7.26	6.94
Deviation					0.02	
1	0.7750	1.15	1.1958	0.0856	7.16	
2			1.2227	0.0868	7.10	
3			1.1857	0.0845	7.13	
4			1.2178	0.0894	7.34x	
Mean					7.13	6.81
Deviation					0.02	
C. Nylon*						
1	0.005167	1.11	1.3164	0.0084	0.64	
2			1.3170	0.0085	0.65	
3			1.3299	0.0081	0.61	
4			1.2960	0.0078	0.60	
Mean					0.62	0.30
Deviation					0.02	
1	0.05167	1.13	1.3083	0.0461	3.52	
2			1.2971	0.0447	3.45	
3			1.2953	0.0451	3.48	
4			1.2859	0.0452	3.52	
Mean					3.49	3.17
Deviation					0.03	
1	0.2584	1.15	1.2989	0.0962	7.41	
2			1.2996	0.0962	7.40	
3			1.2792	0.0941	7.36	
4			1.2984	0.0950	7.32	
Mean					7.37	7.05
Deviation					0.03	

* Blank determination for ash of nylon (not heated before treatment): 0.32 per cent.

TABLE 15. (Continued)

Determination number	Mordanting bath: gram Cr_2O_3/gram fiber	pH	Fiber: gram	Ash: gram	Ash: percentage	Cr_2O_3 percentage
1	0.5167	1.15	1.3115	0.0997	7.60	
2			1.3045	0.0986	7.56	
3			1.3045	0.0975	7.47	
4			1.3831	0.0954	7.44	
Mean					7.52	7.20
Deviation					0.06	
1	0.7750	1.15	1.2972	0.1019	7.85	
2			1.2591	0.0997	7.92	
3			1.2824	0.1009	7.87	
4			1.2768	0.0999	7.82	
Mean					7.86	7.54
Deviation					0.03	
D. Silk*						
1	0.02584	1.67	1.1455	0.0171	1.49x	
2			1.2818	0.0200	1.56	
3			1.3543	0.0212	1.57	
4			1.3583	0.0212	1.56	
Mean					1.56	1.43
Deviation					0.00	
1	0.05167	1.68	1.2581	0.0303	2.41	
2			1.0793	0.0256	2.37x	
3			1.0054	0.0241	2.40	
4			1.3602	0.0327	2.40	
Mean					2.40	2.27
Deviation					0.00	
1	0.2584	1.70	1.4030	0.0514	3.66	
2			1.2684	0.0462	3.64	
3			1.1078	0.0402	3.63	
4			1.1061	0.0408	3.69	
Mean					3.66	3.53
Deviation					0.02	

* Blank determination for ash of silk: 0.13 per cent

TABLE 15. (Continued)

Determination number	Mordanting bath: gram Cr_2O_3/gram fiber	pH	Fiber: gram	Ash: gram	Ash: percentage	Cr_2O_3 percentage
1	0.5167	1.70	1.1152	0.0445	3.99	
2			1.2574	0.0514	4.09	
3			1.2725	0.0506	3.98	
4			1.0466	0.0421	4.02	
Mean					4.02	3.89
Deviation					0.04	
1	0.7750	1.70	1.1206	0.0485	4.33	
2			1.0729	0.0460	4.29	
3			1.2651	0.0545	4.31	
4			1.3194	0.0568	4.31	
Mean					4.31	4.18
Deviation					0.01	
1	1.5501	1.70	1.0902	0.0520	4.77	
2			1.4648	0.0695	4.74	
3			1.2931	0.0609	4.71	
4			1.3256	0.0640	4.83	
Mean					4.76	4.63
Deviation					0.04	

TABLE 16. EFFECT OF CONCENTRATION OF FIFTY-VOLUME MORDANTING BATH OF POTASSIUM DICHROMATE ON RESIDUAL WEIGHT OF FIBER IN 48 HOURS AT 40° C.

Determination number	Mordanting bath: gram Cr_2O_3/gram fiber	pH	Fiber: Conditioned weight, gram	Fiber: Calculated oven-dry weight, gram	Residual Fiber: Conditioned, gram	Residual Fiber: Conditioned, percentage of conditioned weight	Residual Fiber: Determined Oven-dry, gram	Residual Fiber: Determined Oven-dry, percentage of dry weight
A. Cellulose-acetate rayon								
1	0.05167	1.26	2.6867	2.5639	2.7200	101.24	2.5245	98.46
2			2.7324	2.6075	2.7671	101.27	2.5688	98.52
3			2.6714	2.5493	2.7036	101.21	2.5081	98.38
4			2.6352	2.5148	2.6725	101.42x	2.4795	98.60
Mean						101.24		98.49
Deviation						0.02		0.07
1	0.2584	1.27	2.6342	2.5138	2.7786	105.48x	2.5504	101.46x
2			2.6214	2.5016	2.7549	105.09	2.5333	101.27
3			2.5754	2.4577	2.7065	105.09	2.4888	101.27
4			2.6200	2.5003	2.7536	105.10	2.5310	101.23
Mean						105.09		101.26
Deviation						0.00		0.02
1	0.5167	1.28	2.6826	2.5600	2.8851	107.55	2.6322	102.82
2			2.7312	2.6064	2.9342	107.43	2.6815	102.88
3			2.7240	2.5995	2.9272	107.46	2.6710	102.75
4			2.6885	2.5657	2.8848	107.30	2.6347	102.69
Mean						107.44		102.78
Deviation						0.07		0.06

x Rejected observation

TABLE 16. (Continued)

Determination number	Mordanting bath: gram / gram Cr_2O_3/ fiber	pH	Fiber: Conditioned weight gram	Fiber: Calculated oven-dry weight gram	Residual Fiber: Conditioned gram	Residual Fiber: Conditioned percentage of conditioned weight	Residual Fiber: Determined Oven-dry gram	Residual Fiber: Determined Oven-dry percentage of dry weight
1	1.0334	1.29	2.7112	2.5873	2.9700	109.54	2.7023	104.44
2			2.6525	2.5313	2.9096	109.69	2.6428	104.40
3			2.6903	2.5674	2.9493	109.63	2.6819	104.46
4			2.6852	2.5625	2.9378	109.41x	2.6750	104.39
Mean						109.62		104.42
Deviation						0.05		0.03
1	2.0668	1.29	2.6816	2.5591	2.9867	111.38	2.6920	105.19
2			2.7568	2.6308	2.0707	111.39	2.7691	105.25
3			2.6268	2.5068	2.9291	111.51	2.6367	105.18
4			2.7367	2.6116	3.0543	111.61	2.7516	105.36x
Mean						111.47		105.21
Deviation						0.09		0.03
B. Nylon								
1	0.005167	1.11	1.3561	1.3164	1.3628	100.49x	1.3215	100.39
2			1.3568	1.3170	1.3650	100.60	1.3216	100.35
3			1.3700	1.3299	1.3779	100.57	1.3342	100.32
4			1.3351	1.2960	1.3424	100.55	1.3001	100.32
Mean						100.57		100.34
Deviation						0.02		0.02

TABLE 16. (Continued)

Determination number	Mordanting bath: gram Cr_2O_3/gram fiber	Mordanting bath: pH	Fiber: Conditioned weight gram	Fiber: Calculated oven-dry weight gram	Residual Fiber: Conditioned gram	Residual Fiber: Conditioned percentage of conditioned weight	Residual Fiber: Determined Oven-dry gram	Residual Fiber: Determined Oven-dry percentage of dry weight
1	0.05167	1.13	1.3478	1.3083	1.4158	105.05	1.3616	104.07
2			1.3363	1.2971	1.4014	104.87	1.3506	104.12
3			1.3344	1.2953	1.3968	104.68	1.3471	104.00
4			1.3247	1.2859	1.3863	104.65	1.3389	104.12
Mean						104.81		104.08
Deviation						0.15		0.04
1	0.2584	1.15	1.3381	1.2989	1.4765	110.34	1.4185	109.21
2			1.3388	1.2996	1.4794	110.50	1.4207	109.32
3			1.3178	1.2792	1.4520	110.18	1.3967	109.19
4			1.3376	1.2984	1.4714	110.00	1.4123	108.77x
Mean						110.26		109.24
Deviation						0.16		0.05
1	0.5167	1.15	1.3511	1.3115	1.4973	110.82	1.4344	109.37
2			1.3439	1.3045	1.4879	110.72	1.4273	109.41
3			1.3439	1.3045	1.4850	110.50	1.4255	109.28
4			1.3218	1.2831	1.4579	110.30	1.3998	109.10x
Mean						110.58		109.35
Deviation						0.18		0.05

