A COMPARISON OF THE RELATION BETWEEN CERTAIN BODY MEASUREMENTS OF INDIVIDUALS AND THOSE SHOWN IN COMMERCIAL PATTERNS

by

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INTRODUCTION

The economic importance of a well fitted garment is a comparatively recent outgrowth of quantity production. Before the advent of the factory system clothing was custom made if not constructed by the home seamstress. In either event it was designed for and fitted to the individual who would wear it. Under the present system most patterns, and in an increasingly large number of cases, the garments themselves are made without knowledge of the individual who will use them.

For the consumer of clothing the expenditure of time and money does not always result in the greatest satisfaction because of the lack of standardization in sizes of patterns or of garments. Alterations necessary to fit the garment mean additional expense which will ultimately result in increased costs to the purchaser.

A study made by the Bureau of Home Economics shows that the problems of altering and fitting patterns, as well as ready-made garments, present more difficulty than do any others to women who do their own sewing. Wastes incurred in the attempt to gain a properly fitted garment are re-

sponsible for a considerable part of the 8½ billion dollar annual clothing bill of the United States (Campbell, 1927).

Class room use of commercial patterns has lead to the observation that wide variation exists among the different styles, in a given size of one make of pattern, as well as that a variation exists in the measurements among the several makes marked with the same size.

The ill fit of a garment is not generally distributed throughout the garment but is centered at some point of construction which may be the shoulder, armscye, hip, length of waist, or other point which involves attention. The shoulder line often requires changing because the slope of the shoulder varies among individuals and because there seems to be no standard of measurement which has generally been adopted by manufacturers of ready-made garments and of patterns.

The fit of the shoulder is basic. The shoulder line is fitted first as it determines the swing of the garment. It would seem that a conformity to a determined slope depth based on the average of a large number of measurements would result in fewer alterations of patterns or of garments bought ready-made.

The height of the sleeve cap frequently needs to be

lengthened in order to fit the top of the arm. A too shallow cap causes the sleeve to curve forward at the level of the armpit and folds to appear from the top of the sleeve to the underarm.

The width of the sleeve cap is frequently found to be too narrow for the width of the arm. This causes the sleeve to draw across the top above the level of the armpit. The establishment of a mean cap height and cap width would eliminate many sleeve fitting problems.

Recognition is given of the fact that wide variations in the physical measurements of persons would make impossible the complete elimination of alteration and fitting. It is believed that much could be done toward bringing about the adoption of proportions which more nearly conform to the measurements of the group to be fitted.

It has been felt that a relation may exist between the slope of the shoulder and height of the sleeve cap. If that relation can then be expressed mathematically a basis has been established whereby the fit of a garment may be checked. It is recognized that sufficient data to justify steps toward standardization cannot be presented in so brief a study as this is, but it is possible to point out the need for a further study of these garment proportions.

PURPOSE

The purpose of this study was to determine whether a relation existed between the slope of the shoulder and the height of the sleeve cap.

REVIEW OF LITERATURE

The study of human proportions, has long been a source of interest to man. Painters and sculptors have divided the body into imaginary systems of proportions called canons. Many of these canons are recorded in literature. In most of them some sort of relation is forced between the body and some unit of the body, such as the foot, hand, or head.

One of the earliest canons published is a Sancrit treatise entitled "Silpi Sastri", which has been traced to remote civilization in India. The author divided the body into 480 parts, the head being one-seventh of the whole. A canon, often referred to by the Greeks, was one established by Polycletus about 400 B. C. He made a statue called the "Spearbearer" according to his system and wrote

a paper on human proportion, neither of which has survived (O'Brien, 1930).

Through the science of human proportions, called anthropometry, many body measurements have been recorded. The procedure and equipment have been defined but no definite relation has been established between them and the measurements for garment sizes.

In recent years investigators have measured the body for various purposes. Unfortunately, with few exceptions these studies have been made by people untrained in anthropometry or statistics, and the figures recorded are practically useless. From the standpoint of the clothing industry, according to O'Brien (1930) the data which have been collected by anthropometrists who have done reliable work prove of no value since the body landmarks used by them are entirely different than those used in garment construction.

The measurement of the human body for the mass production of clothing had its beginning during the Civil War. The height and chest measurements were taken to form a basis for uniform construction and were later used for civilian garments (Nystrom, 1928).

During demobilization after the World War, Ireland,

Davenport and Love (1921) directed the measuring of 100,000 men. The measurements taken were those necessary for uniforms. They were scientific in that standardized equipment was used and each measurement was taken according to a set standard. It is the first report of physical measurements published with clothing construction definitely in view.

In more recent times an attempt has been made to find the number of head lengths in the average woman's figure. A group of 350 women were measured by Goldstein and Goldstein of the University of Minnesota. It was found that there were 7.5009 head lengths in the average woman's height (Goldstein, 1928).

The investigation of physical proportions is now being directed toward the comparison of those measurements to the measurements of commercial patterns or ready-to-wear garments. Great difficulty is experienced in the fitting of garments due to the lack of standardization of sizes.

That there was a great need for the standardization of garment sizes is emphasized by the expression of an organization in close contact with trends in clothing consumption. "The Bureau of Home Economics is convinced that the only way to remedy the situation is to conduct a sci-

entific nation wide study of body measurements to give a basis for standardization of pattern sizes" (O'Brien, 1929).

Clayton and Phelps (1926) found that the maximum differences in size of patterns were found to be 4.75 inches in the center front and approximately 2 inches width at chest and bust. Another significant difference appeared in the length of the shoulder seam which varied nearly 1 inch. Differences in sleeve measurements were also noteworthy. There was a difference of 1.13 inches in the depth of the sleeve cap, equal to 25 percent of the total depth of the cap in one pattern.

Dunn and Cranor (1927) in a later study measured 11 makes of commercial patterns ranging in size from 32 to 42 inches bust measure. They observed that the measurements indicated on the patterns frequently did not correspond with actual measurements of the patterns, and that these measurements are not the same in all makes of patterns. Measurements varied both in different sizes of patterns of the same make, and in patterns of the same size but of different makes.

In a comparative study of the measurements of 563

women and 130 commercial patterns a wide variation in the measurements of patterns of the same size and of various makes was found to exist, the variation being greater in the case of girls' and misses' patterns than in the case of women's patterns. The patterns did not agree with either the median or the maximum physical measurement as to rate of increase of size. The variations and discrepancies observed in the patterns studied justified the complaints frequently voiced by users of the commercial patterns (Little, 1928).

The mature figure was studied by Morgan (1931) and found to have a typical distribution of body mass which was expressed in terms of the norm for each body measurement taken. The analysis revealed the greater percentage of individual measurements of both groups to cluster about the norm of the corresponding size. Large deviations were the exception rather than the rule. The pattern study revealed the corresponding measurements of the same size varied in different makes of the patterns. Patterns of the same make did not show consistent increase of the same measurement in different sizes.

La Fleur (1931) found in her measurement study that the least variation was in the size of the shoulder. In

no case studied was it found to deviate more than one-half inch from the median shoulder. She found that the deviation was most marked in the waist and hip measurements. Her pattern study indicated that patterns of the same size, but different makes varied in actual measurements, that the measurements printed on the pattern envelope did not correspond to actual pattern measurements, and that certain measurements such as shoulder and chest which should remain the same for all patterns even though other parts are affected by the style of the garment, were not the same in commercial patterns.

A study of the measurements of 8 commercial patterns by Eddy and Wiley (1932) deals with the depth of the shoulder of both the back and front of the pattern, and with the height of the sleeve cap. They found that the depth of the front shoulder varied from 1.25 to 1.88 inches, and the depth of the back shoulder from 1.5 to 2.5 inches. The cap depth was found to vary from 5 to 5.5 inches.