TABLE 16. (Continued)

Determination number	Mordanting bath: gram Cr_2O_3 / gram fiber	Mordanting bath: pH	Fiber: Conditioned weight, gram	Fiber: Calculated oven-dry weight, gram	Residual Fiber: Conditioned, gram	Residual Fiber: Conditioned, percentage of conditioned weight	Residual Fiber: Determined Oven-dry, gram	Residual Fiber: Determined Oven-dry, percentage of dry weight
1	0.7750	1.15	1.3369	1.2977	1.4834	110.96	1.4184	109.30x
2			1.2971	1.2591	1.4406	111.06	1.3815	109.72
3			1.3211	1.2824	1.4673	111.06	1.4046	109.53
4			1.3153	1.2768	1.4619	111.15	1.3997	109.63
Mean						111.06		109.63
Deviation						0.05		0.06
C. Silk								
1	0.02584	1.65	1.2286	1.1455	1.2615	102.68	1.1554	100.86
2			1.3747	1.2818	1.4175	103.11	1.2975	101.23
3			1.4525	1.3543	1.4849	102.23	1.3540	99.97
4			1.4568	1.3583	1.4950	102.62	1.3622	100.29
Mean						102.66		100.59
Deviation						0.24		0.46
1	0.05167	1.66	1.3493	1.2581	1.4018	103.89	1.2778	101.57
2			1.1576	1.0793	1.2022	103.85	1.0966	101.60
3			1.0783	1.0054	1.1178	103.66	1.0204	101.49
4			1.4588	1.3602	1.5286	104.78x	1.3887	102.09x
Mean						103.80		101.55
Deviation						0.09		0.04

TABLE 16. (Continued)

Determination number	Mordanting bath: gram CR_2O_3/gram fiber	Mordanting bath: pH	Fiber: Conditioned weight gram	Fiber: Calculated oven-dry weight gram	Residual Fiber: Conditioned gram	Residual Fiber: Conditioned percentage of conditioned weight	Residual Fiber: Determined Oven-dry gram	Residual Fiber: Determined Oven-dry percentage of dry weight
1	0.2584	1.70	1.5047	1.4030	1.5993	106.29	1.4455	103.03
2			1.3604	1.2684	1.4330	105.34	1.3005	102.53x
3			1.1881	1.1078	1.2574	105.83	1.1424	103.12
4			1.1863	1.1061	1.2563	105.90	1.1422	103.26
Mean						105.84		103.14
Deviation						0.26		0.08
1	0.5167	1.70	1.1960	1.1152	1.2732	106.45	1.1542	103.50
2			1.3486	1.2574	1.4450	107.15	1.3099	104.18
3			1.3648	1.2725	1.4464	105.97	1.3124	103.14
4			1.1225	1.0466	1.1986	106.78	1.0865	103.81
Mean						106.59		103.66
Deviation						0.38		0.34
1	0.7750	1.70	1.2018	1.1206	1.2939	107.66	1.1702	104.42
2			1.1507	1.0729	1.2363	107.44	1.1205	104.44
3			1.3547	1.2631	1.4599	107.77	1.3201	104.51
4			1.4151	1.3194	1.5193	107.36	1.3652	103.47x
Mean						107.56		104.46
Deviation						0.16		0.04

TABLE 17. EFFECT OF CONCENTRATION OF FIFTY-VOLUME MORDANTING BATH OF POTASSIUM DICHROMATE ON ABSORPTION OF LIGHT BY MORDANTED FIBER IN 48 HOURS AT 40° C.

Determination number	Mordanting bath gram Cr_2O_3/gram fiber	Absorption of light By cellulose-acetate rayon Conditioned percentage	By nylon Conditioned percentage	By nylon Heated percentage	By silk Conditioned percentage
1	0	10.8			14.8
2		12.8			14.8
3		11.7			14.0
4		17.0x			14.8
5		12.2			14.2
Mean		11.9	12.0	12.0	14.5
Deviation		0.6			0.3
1	0.005167		29.0	38.3x	
2			28.2	33.1	
3			25.0	28.9	
4			27.0	29.1	
5			31.0	29.6	
Mean			28.0	30.2	
Deviation			1.6	1.5	
Increase			16.0	18.2	

x Rejected observation

TABLE 17. (Continued)

Determination number	Mordanting bath gram Cr_2O_3/gram fiber	Absorption of light By cellulose-acetate rayon Conditioned percentage	By nylon Conditioned percentage	By nylon Heated percentage	By silk Conditioned percentage
1	0.02584				54.8
2					54.5
3					55.8
4					58.2
5					66.8x
Mean					55.8
Deviation					1.2
Increase					41.3
1	0.05167	69.2x	72.0	72.1	66.1
2		62.3	71.8	74.1	63.7
3		60.3	71.3	72.0	64.3
4		59.0	76.8	72.8	65.4
5		54.0	75.4	73.9	64.0
Mean		58.9	73.5	73.0	64.7
Deviation		2.4	2.1	0.8	0.8
Increase		47.0	61.5	61.0	50.2

TABLE 17. (Continued)

Determination number	Mordanting bath gram Cr_2O_3/gram fiber	By cellulose-acetate rayon Conditioned percentage	Absorption of light By nylon Conditioned percentage	By nylon Heated percentage	By silk Conditioned percentage
1	0.2584	78.3	89.1	90.0x	71.5
2		86.0	89.1	87.0	71.5
3		82.0	87.8	87.2	79.2x
4		92.2x	87.8	86.0	70.7
5		74.0	88.6	86.0	72.0
Mean		80.1	88.5	86.6	71.4
Deviation		3.9	0.5	0.6	0.4
Increase		68.2	76.5	74.6	56.9
1	0.5167	86.3	88.1	91.0	76.2
2		81.2	88.1	91.2	76.2
3		86.7	88.7	89.6	76.8
4		94.3	88.6	89.7	76.3
5		94.8	88.2	89.2	76.7
Mean		90.5	88.3	90.1	76.4
Deviation		4.9	0.2	0.8	0.2
Increase		76.7	76.3	78.1	61.9

TABLE 17. (Continued)

Determination number	Mordanting bath gram Cr_2O_3/gram fiber	By cellulose-acetate rayon Conditioned percentage	Absorption of light By nylon Conditioned percentage	By nylon Heated percentage	By silk Conditioned percentage
1	0.7750		88.9	88.8	75.2
2			88.3	88.6	77.1
3			89.2	90.0x	76.8
4			89.3	89.0	78.6
5			89.2	88.2	79.1
Mean			89.0	88.6	77.4
Deviation			0.3	0.5	1.2
Increase			77.0	76.9	62.9
1	1.0334	87.2			
2		89.5			
3		91.2			
4		94.0x			
5		88.2			
Mean		89.0			
Deviation		1.3			
Increase		77.1			
1	2.0668	90.8			
2		89.0			
3		94.2			
4		94.6			
5		96.2x			
Mean		92.2			
Deviation		2.2			
Increase		80.3			

TABLE 18. EFFECT OF CONCENTRATION OF FIFTY-VOLUME MORDANTING BATH OF POTASSIUM DICHROMATE ON FIXATION OF MORDANT IN ONE HOUR AT BOILING

Determination number	Mordanting bath: gram Cr_2O_3/gram fiber	Mordanting bath: pH	Fiber: gram	Ash: gram	Ash: percentage	Cr_2O_3: percentage	Barometric pressure: millimeter of mercury
A. Cellulose-acetate rayon*							
1	0.005167	1.25	2.5231	0.0016	0.06		731.7
2			2.5262	0.0015	0.06		
3			2.5282	0.0019	0.08		
4			2.5197	0.0019	0.08		
Mean					0.07	0.02	
Deviation					0.01		
1	0.05167	1.26	2.5298	0.0119	0.47		
2			2.5333	0.0122	0.48		
3			2.5412	0.0118	0.46		
4			2.5437	0.0124	0.49		
Mean					0.48	0.43	
Deviation					0.01		
1	0.2584	1.27	2.5441	0.0488	1.92x		731.7
2			2.5477	0.0501	1.97		
3			2.5333	0.0507	2.00		
4			2.5589	0.0505	1.97		
Mean					1.98	1.93	
Deviation					0.01		

* Blank determination for ash of cellulose-acetate rayon: 0.05 per cent.

x Rejected observation.