The standardization of commercial dress pattern sizes has progressed to the extent that certain standardized measures were to become effective January 1, 1930. Pattern sizes from 34 to 50 inches bust measure were to have definite waist and hip proportions. These standard-

ized measurements were accepted by a large group of users and manufacturers of commercial patterns. The recommendations may not coincide with anthropometric measurements but were rather a practical compromise between such measures and those of pattern manufacturers. The approximate dimensions were to suit the average figure and adjustments made to the individual figure (Commercial Standards, 1929).

Jordan (1928) states that in constructing the front shoulder line of a garment the shoulder at the neck should be 2 inches higher than the shoulder at the armscye.

In a study (unpublished) undertaken to determine the relation between the slope of the shoulder in front to the slope of the shoulder in back, 22 women of college age 31 to 35 inches bust measure and 16 mature women were measured. The mean shoulder slope for the college group was found to be in the ratio of 1:3.83 and in the mature group was found to be 1:3.30. The groups were too small to give sufficient data to draw definite conclusions but they may be thought of as a preliminary step in determining the slope relation. (Anderson, paper in departmental files).

The findings reported in these studies have a bearing of more or less importance on the purpose of the investiga-

tion as stated. Few writers have been concerned with the measurements needed to express the relation between shoulder slope and cap height. Mention is made of the depth of the shoulder by Jordan, Little, and by Eddy and Wiley. The cap height is a measure recorded in most recent studies dealing with pattern measurements. There is yet to be found an investigation dealing with the relation of the cap height to the shoulder slope.

PROCEDURE

The procedure followed in this study consisted of measuring 100 women of college age varying between 31 and 34 inches bust measure, 110 to 130 pounds in weight, and in height from 61 to 65 inches and comparing their measurements with similar ones of four commercial patterns.

The height was taken with the subject in stocking feet as she stood erect with the heels touching the wall surface. A 60 inch double stitched cloth tape-measure held in place 12 inches from the floor was used as a gauge for determining height. This tape was found to be accurate when compared with a standard linear measure. A square placed against the tape and lowered to the top of the head

indicated the exact height of the subject.

The weight was taken on a Continental scale with the subject clad in the usual amount of clothing but without shoes, or was obtained from the Physical Education examinations charts.

All the measurements were taken and recorded by the investigator. The tape measure used for the body measurements was of Swiss make, a cloth tape finished with a composition to increase its durability. Metal ends finished the tape. The accuracy was checked with a standard linear measure and was found to be .0001 percent longer than the standard. It was recognized that this discrepancy was of minor importance since the human element in the taking of measures is no doubt responsible for a much greater percent of error.

All location lines were marked on the body by means of a soft pencil. Only those measurements having a definite bearing upon the investigation were recorded, and were taken in the logical order of their progression. The following measures were recorded in Table I:

1. Neckline
2. Shoulder line
3. Shoulder to under arm in front
4. Shoulder to under arm in back
5. Chest line
6. Chest to shoulder at armscye

7. Chest to shoulder at neck
8. Arm circumference
9. Height of cap to shoulder
10. Width of cap
11. Cap height from width of cap to shoulder
12. Outer arm length
13. Inner arm length
14. Width of back
15. Width of back to shoulder at armscye
16. Width of back to shoulder at neck

The measurements taken were made according to the plan outlined by the Clothing and Textiles Department of the Kansas State College.

Bust line. The bust measure was taken with the investigator directly behind the subject. The tape measure was placed over the tips of the bust, under the arms, and raised slightly to pass over the tips of the shoulder blades.

Neckline. The neckline was located by placing the tape around the base of the neck (where the neck joined the shoulders), and allowed to pass above the large bone at the base of the neck and dropped to the middle of the pit in the front of the neck.

Shoulder line. With the head erect and face forward, the length of a pencil was placed on the crest of the bone behind the ear. The pencil was held so that it was parallel to the back contour line of the neck and touched the neckline. The shoulder line had its beginning at that

point and extended at right angles to the armscye. A point ½ inch back of this connected with the point at the neck formed the shoulder line.

Armscye line. The thumb and forefinger were placed on either side of the top of the ball of the arm as it swung in its socket. Lines were dropped from these points of articulation parallel to the center front and center back to the points where the arm left the body. Curved lines were used to continue the armscye to a point 1½ inches below the highest point of the armpit. The front armscye was measured from the underarm line to the shoulder line in front, and the back armscye was measured between the same points on the back.

Chest line. The chest line was located by bisecting the front armscye and measuring the distance between the two points.

Chest to shoulder at armscye. The bisecting of the front armscye gave the chest to shoulder at armscye measurement.

Chest to shoulder at neck. A line was dropped from the shoulder at the neck perpendicular to the chest line to give the chest-to-shoulder-at-neck measurement.

Arm circumference. The tape measure was placed 1½

inches below the normal pit of the arm with the arm held at right angles to the trunk. The arm was dropped to the side and the tape was placed around the arm parallel to the floor. One and one-half inches were added to allow for ease of movement.

Cap width. The width of the cap was determined by establishing a line parallel to the arm circumference through the intersection of the chest and front armscye to the back armscye. One inch allowance for movement was added to this measure.

Cap height. The height of the cap was determined by erecting a perpendicular from the line which marks the arm circumference to the highest point on the armscye. This distance was the cap height. The distance from the cap width to the armscye was chosen as the cap height for the calculation as most variations in cap height occur above the width of the cap. A tolerance of $\frac{1}{2}$ inch as is allowed for body movement was not included.

Outer arm length. The outer arm measure was taken from the point of intersection of the shoulder line and the armscye line over the elbow bent at right angles, to a point directly below the bone at the wrist.

Inner arm length. The length was measured with the

arm extended at right angles to the body, and was taken from a point 1½ inches below the normal pit of the arm to the junction of the wrist and thumb.

Width of back. The width was determined by measuring the distance between the point on each arm which marks the intersection of the sleeve cap width and the back armscye.

Width of back to shoulder at armscye. The distance from the width of the back to the shoulder at the armscye gives this measurement.

Width of back to shoulder at neck. A line was dropped from the shoulder at the neck perpendicular to the width of the back to give this measurement.

A summary of the measures of the 100 subjects as minimum, maximum and mean may be found in Table II.

Table I. Body measurements (in inches) of one hundred college women.