TABLE 18. (Continued)

Determination number	Mordanting bath: gram Cr_2O_3/gram fiber	Mordanting bath: pH	Fiber: gram	Ash: gram	Ash: percentage	Cr_2O_3 percentage	Barometric pressure: millimeter of mercury
1	0.5167	1.28	2.5962	0.0843	3.25		
2			2.5991	0.0851	3.27		
3			2.5901	0.0805	3.11x		
4			2.5925	0.0853	3.29		
Mean					3.27	3.22	
Deviation					0.01		
1	0.7750	1.29	2.5207	0.0926	3.67x		732.5
2			2.5351	0.0957	3.77		
3			2.5493	0.0965	3.79		
4			2.6112	0.0984	3.77		
Mean					3.78	3.73	
Deviation					0.01		
	1.0334**	1.29				4.03**	732.5
1	1.2918	1.29	2.6199	0.1070	4.08		
2			2.5144	0.1053	4.19		
3			2.5276	0.1043	4.13		
4			2.5144	0.1018	4.05		
Mean					4.11	4.06	
Deviation					0.05		
1	1.5501	1.29	2.6007	0.1186	4.56		
2			2.5255	0.1114	4.41x		
3			2.4961	0.1167	4.68		
4			2.5463	0.1173	4.61		
Mean					4.62	4.57	
Deviation					0.04		

** See Table 12.

TABLE 18. (Continued)

Determination number	Mordanting bath: gram Cr_2O_3/gram fiber	pH	Fiber: gram	Ash: gram	Ash: percentage	Cr_2O_3 percentage	Barometric pressure millimeter of mercury
1	1.8084	1.29	2.4747	0.1274	5.15		742.0
2			2.4353	0.1278	5.25		
3			2.5032	0.1309	5.23		
4			2.4945	0.1275	5.11		
Mean					5.18	5.12	
Deviation					0.06		
1	2.0668	1.30	2.1828	0.1274	5.84		742.0
2			2.3208	0.1337	5.76		
3			2.4596	0.1402	5.70		
4			2.2358	0.1291	5.77		
Mean					5.77	5.71	
Deviation					0.04		
1	2.5835	1.30	2.4241	0.1382	5.70		
2			2.3247	0.1369	5.89		
3			2.2987	0.1342	5.84		
4			2.4696	0.1415	5.73		
Mean					5.79	5.73	
Deviation					0.08		
B. Nylon*							
1	0.005167	1.11	1.2691	0.0066	0.52		748.0
2			1.2362	0.0068	0.55		
3			1.0585	0.0067	0.63x		
4			1.0746	0.0059	0.55		
5			1.0973	0.0058	0.53		
Mean					0.54	0.22	
Deviation					0.01		

* Blank determination for ash of nylon: 0.32 per cent.

TABLE 18. (Continued)

Determination number	Mordanting bath: gram Cr_2O_3 / gram fiber	pH	Fiber: gram	Ash: gram	Ash: percentage	Cr_2O_3 percentage	Barometric pressure: millimeter of mercury
1	0.02584	1.12	1.3005	0.0172	1.32		742.0
2			1.3192	0.0183	1.39		
3			1.3605	0.0169	1.24		
4			1.3429	0.0179	1.33		
Mean					1.32	1.00	
Deviation					0.04		
1	0.05167	1.13	0.9723	0.0231	2.38		738.0
2			0.9779	0.0231	2.36		
3			1.0895	0.0243	2.23		
4			1.0938	0.0245	2.24		
5			1.0625	0.0245	2.31		
Mean					2.30	1.98	
Deviation					0.06		
1	0.1292	1.14	0.9443	0.0475	5.03		
2			0.9707	0.0487	5.02		
3			1.0756	0.0549	5.10		
4			1.1376	0.0572	5.03		
5			1.1190	0.0557	4.98		
Mean					5.03	4.71	
Deviation					0.03		
	0.2584**	1.15				7.71**	744.5

** See Table 12.

TABLE 18. (Continued)

Determination number	Mordanting bath: gram Cr_2O_3 / gram fiber	pH	Fiber: gram	Ash: gram	Ash: percentage	Cr_2O_3 percentage	Barometric pressure: millimeter of mercury
1	0.3875	1.15	1.2677	0.1153	9.10		748.0
2			1.2545	0.1168	9.31x		
3			1.2669	0.1163	9.18		
4			1.1064	0.1000	9.04		
5			1.2775	0.1167	9.14		
Mean					9.12	8.80	
Deviation					0.04		
1	0.5167	1.15	1.0435	0.1025	9.82		
2			1.0172	0.1007	9.90		
3			1.0454	0.1043	9.98		
4			1.0727	0.1080	10.07		
5			1.0604	0.1097	10.35x		
Mean					9.94	9.62	
Deviation					0.08		
1	0.7750	1.15	1.0644	0.1176	11.05		
2			1.2667	0.1390	10.97		
3			1.3374	0.1474	11.02		
4			1.2914	0.1396	10.81x		
5			1.3044	0.1431	10.97		
Mean					11.00	10.68	
Deviation					0.03		

TABLE 18. (Continued)

Determination number	Mordanting bath: gram Cr_2O_3 / gram fiber	pH	Fiber: gram	Ash: gram	Ash: percentage	Cr_2O_3 percentage	Barometric pressure: millimeter of mercury
1	1.0334*	1.15	1.4054	0.1781	12.67		741.6
2			1.4068	0.1798	12.78		
3			1.4025	0.1756	12.52		
4			1.4033	0.1770	12.61		
Mean					12.64	12.32	
Deviation					0.08		
1	1.2918*	1.16	1.4055	0.1815	12.91		
2			1.4003	0.1781	12.72		
3			1.3878	0.1812	13.06		
4			1.3926	0.1794	12.88		
Mean					12.89	12.57	
Deviation					0.09		
1	1.5501*	1.16	1.4058	0.1850	13.16		
2			1.4075	0.1842	13.09		
3			1.4024	0.1848	13.18		
4			1.3856	0.1837	13.26		
Mean					13.17	12.85	
Deviation					0.05		
C. Silk**							
1	0.02584	1.65	1.3918	0.0216	1.55x		736.2
2			1.2389	0.0185	1.49		
3			1.3386	0.0201	1.50		
4			1.3272	0.0202	1.52		
Mean					1.50	1.37	
Deviation					0.01		

* Visible degradation of fiber.

** Blank determination for ash of silk: 0.13 per cent.

TABLE 18. (Continued)

Determination number	Mordanting bath: gram Cr_2O_3 / gram fiber	pH	Fiber: gram	Ash: gram	Ash: percentage	Cr_2O_3 percentage	Barometric pressure: millimeter of mercury
1	0.05167	1.66	1.2331	0.0324	2.63		
2			1.3383	0.0352	2.63		
3			1.3760	0.0367	2.67		
4			1.3648	0.0361	2.65		
5			1.3454	0.0354	2.63		
Mean					2.64		
Deviation					0.01	2.51	
1	0.1292	1.69	1.3655	0.0627	4.59		
2			1.2153	0.0542	4.46		
3			1.2748	0.0562	4.41		
4			1.3546	0.0618	4.56		
Mean					4.50	4.37	
Deviation					0.07		
	0.2584*	1.70				6.25*	722.6
1	0.3875**	1.70	1.2326	0.0842	6.83		736.6
2			1.2344	0.0865	7.01		
3			1.2602	0.0887	7.04		
4			1.2711	0.0879	6.92		
Mean					6.95	6.82	
Deviation					0.08		
1	0.5167**	1.70	1.3642	0.1023	7.50		
2			1.0648	0.0804	7.55x		
3			1.0749	0.0807	7.51		
4			1.0826	0.0809	7.47		
5			1.1860	0.0890	7.50		
Mean					7.50	7.37	
Deviation					0.01		

* See Table 12.

** Equilibrial solution was turbid indicating possible degradation of fiber.

TABLE 19. EFFECT OF TEMPERATURE OF MORDANTING ON FIXATION OF MORDANT FROM FIFTY-VOLUME BATH OF POTASSIUM DICHROMATE IN ONE HOUR

Determination number	Temperature °C	Fiber gram	Ash gram	Ash percentage	Cr_2O_3 percentage
A. Cellulose-acetate rayon*, 2.0000 g. $K_2Cr_2O_7$/ gram fiber at pH 1.29.					
1	25 ± 0.1	2.5473	0.0031	0.12	
2		2.5015	0.0028	0.11	
3		2.5235	0.0029	0.11	
4		2.5917	0.0032	0.12	
Mean				0.12	0.06
Deviation				0.00	
1	40 ± 0.1	2.5707	0.0050	0.19	
2		2.4838	0.0045	0.18	
3		2.4937	0.0044	0.18	
4		2.5118	0.0047	0.19	
Mean				0.18	0.12
Deviation				0.00	
1	60 ± 0.1	2.5125	0.0128	0.51	
2		2.5017	0.0126	0.50	
3		2.4878	0.0130	0.52	
4		2.5073	0.0131	0.52	
Mean				0.51	0.45
Deviation				0.01	
1	80 ± 1	2.4574	0.0388	1.58	
2		2.5116	0.0424	1.69	
3		2.4873	0.0438	1.76	
4		2.4694	0.0401	1.62	
Mean				1.66	1.60
Deviation				0.06	
	99.0**				4.03**

* Blank determination for ash of cellulose-acetate rayon: 0.06 per cent.

** See Table 12.

TABLE 19. (Continued)

Determination number	Temperature °C	Fiber gram	Ash gram	Ash percentage	Cr_2O_3 percentage
B. Nylon, * 0.5000 g. $K_2Cr_2O_7$/ gram fiber at pH 1.15.					
1	27 - 0.1	1.0608	0.0120	1.13	
2		1.4998	0.0173	1.15	
3		1.2918	0.0150	1.16	
4		1.2661	0.0146	1.15	
5		1.2872	0.0150	1.17	
Mean				1.15	0.83
Deviation				0.01	
1	40 - 0.1	1.3108	0.0233	1.78	
2		1.3756	0.0243	1.77	
3		1.3055	0.0224	1.72	
4		1.4629	0.0251	1.72	
5		1.4444	0.0260	1.80	
Mean				1.76	1.44
Deviation				0.03	
1	80 - 1	1.4852	0.0681	4.59	
2		1.2709	0.0569	4.48	
3		1.0559	0.0465	4.40	
4		1.0440	0.0481	4.61	
5		1.0638	0.0490	4.61	
Mean				4.54	4.22
Deviation				0.08	
	99.4**				7.71**
C. Silk, *** 0.5000 g. $K_2Cr_2O_7$/ gram fiber at pH 1.70.					
1	25 _ 0.1	1.3690	0.0086	0.63	
2		1.3386	0.0086	0.64	
3		1.1083	0.0071	0.64	
4		1.3256	0.0077	0.58	
5		1.3225	0.0075	0.57	
Mean				0.61	0.48
Deviation				0.03	

* Blank determination for ash of nylon:0.32 per cent
** See Table 12.
*** Blank determination for ash of silk:0.13 per cent.

TABLE 19. (Continued)

Determination number	Temperature °C	Fiber gram	Ash gram	Ash percentage	Cr_2O_3 percentage
1	40 ± 0.1	1.3032	0.0099	0.76	
2		1.3195	0.0106	0.80	
3		1.0684	0.0083	0.78	
4		1.2877	0.0101	0.78	
5		1.2749	0.0099	0.78	
Mean				0.78	0.65
Deviation				0.01	
1	60 ± 0.1	1.2759	0.0200	1.57	
2		1.2771	0.0206	1.61	
3		1.2869	0.0204	1.59	
4		1.3018	0.0202	1.55	
Mean				1.58	1.45
Deviation				0.02	
1	80 ± 1	1.3267	0.0394	2.97	
2		1.1360	0.0341	3.00	
3		1.1895	0.0372	3.13x	
4		1.1895	0.0352	2.96	
5		1.2355	0.0363	2.94	
Mean				2.97	2.84
Deviation				0.02	
	98.6*				6.25*

x Rejected observation.
* See Table 12.

TABLE 20. EFFECT OF TIME OF MORDANTING ON FIXATION OF MORDANT FROM FIFTY-VOLUME BATH OF POTASSIUM DICHROMATE AT 40° C.

Determination number	Time hour	Final pH of bath	Fiber gram	Ash gram	Ash percentage	Cr_2O_3 percentage
A. Cellulose-acetate rayon,* 2.0000 g. $K_2Cr_2O_7$/ gram fiber at pH 1.29.						
	1**					0.12**
1	4	1.42	2.5314	0.0134	0.53	
2			2.5144	0.0130	0.52	
3			2.4555	0.0125	0.51	
4			2.5049	0.0127	0.51	
Mean					0.52	0.46
Deviation					0.01	
1	9	1.44	2.5085	0.0347	1.38	
2			2.4697	0.0330	1.34	
3			2.5101	0.0339	1.35	
4			2.4814	0.0342	1.38	
Mean					1.36	1.30
Deviation					0.02	
1	16	1.48	2.5001	0.0634	2.54	
2			2.4983	0.0612	2.45	
3			2.5210	0.0626	2.48	
Mean					2.49	2.43
Deviation					0.03	
1	25	1.53	2.4867	0.0925	3.72x	
2			2.5016	0.0893	3.57	
3			2.5045	0.0896	3.58	
4			2.4971	0.0887	3.55	
Mean					3.57	3.51
Deviation					0.01	

* Blank determination for ash of cellulose-acetate rayon: 0.06 per cent.
** See Table 19.
x Rejected observation.

TABLE 20. (Continued)

Determination number	Time hour	Final pH of bath	Fiber gram	Ash gram	Ash percentage	Cr_2O_3 percentage
1	36	1.60	2.5246	0.1247	4.94	
2			2.4740	0.1171	4.73	
3			2.5101	0.1246	4.96	
4			2.4982	0.1207	4.83	
Mean					4.86	4.80
Deviation					0.08	
1	49	1.65	2.5074	0.1490	5.94	
2			2.5007	0.1479	5.91	
3			2.6042	0.1532	5.88	
4			2.5305	0.1491	5.89	
5			2.5040	0.1532	6.12x	
Mean					5.90	5.84
Deviation					0.02	
1	64	1.83	2.5122	0.1834	7.30x	
2			2.5149	0.1795	7.14	
3			2.4974	0.1754	7.02	
4			2.4977	0.1768	7.08	
Mean					7.08	7.02
Deviation					0.04	
1	72		2.5761	0.1978	7.68	
2			2.5438	0.1951	7.67	
3			2.5382	0.1949	7.68	
4			2.5672	0.1966	7.66x	
Mean					7.68	7.62
Deviation					0.00	
1	81		2.4490	0.2010	8.21x	
2			2.3008	0.1893	8.23	
3			2.5232	0.2077	8.23	
4			2.5015	0.2056	8.22	
Mean					8.23	8.17
Deviation					0.00	

TABLE 20. (Continued)

Determination number	Time hour	Final pH of bath	Fiber gram	Ash gram	Ash percentage	Cr_2O_3 percentage
1	92		2.5473	0.2204	8.65	
2			2.5643	0.2216	8.64	
3			2.5295	0.2203	8.71x	
4			2.5551	0.2205	8.63	
Mean					8.64	8.58
Deviation					0.01	
1	100	2.00	2.5097	0.2215	8.83	
2			2.5008	0.2217	8.87	
3			2.4504	0.2162	8.82	
4			2.4922	0.2190	8.79	
Mean					8.83	8.77
Deviation					0.02	
1	211	1.98	2.4330	0.2773	11.40	
2			2.4131	0.2771	11.48	
3			2.3519	0.2689	11.43	
4			2.4543	0.2824	11.51	
Mean					11.46	11.40
Deviation					0.04	
1	485	2.02	2.1192	0.2552	12.04	
2			2.1324	0.2624	12.31x	
3			2.1508	0.2614	12.15	
4			2.1494	0.2612	12.15	
Mean					12.11	12.05
Deviation					0.05	
B. Nylon,* 0.5000 g. $K_2Cr_2O_7$/ gram fiber at pH 1.15.						
	1**					1.45**

* Blank determination for ash of nylon: 0.31 per cent.
** See Table 19.