Subject	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Age (years)	26	20	20	19	19	20	18	29	21	21	20	19	19	25	22	19	19	20	18	18	24	19	19	19	21
Weight (pounds)	113	115	113	110	110	124	110	113	110	110	118	112	114	110	110	110	110	110	110	110	119	110	110	111	110
Height (inches)	64	62.5	63	63.5	64.5	64	62.75	63	63	64	62.75	63	65	63.75	62.75	63	61	65	64	65	64.75	65	65	63	63.5
Bust	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	32	32
Neckline	14	12.75	13.5	13.5	13.5	13.75	12.5	13.25	13.25	13.25	13	14	14.5	13	13.5	13.75	12.5	13	13	13.5	13.5	13.25	13.5	13.5	14
Shoulder line	4.5	4	4.5	4.5	5.12	4.12	4.25	4.5	3.75	4.25	4	4.5	4.75	4.75	4.5	3.75	4.36	5	5.25	4.5	4.6	4.25	4	4.5	4.88
Shoulder to underarm in front	8	8.	7.5	7.75	7.5	7.5	7.25	7.75	7.5	7	7.5	7.5	7.5	8.25	7.5	7.5	7.25	7.5	7.5	7.5	7.5	8	7.5	7.25	7.5
Shoulder to underarm in back	7.5	4	7.25	7.25	7	7.5	7	7.5	7.25	7.25	7.25	7.25	7	7	7	7	7	7	7	7	7.25	8	7	7.25	7.5
Chest line	12	11.75	11.75	11.25	11.12	12.5	11	12	11.25	11.75	11.25	11.75	11.36	12.6	12.75	11.75	13.5	12.5	13.5	13	12.5	12.36	11.5	11.75	12
Chest to shoulder at armscye	4	3.36	3.75	3.88	3.75	3.75	3.6	3.88	3.75	3.5	3.75	3.75	3.75	4.12	3.75	3.75	3.6	3.75	3.75	3.75	3.75	4	3.75	3.6	3.75
Chest to shoulder at neck	4.75	4.25	4.25	4.6	4.75	4.6	4.25	4.88	4.25	4.12	4.75	4.75	4.75	4.6	4.6	4.36	4.5	4.75	5	4.5	5	4.75	4.6	4.5	4.36
Arm circumference	11.5	11.5	11	10.5	10.5	12	11	10.5	11.5	11.25	12.5	11.5	11.5	11.25	11.25	11.5	11.5	11.5	10.5	11	11	11.5	10.5	10.75	10.25
Height of sleeve cap to shoulder	5.25	5.5	5.36	5.5	5.5	5.75	5.75	5.75	5.12	6	5.6	5.24	5	5.5	5.12	5.5	4.75	5.36	5.5	5.5	5.12	5.12	5.75	5.6	5.75
Width of sleeve cap	6.5	6.5	6.5	6.6	6.5	7	6.36	7.25	6.36	6.25	7	7	6.75	6.75	6.75	6.36	6.6	7	6	6.75	6.5	6.75	6.25	6.25	7
Cap height from width of cap to shoulder	3	2.5	2.25	2.6	2.5	3.12	2.75	3.36	2.6	3	3	2.75	2.5	2.88	3.12	2.75	3	2.88	2.75	3	2.75	2.75	3	2.5	2.75
Outer arm length	23	23	23.5	23.75	24	24.5	23.5	25	24.5	25.5	24.5	24	24	25	22.5	23.5	22	24.5	23.5	23.5	25	23.5	23.5	24.5	25.5
Inner arm length	17	16.25	17	17.75	17.36	17.5	18	18.5	19.25	19.25	18	18	18	18	16.75	17	16.5	18.5	18	17	19	18	17.5	17.5	18.5
Width of back	12.75	12	11	13.5	14.25	12	13.5	11.25	12.25	12.5	13.5	14	13	11.24	12.25	12.25	11.5	13	11.5	12.6	13.75	13	13.5	12.5	12
Width of back to shoulder at armscye	3	4	3.25	3.5	2.75	4	3.25	4	3.12	4.25	4	3.6	3.25	3	3.75	3.12	3.5	3	3	4	3	4	3	3	3.25
Width of back to shoulder at neck	6	5.88	4.36	6	5.75	5.88	5.25	6.75	5.25	6	6.12	6.25	5.75	5.75	6.6	5.5	6.25	5.75	6	6.75	6	6.25	5	6.25	6.25

Table I. Continued.