TABLE 20. (Continued)

Determination number	Time hour	Final pH of bath	Fiber gram	Ash gram	Ash percentage	Cr_2O_3 percentage
1	4	1.18	1.3785	0.0407	2.95	
2			1.3486	0.0398	2.95	
3			1.2776	0.0364	2.85	
4			1.3241	0.0381	2.88	
5			1.2916	0.0373	2.89	
Mean					2.90	2.59
Deviation					0.04	
1	9		1.2267	0.0487	3.97	
2			1.2269	0.0492	4.01	
3			1.2729	0.0514	4.04	
4			1.2823	0.0510	3.98	
5			1.3594	0.0542	3.99	
Mean					4.00	3.69
Deviation					0.02	
1	16	1.22	1.0729	0.0552	5.14	
2			1.0633	0.0564	5.30x	
3			1.0583	0.0544	5.14	
4			1.0773	0.0559	5.19	
5			1.0843	0.0559	5.16	
Mean					5.16	4.85
Deviation					0.02	
1	25	1.26	1.1450	0.0709	6.19	
2			1.1420	0.0709	6.21	
3			1.3561	0.0836	6.16	
4			1.0582	0.0639	6.04	
5			1.0559	0.0633	5.99	
Mean					6.12	5.81
Deviation					0.08	

TABLE 20. (Continued)

Determination number	Time hour	Final pH of bath	Fiber gram	Ash gram	Ash percentage	Cr_2O_3 percentage
1	36	1.32	1.1341	0.0772	6.81	
2			1.1420	0.0787	6.89	
3			1.1197	0.0769	6.87	
4			1.0904	0.0743	6.81	
5			1.0623	0.0713	6.71	
Mean					6.82	6.51
Deviation					0.05	
1	49	1.43	1.0658	0.0780	7.32	
2			1.1894	0.0883	7.42	
3			1.1950	0.0879	7.36	
4			1.0939	0.0783	7.16	
5			1.0850	0.0788	7.26	
Mean					7.30	6.99
Deviation					0.08	
1	64		1.1156	0.0837	7.50	
2			1.0875	0.0839	7.71	
3			1.2850	0.0994	7.74	
4			1.1158	0.0885	7.93	
5			1.0847	0.0850	7.84	
Mean					7.74	7.43
Deviation					0.11	
1	100	1.50	1.2923	0.1079	8.35	
2			1.1719	0.0965	8.23	
3			1.2741	0.1051	8.25	
4			1.0725	0.0894	8.34	
5			1.2961	0.1059	8.17	
Mean					8.27	7.96
Deviation					0.06	
1	114	1.70	1.4027	0.1143	8.15	
2			1.4029	0.1141	8.13	
3			1.4030	0.1142	8.14	
4			1.4037	0.1145	8.16	
Mean					8.14	7.82
Deviation					0.01	

TABLE 20. (Continued)

Determination number	Time hour	Final pH of bath	Fiber gram	Ash gram	Ash percentage	Cr_2O_3 percentage
C. Silk,* 0.5000 g. $K_2Cr_2O_7$/ gram fiber at pH 1.70.						
	1**					0.65**
1	4	1.92	1.1673	0.0168	1.44	
2			1.1043	0.0158	1.43	
3			1.3297	0.0190	1.43	
4			1.2196	0.0173	1.42	
5			1.3571	0.0194	1.43	
Mean					1.43	1.30
Deviation					0.00	
1	9	2.10	1.2789	0.0256	2.00	
2			1.3142	0.0268	2.04	
3			1.2848	0.0261	2.03	
4			1.2932	0.0260	2.01	
5			1.2591	0.0260	2.06	
Mean					2.03	1.90
Deviation					0.02	
1	16	2.25	1.2805	0.0339	2.65	
2			1.2531	0.0328	2.62	
3			1.2599	0.0328	2.60	
4			1.2552	0.0326	2.60	
5			1.2975	0.0341	2.63	
Mean					2.62	2.49
Deviation					0.02	
1	25	2.40	1.2533	0.0367	2.93	
2			1.2420	0.0366	2.95	
3			1.2488	0.0367	2.95	
4			1.2519	0.0372	2.97	
5			1.2538	0.0366	2.92	
Mean					2.94	2.81
Deviation					0.02	

* Blank determination for ash of silk: 0.13 per cent.
** See Table 19.

TABLE 20. (Continued)

Determination number	Time hour	Final pH of bath	Fiber gram	Ash gram	Ash percentage	Cr_2O_3 percentage
1	36	2.60	1.2924	0.0440	3.40	
2			1.3057	0.0450	3.45	
3			1.2863	0.0440	3.42	
4			1.1489	0.0389	3.39	
5			1.1367	0.0392	3.45	
Mean					3.42	3.29
Deviation					0.02	
1	49	2.85	1.2375	0.0476	3.85	
2			1.2590	0.0487	3.87	
3			1.2386	0.0479	3.87	
4			1.2360	0.0475	3.84	
5			1.2415	0.0482	3.88	
Mean					3.86	3.73
Deviation					0.01	
1	72	3.20	1.3097	0.0573	4.38	
2			1.3500	0.0595	4.41	
3			1.2956	0.0575	4.44	
4			1.4021	0.0609	4.34	
Mean					4.39	4.26
Deviation					0.03	
1	120	3.40	1.4126	0.0767	5.43	
2			1.4070	0.0760	5.40	
3			1.3598	0.0744	5.47	
4			1.3824	0.0752	5.44	
Mean					5.44	5.31
Deviation					0.02	
1	169	3.50	1.3508	0.0896	6.63	
2			1.2908	0.0845	6.55	
3			1.3410	0.0882	6.58	
4			1.3726	0.0906	6.60	
Mean					6.59	6.46
Deviation					0.02	

TABLE 20. (Continued)

Determination number	Time hour	Final pH of bath	Fiber gram	Ash gram	Ash percentage	Cr_2O_3 percentage
1	229	3.70	1.3434	0.1044	7.77	
2			1.2350	0.0966	7.82	
3			1.2253	0.0959	7.83	
4			1.1983	0.0929	7.75	
Mean					7.79	7.66
Deviation					0.03	

TABLE 21. EFFECT OF TIME OF MORDANTING ON WET STRENGTH OF FABRIC IN FIFTY-VOLUME BATH OF POTASSIUM DICHROMATE AT 40° C.

Determination number	Breaking strength of fabric								
	pound/ inch	pound/ inch	pound/ inch	pound/ inch	pound/ inch	pound/ inch	pound/ inch	pound/ inch	pound/ inch
A. Cellulose-acetate rayon,* 2.0000 g. $K_2Cr_2O_7$/ gram fiber at pH 1.29.									
Time, hour	4	9	16	25	36	49	64	100	485
1A**	30	30	29	26	24	29	22	30	22
2A	26	30	26	28	26	29	24	29	24
3A	33	30	30	26	17x	30	31	30	23
4A	31	30	29	27	27	29	31	33	17x
5A	33	30	24x	24	27	28	30	31	24
6B	30	31	28	25	27	29	19x	29	23
7B	34	26x	29	25	26	30	24	28	23
8B	29	30	28	26	28	29	31	28	21
9B	26	32	28	26	27	29	31	31	24
10B	20x	30	27	26	28	29	32	30	23
Mean	30	30	28	26	27	29	28	30	23
Deviation	2	0	1	1	1	0	4	1	1
Percentage of original wet strength	94	94	88	81	84	91	88	94	72

* Wet warp strength.
** Parallel determinations lettered alike.
x Rejected observation.

TABLE 21. (Continued)

Determination number	Breaking strength of fabric pound/ inch	pound/ inch	pound/ inch	pound/ inch	pound/ inch	pound/ inch	pound/ inch
B. Nylon,* 0.5000 g. $K_2Cr_2O_7$/ gram fiber at pH 1.15.							
Time, hour	4	16	25	36	49	100	114
1A	22	10	6	4	1	0	
2A	23	10	6	7x	1	0	
3A	22	12	6	2	2	1	
4A	23	12	5	3	3	0	
5A	24	11	5	2	1	1	
6B	24	10	5	3	2	0	
7B	23	11	6	3	1	0	
8B	23	11	6	4	1	0	
9B	23	12	7	4	2	1	
10B	23	10	6	2	1	0	
Mean	23	11	6	3	2	<1	< 1
Deviation	0	1	0	1	1		
Percentage of original wet strength	68	32	18	9	6	-	-

* Wet filling strength.

TABLE 21. (Continued)

Determination number	Breaking strength of fabric pound/ inch	pound/ inch	pound/ inch	pound/ inch	pound/ inch	pound/ inch	pound/ inch	pound/ inch
C. Silk,* 0.5000 g. $K_2Cr_2O_7$/ gram fiber at pH 1.70.								
Time, hour	4	9	16	25	36	49	72	120
1A	16	15	13	10	12	12	10	8
2A	18	13	13	14	7	8	8	5
3A	16	17	10	9	8	9	9	6
4A	15	12	11	10	10	10	7	5
5A	17	14	15	12	11	9	10	7
6B	16	15	14	10	11	8	7	8
7B	18	15	15	9	10	8	8	6
8B	15	12	13	12	10	10	8	8
9B	17	13	10	11	8	10	9	7
10B	16	16	14	14	12	9	6	7
Mean	16	14	13	11	10	9	8	7
Deviation	1	1	1	2	1	1	1	1
Percentage of original wet strength	89	78	72	61	56	50	44	39

* Wet warp strength.

TABLE 22. EFFECT OF TIME OF MORDANTING ON FIXATION OF MORDANT FROM FIFTY-VOLUME BATH OF POTASSIUM DICHROMATE AT BOILING

Determination number	Time hour	Fiber gram	Ash gram	Ash percentage	Cr_2O_3 percentage
A.	Cellulose-acetate rayon, * 2.0000 g. $K_2Cr_2O_7$/ gram fiber at pH 1.29.				
1	0.25	2.1710	0.0316	1.46	
2		2.2856	0.0338	1.48	
3		2.3298	0.0336	1.44	
4		2.3059	0.0337	1.46	
Mean				1.46	1.40
Deviation				0.01	
1	0.50	2.5218	0.0652	2.58	
2		2.4256	0.0628	2.59	
3		2.4536	0.0644	2.62x	
4		2.5028	0.0645	2.58	
Mean				2.58	2.52
Deviation				0.00	
1	0.75	2.4433	0.0926	3.79	
2		2.4526	0.0928	3.78	
3		2.5032	0.0945	3.78	
4		2.4075	0.0908	3.77	
Mean				3.78	3.72
Deviation				0.00	
	1.0**				4.03**
1	2.0	2.4273	0.1233	5.08	
2		2.3892	0.1242	5.20	
3		2.4056	0.1241	5.16	
4		2.3228	0.1187	5.11	
Mean				5.14	5.08
Deviation				0.04	

* Blank determination for ash of cellulose-acetate rayon: 0.06 per cent.
x Rejected observation.
** See Table 12.

TABLE 22. (Continued)

Determination number	Time hour	Fiber gram	Ash gram	Ash percentage	Cr_2O_3 percentage
1	4.0	2.3978	0.1821	7.60	
2		2.3158	0.1737	7.50	
3		2.4256	0.1805	7.44	
4		2.3929	0.1806	7.55	
Mean				7.52	7.46
Deviation				0.05	
B. Nylon, * 0.5000 g. $K_2Cr_2O_7$/ gram fiber at pH 1.15.					
1	0.25	1.3935	0.0492	3.53	
2		1.3961	0.0495	3.55	
3		1.4146	0.0507	3.58	
4		1.4008	0.0504	3.60	
Mean				3.56	3.24
Deviation				0.02	
1	0.50	1.3910	0.0729	5.24	
2		1.4007	0.0763	5.45x	
3		1.3641	0.0711	5.21	
4		1.3685	0.0696	5.09	
Mean				5.18	4.86
Deviation				0.06	
1	0.75	1.3684	0.0881	6.44	
2		1.3980	0.0894	6.39	
3		1.3801	0.0877	6.35	
4		1.4032	0.0904	6.44	
Mean				6.40	6.08
Deviation				0.04	
	1.0**				7.71**

* Blank determination for ash of nylon: 0.32 per cent.
** See Table 12.

TABLE 23. EFFECT OF VOLUME OF MORDANTING BATH OF POTASSIUM DICHROMATE ON FIXATION OF MORDANT IN ONE HOUR AT BOILING

Determination number	Mordanting bath: milliliter/gram fiber	pH	Fiber: gram	Ash: gram	Ash: percentage	Cr_2O_3: percentage	Barometric pressure: millimeter of mercury
A. Cellulose-acetate rayon,* 2.0000 g. $K_2Cr_2O_7$/ gram fiber.							
	50**	1.29				4.03**	732.5
1	100	1.39	2.4599	0.0329	1.34		736.0
2			2.5035	0.0342	1.37		
3			2.5054	0.0342	1.37		
			2.4747	0.0346	1.40		
Mean					1.37	1.31	
Deviation					0.02		
1	150	1.57	2.4765	0.0126	0.51		735.7
2			2.5096	0.0139	0.55		
3			2.5015	0.0131	0.52		
4			2.4990	0.0134	0.54		
Mean					0.53	0.47	
Deviation					0.02		
1	200	1.70	2.5028	0.0089	0.36		735.7
2			2.4865	0.0093	0.37		
3			2.5046	0.0095	0.38		
4			2.4921	0.0102	0.41		
Mean					0.38	0.32	
Deviation					0.02		

* Blank determination for ash of cellulose-acetate rayon: 0.06 per cent.
** See Table 12.

TABLE 22. (Continued)

Determination number	Time hour	Fiber gram	Ash gram	Ash percentage	Cr_2O_3 percentage
1	1.5	1.3759	0.1321	9.60	
2		1.4016	0.1315	9.38	
3		1.3855	0.1334	9.62	
4		1.3790	0.1301	9.43	
Mean				9.51	9.19
Deviation				0.10	
1	2.0*	1.3996	0.1466	10.47	
2		1.4088	0.1487	10.56	
3		1.4094	0.1436	10.19x	
4		1.4007	0.1457	10.40	
Mean				10.48	10.16
Deviation				0.06	
1	3.0*	1.4038	0.1743	12.42	
2		1.4040	0.1759	12.53x	
3		1.3704	0.1702	12.42	
4		1.3889	0.1721	12.39	
Mean				12.41	12.09
Deviation				0.01	
C. Silk,** 0.5000 g. $K_2Cr_2O_7$/ gram fiber at pH 1.70.					
1	0.25	1.4078	0.0428	3.04	
2		1.3867	0.0416	3.00	
3		1.3528	0.0392	2.90	
4		1.3298	0.0390	2.93	
Mean				2.97	2.84
Deviation				0.05	
1	0.50	1.2806	0.0528	4.12	
2		1.3521	0.0568	4.20	
3		1.3026	0.0541	4.15	
4		1.2959	0.0548	4.23	
Mean				4.18	4.05
Deviation				0.04	

* Visible degradation of fiber.
** Blank determination for ash of silk: 0.13 per cent.

TABLE 22. (Continued)

Determination number	Time hour	Fiber gram	Ash gram	Ash percentage	Cr_2O_3 percentage
1	0.75	1.4858	0.0800	5.38	
2		1.3929	0.0737	5.29	
3		1.3619	0.0746	5.48	
4		1.4265	0.0765	5.36	
Mean				5.38	5.25
Deviation				0.05	
	1.0*				6.25*
1	1.5**	1.1174	0.0865	7.74	
2		1.3621	0.1046	7.68	
3		1.3222	0.1018	7.70	
4		1.2686	0.0986	7.77	
Mean				7.72	7.59
Deviation				0.03	
1	2.0**	1.0879	0.0889	8.17	
2		1.2592	0.1010	8.02	
3		1.3068	0.1060	8.11	
4		1.1983	0.0990	8.26	
Mean				8.14	8.01
Deviation				0.08	

* See Table 12.
** Equilibrial solution was turbid indicating possible degradation of fiber.

TABLE 23. (Continued)

Determination number	Mordanting bath: milliliter/gram fiber	Mordanting bath: pH	Fiber: gram	Ash: gram	Ash: percentage	Cr_2O_3: percentage	Barometric pressure: millimeter of mercury
1	250	2.04	2.5064	0.0059	0.24		
2			2.5014	0.0066	0.26		
3			2.5045	0.0067	0.27		
4			2.4745	0.0061	0.25		
Mean					0.26	0.20	
Deviation					0.01		
1	300	2.17	1.1243	0.0023	0.20		733.5
2			1.1248	0.0021	0.19		
3			1.1244	0.0024	0.21		
4			1.1334	0.0027	0.24		
Mean					0.21	0.15	
Deviation					0.02		

TABLE 23. (Continued)

Determination number	Mordanting bath: milliliter/gram fiber	Mordanting bath: pH	Fiber: gram	Ash: gram	Ash: percentage	Cr_2O_3: percentage	Barometric pressure: millimeter of mercury
1	100	1.30	2.5848	0.0832	3.22x		728.0
2			2.4707	0.0855	3.46		
3			2.3939	0.0833	3.48		
4			2.4461	0.0843	3.45		
Mean					3.46	3.40	
Deviation					0.01		
1	150	1.30	2.4121	0.0619	2.57		
2			2.4306	0.0652	2.68		
3			2.4918	0.0671	2.69		
4			2.4015	0.0626	2.61		
Mean					2.64	2.58	
Deviation					0.05		
1	200	1.30	2.4597	0.0476	1.94x		
2			2.5445	0.0530	2.08		
3			2.3225	0.0475	2.05		
4			2.5240	0.0533	2.11		
Mean					2.08	2.02	
Deviation					0.02		

x Rejected observation.

TABLE 23. (Continued)

Determination number	Mordanting bath: milliliter/gram fiber	Mordanting bath: pH	Fiber: gram	Ash: gram	Ash: percentage	Cr_2O_3: percentage	Barometric pressure: millimeter of mercury
1	250	1.30	2.1103	0.0356	1.69x		728.0
2			2.1643	0.0390	1.80		
3			2.0195	0.0367	1.82		
4			1.9430	0.0351	1.81		
Mean					1.81	1.75	
Deviation					0.01		
1	300	1.30	2.1056	0.0285	1.35x		
2			2.1021	0.0308	1.47		
3			2.0046	0.0291	1.45		
4			2.1333	0.0320	1.50		
Mean					1.47	1.41	
Deviation					0.02		

TABLE 23. (Continued)

Determination number	Mordanting bath: milliliter/gram fiber	Mordanting bath: pH	Fiber: gram	Ash: gram	Ash: percentage	Cr_2O_3 percentage	Barometric pressure: millimeter of mercury
B. Nylon,* 0.5000 g. $K_2Cr_2O_7$/ gram fiber.							
	50**	1.15				7.71**	744.5
1	100	1.45	1.3666	0.0439	3.21x		739.8
2			1.3729	0.0477	3.47		
3			1.3707	0.0464	3.39		
4			1.3795	0.0474	3.44		
5			1.4085	0.0495	3.51		
Mean					3.45	3.13	
Deviation					0.04		
1	150	1.64	1.3759	0.0287	2.09		
2			1.3866	0.0292	2.11		
3			1.3041	0.0278	2.13		
4			1.4073	0.0294	2.09		
5			1.4126	0.0296	2.10		
Mean					2.10	1.78	
Deviation					0.01		

* Blank determination for ash of nylon: 0.32 per cent.
** See Table 12.

TABLE 23. (Continued)

Determination number	Mordanting bath milliliter/gram fiber	pH	Fiber gram	Ash gram	Ash percentage	Cr_2O_3 percentage	Barometric pressure millimeter of mercury
1	200	1.75	1.3877	0.0184	1.33		739.8
2			1.3881	0.0189	1.36		
3			1.2686	0.0173	1.36		
4			1.3863	0.0189	1.36		
5			1.3802	0.0173	1.25x		
Mean					1.35	1.03	
Deviation					0.01		
1	250	1.83	1.3993	0.0155	1.11		731.7
2			1.3742	0.0158	1.15		
3			1.3092	0.0149	1.14		
4			1.2045	0.0140	1.16		
5			1.3466	0.0154	1.14		
Mean					1.14	0.82	
Deviation					0.01		
1	300	1.92	1.3441	0.0128	0.95		
2			1.2012	0.0114	0.95		
3			1.2594	0.0124	0.98x		
4			1.3123	0.0126	0.96		
5			1.3962	0.0133	0.95		
Mean					0.95	0.63	
Deviation					0.00		

TABLE 23. (Continued)

Determination number	Mordanting bath milliliter/gram fiber	pH	Fiber gram	gram	Ash percentage	Cr_2O_3 percentage	Barometric pressure millimeter of mercury
1	100	1.15	1.5000	0.0906	6.04		744.5
2			1.4839	0.0903	6.09		
3			1.4789	0.0890	6.02		
4			1.5191	0.0912	6.00		
5			1.5162	0.0904	5.96		
Mean					6.02	5.70	
Deviation					0.03		
1	150	1.15	1.3975	0.0651	4.66		731.8
2			1.3756	0.0657	4.78		
3			1.3629	0.0677	4.97x		
4			1.3890	0.0661	4.76		
5			1.3859	0.0653	4.71		
Mean					4.73	4.41	
Deviation					0.04		
1	200	1.15	1.5580	0.0567	3.64		726.0
2			1.5306	0.0570	3.72		
3			1.2931	0.0494	3.82		
4			1.3480	0.0494	3.66		
5			1.3144	0.0500	3.80		
Mean					3.73	3.41	
Deviation					0.07		

TABLE 23. (Continued)

Determination number	Mordanting bath: milliliter/gram fiber	Mordanting bath: pH	Fiber: gram	Ash: gram	Ash: percentage	Cr_2O_3 percentage	Barometric pressure millimeter of mercury
1	250	1.15	1.2205	0.0396	3.24		735.2
2			1.3292	0.0421	3.17		
3			1.2462	0.0401	3.22		
4			1.2725	0.0405	3.18		
Mean					3.20	2.88	
Deviation					0.03		
1	300	1.15	1.4874	0.0405	2.72		739.0
2			1.4693	0.0407	2.77		
3			1.3827	0.0388	2.81		
4			1.3664	0.0388	2.84		
5			1.3568	0.0367	2.70		
Mean					2.77	2.45	
Deviation					0.05		

TABLE 23. (Continued)

Determination number	Mordanting bath: milliliter/gram fiber	Mordanting bath: pH	Fiber: gram	Ash: gram	Ash: percentage	Cr_2O_3 percentage	Barometric pressure: millimeter of mercury
C. Silk,* 0.5000 g. $K_2Cr_2O_7$/ gram fiber.							
	50**	1.70				6.25**	722.6
1	100	1.92	1.5420	0.0679	4.40		739.0
2			1.4273	0.0624	4.37		
3			1.5938	0.0692	4.34		
4			1.6643	0.0740	4.45		
Mean					4.39	4.26	
Deviation					0.04		
1	150	2.13	1.2732	0.0402	3.15x		
2			1.3353	0.0433	3.24		
3			1.3398	0.0436	3.25		
4			1.3486	0.0440	3.26		
5			1.2797	0.0416	3.25		
Mean					3.25	3.12	
Deviation					0.00		

* Blank determination for ash of silk: 0.13 per cent.
** See Table 12.

TABLE 23. (Continued)

Determination number	Mordanting bath: milliliter/gram fiber	Mordanting bath: pH	Fiber: gram	Ash: gram	Ash: percentage	Cr_2O_3: percentage	Barometric pressure: millimeter of mercury
1	200	2.24	1.2593	0.0337	2.68		739.0
2			1.2573	0.0335	2.66		
3			1.2699	0.0337	2.65		
4			1.2650	0.0334	2.64		
Mean					2.66	2.53	
Deviation					0.01		
1	250	2.34	1.2445	0.0263	2.11x		
2			1.2245	0.0271	2.21		
3			1.2319	0.0275	2.23		
4			1.2386	0.0276	2.23		
5			1.2660	0.0278	2.20		
Mean					2.22	2.09	
Deviation					0.01		
1	300	2.43	1.1456	0.0205	1.79x		
2			1.2160	0.0236	1.94		
3			1.1297	0.0214	1.89		
4			1.1470	0.0215	1.87		
5			1.2715	0.0237	1.86		
Mean					1.89	1.76	
Deviation					0.02		

TABLE 24. EFFECT OF WEIGHT OF FIBER ON FIXATION OF MORDANT FROM 600-MILLILITER BATH OF POTASSIUM DICHROMATE IN ONE HOUR AT BOILING

Determination number	Fiber gram	Ash gram	Ash percentage	Cr_2O_3 percentage	Barometric pressure millimeter of mercury
A. Cellulose-acetate rayon,* 2.0000 g. $K_2Cr_2O_7$ at pH 1.29.					
1	1.0400	0.0092	0.88		725.6
2	1.0480x	0.0086	0.82x		
3	1.0182	0.0089	0.87		
4	1.0149	0.0087	0.86		
Mean	1.0244		0.87	0.81	
Deviation	0.0104		0.01		
1	3.9753x	0.0297	0.75x		724.3
2	3.9945	0.0312	0.78		
3	4.0204	0.0314	0.78		
4	3.9818	0.0310	0.78		
Mean	3.9989		0.78	0.72	
Deviation	0.0143		0.00		
1	7.1025x	0.0465	0.65x		
2	7.0584	0.0506	0.72		
3	7.1416	0.0527	0.74		
4	7.2028	0.0525	0.73		
Mean	7.1343		0.73	0.67	
Deviation	0.0506		0.01		

* Blank determination for ash of cellulose-acetate rayon: 0.06 per cent.
x Rejected observation.

TABLE 24. (Continued)

Determination number	Fiber gram	Ash gram	Ash percentage	Cr_2O_3 percentage	Barometric pressure millimeter of mercury
1	9.8256	0.0661	0.67		724.3
2	9.8684	0.0694	0.70		
3	9.8278	0.0701	0.71		
4	9.7780	0.0669	0.68		
Mean	9.8247		0.69	0.63	
Deviation	0.0234		0.02		
1	12.9919x	0.0783	0.60x		
2	13.0983	0.0846	0.65		
3	13.0794	0.0858	0.66		
4	12.9896	0.0836	0.64		
Mean	13.0558		0.65	0.59	
Deviation	0.0441		0.01		
B. Nylon,* 1.5000 g. $K_2Cr_2O_7$ at pH 1.15.					
1	1.0002x	0.0354	3.54x		740.3
2	1.0105	0.0374	3.70		
3	1.0120	0.0388	3.83		
4	1.0192	0.0385	3.78		
5	1.0241	0.0381	3.72		
Mean	1.0164		3.76	3.44	
Deviation	0.0052		0.05		

* Blank determination for ash of nylon: 0.32 per cent.

TABLE 24. (Continued)

Determination number	Fiber gram		Ash percentage	Cr_2O_3 percentage	Barometric pressure millimeter of mercury
1	4.0288	0.1387	3.44		744.0
2	4.0301	0.1417	3.52		
3	4.0386	0.1447	3.58		
4	4.0639	0.1449	3.57		
5	4.0707	0.1405	3.45		
Mean	4.0464		3.51	3.19	
Deviation	0.0167		0.05		
1	7.1096	0.2187	3.08		744.0
2	7.1894x	0.2291	3.19x		
3	7.1856	0.2211	3.08		
4	7.2178	0.2236	3.10		
5	7.2683	0.2263	3.11		
Mean	7.1953		3.09	2.77	
Deviation	0.0477		0.01		
1	10.2688	0.2938	2.86		733.5
2	10.3690	0.3023	2.92		
3	10.4148	0.3107	2.98		
4	10.4232	0.3044	2.92		
5	10.4289x	0.2890	2.77x		
Mean	10.3690		2.92	2.60	
Deviation	0.0500		0.03		

TABLE 24. (Continued)

Determination number	Fiber gram	Ash gram	Ash percentage	Cr_2O_3 percentage	Barometric pressure millimeter of mercury
1	13.3047	0.3547	2.67		730.0
2	13.4020	0.3685	2.75		
3	13.4247	0.3665	2.73		
4	13.5095	0.3655	2.71		
5	13.5579	0.3580	2.64		
Mean	13.4398		2.70	2.38	
Deviation	0.0752		0.04		
C. Silk,* 0.5000 g. $K_2Cr_2O_7$ at pH 1.70.					
1	1.0190	0.0263	2.58		736.2
2	1.0198	0.0272	2.67		
3	1.0217	0.0267	2.61		
4	1.0238	0.0270	2.64		
Mean	1.0211		2.63	2.50	
Deviation	0.0017		0.03		
1	4.0741	0.0856	2.10		736.2
2	4.0963	0.0852	2.08		
3	4.1042	0.0856	2.09		
4	4.0759	0.0861	2.11		
Mean	4.0876		2.10	1.97	
Deviation	0.0126		0.01		

* Blank determination for ash of silk: 0.13 per cent.

TABLE 24. (Continued)

Determination number	Fiber gram	Ash gram	Ash percentage	Cr_2O_3 percentage	Barometric pressure millimeter of mercury
1	7.2079	0.1207	1.67		
2	7.1816	0.1200	1.67		
3	7.2328	0.1216	1.68		
4	7.2889	0.1186	1.63x		
Mean	7.2278		1.67	1.54	
Deviation	0.0330		0.00		
1	10.1822	0.1413	1.39x		732.5
2	9.9939	0.1424	1.42		
3	10.0925	0.1428	1.41		
4	10.1346	0.1427	1.41		
Mean	10.1008		1.41	1.28	
Deviation	0.0576		0.00		
1	13.2468	0.1586	1.20		
2	13.3527	0.1588	1.19		
3	13.3259	0.1595	1.20		
4	13.3288	0.1595	1.20		
Mean	13.3136		1.20	1.07	
Deviation	0.0334		0.00		

TABLE 25. EFFECT OF CONCENTRATION OF FIFTY-VOLUME MORDANTING BATH OF CHROMIUM ACETATE ON FIXATION OF MORDANT ON SILK IN ONE HOUR AT BOILING.

Determination number	Mordanting bath gram Cr_2O_3/ 100 g. fiber	pH	Fiber gram	Ash gram	Ash percentage of fiber	Cr_2O_3 percentage of fiber
1	0.2566	4.38	1.1957	0.0171	1.43	
2			1.1938	0.0180	1.51	
Mean					1.47	1.34
Deviation					0.04	
1	0.5132	4.42	1.2446	0.0261	2.10	
2			1.3705	0.0292	2.13	
Mean					2.12	1.99
Deviation					0.02	
1	0.7699	4.44	1.2636	0.0297	2.35	
2			1.2547	0.0300	2.39	
Mean					2.37	2.24
Deviation					0.02	
1	0.0265	4.45	1.2102	0.0317	2.62	
2			1.1964	0.0322	2.69	
Mean					2.66	2.53
Deviation					0.04	

TABLE 26. EFFECT OF INITIAL pH OF FIFTY-VOLUME MORDANTING BATH OF CHROMIUM ACETATE, 0.7000g. / GRAM FIBER, ON FIXATION OF MORDANT ON SILK IN ONE HOUR AT BOILING

Determination number	Initial pH of bath	Fabric	Ash		Cr_2O_3
		gram	gram	percentage of fiber	percentage of fiber
1	3.98	1.2068	0.0175	1.46	
2		1.3064	0.0191	1.49	
Mean				1.48	1.35
Deviation				0.02	
	4.38*				1.34
1		1.2666	0.0205	1.61	
2		1.2332	0.0204	1.68	
Mean				1.64	1.51
Deviation				0.04	
1	5.38	1.2228	0.0209	1.72	
2		1.1507	0.0197	1.70	
Mean				1.71	
Deviation				0.01	1.58
1	5.80	1.0357	0.0184	1.78	
2		1.0903	0.0189	1.73	
Mean				1.76	1.63
Deviation				0.02	
1	6.58	1.3154	0.0202	1.54	
2		1.3094	0.0202	1.54	
Mean				1.54	1.41
Deviation				0.00	

* See Table 25.

ACKNOWLEDGMENT

I wish to express my thanks to Dr. Rachel Edgar for her suggestion of the problem and my sincere gratitude for her guidance and patience throughout the work.

My thanks also go to the Biophysical Laboratory for the use of their pH meter.