Subject	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
Age (years)	21	22	21	23	19	18	21	18	19	19	19	19	18	21	20	20	20	22	19	22	20	20	18	19	19
Weight (pounds)	127	116	116	115	118	110	130	115	110	110	118	110	112	120	110	120	110	120	126	115	125	123	112	113	110
Height (inches)	64.75	63	65	64.5	65	62	65	63	62	61.5	62	63	63	64.5	62	64	62.75	65	65	65	63.25	63.25	62	62	62
Bust	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32
Neckline	13.25	12.25	14	13	13.5	13.25	13.75	14	13.5	12.75	14.25	13	13	13.75	13.5	14	13	14	13.75	14	13.5	14	14	13.5	13
Shoulder line	4.5	4.25	4.75	3.75	5	4.5	4.75	4.5	4.5	4.5	4.12	4.36	4.25	5	4	4.6	4.12	4.6	4.6	4	4.5	4.25	4.12	4.5	5
Shoulder to under-arm in front	7.5	7.5	7.5	7.5	8	7.25	7.75	7.5	8	7.5	7.5	7.5	8	8	7.25	7.5	7	7.5	8	7.5	8	7	7.5	8	7.5
Shoulder to under-arm in back	8	7	7.12	7.75	7.75	7	7.5	6.5	7	7	7.25	7	7.5	7.5	7	7.5	7	7.5	7.25	7.25	7.5	7.5	7.5	7.5	7
Chest line	13.25	11.12	12.6	12.25	13	11.6	12.88	12.25	12.5	12.5	11.5	12.12	11.75	12.6	12	12	11.6	13	12	12.25	13	12.25	10.75	12.5	11.12
Chest to shoulder at armscye	3.6	3.75	3.75	3.75	4	3.6	3.88	3.75	4	4	3.75	3.75	4	4	3.6	3.75	3.5	3.75	4	3.75	4	3.5	3.75	4	3.75
Chest to shoulder at neck	4.5	5.12	4.5	4.75	5	4.75	4.5	4.75	4.88	4.12	4.5	4.36	5.25	4.75	4.25	4.5	4.12	4.5	5	4.36	5.12	4.25	4.5	5	4.75
Arm circumference	11.5	11	10.75	10.75	11.75	11.5	12	11.25	11.5	11.25	11.5	11	12	11.25	11.5	11.5	10.75	11	11.5	11.5	12.5	11.5	11.75	12	10.5
Height of sleeve cap to shoulder	6	6	5.5	6.25	6.12	5.36	5.12	5	5	5	5.5	4.75	5.6	5.88	5.5	5.25	5.12	5.5	5.25	5.75	5.75	5.5	5.25	5.25	5.12
Width of sleeve cap	6.75	6.5	6.75	6.6	7.25	6.6	6.75	6.5	6.88	6.25	7	6.75	7.12	6.75	6.5	7	6.12	7	6.5	6.75	6.88	6.36	6.75	6.75	6.5
Cap height from width of cap to shoulder	3.25	3	2.75	3.12	3.12	2.75	2.75	2.88	2.6	2.6	2.75	2.75	3.12	3	2.75	3	2.5	3	3	2.75	2.75	2.5	2.5	2.75	2.5
Outer arm length	25.5	24.5	25.25	23.75	25	23.5	25.5	23	24.25	23.75	24.75	24	24.5	25	22.5	24	23.5	24.5	24.5	25	23.5	24	23	22	22
Inner arm length	19.24	17.75	19.5	18	19.25	18	19.5	17.25	18	17.5	18	18.5	17	19	16.5	18.5	17.5	17.5	18.5	19.5	17.5	18	17	17	16
Width of back	12.12	13.5	13	12	12.75	13.5	13.6	13.75	13	13	14.5	13.6	14	14.75	12.25	13.75	13.36	13.6	13.75	12.25	14	13.36	13.12	13.75	14.25
Width of back to shoulder at armscye	4.25	3.75	4	3.75	3.88	3.36	3.5	3.25	3	3	3.25	3.5	4	3.25	3.25	3.5	3	3.75	3.6	3.5	3.25	3.36	3	3	2.75
Width of back to shoulder at neck	6.75	6.12	6.75	6	6.88	6.25	6.26	5.5	5.36	5.25	5.5	5.75	6.25	6.25	6	6	5	6.25	6.25	6.25	5.75	5.5	5.6	5.75	5.12

Table I. Continued.

Subject	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
Age (years)	19	19	20	19	27	25	22	21	20	29	20	20	21	20	19	19	24	19	21	21	19	20	18	21	21
Weight (pounds)	110	115	127	117	125	128	126	128	126	129	120	115	125	117	110	124	115	110	110	115	130	116	117	130	129
Height (inches)	61	62	65	64	62	63.75	64.5	65	63	61.75	64.5	62.75	64	63.5	62.5	65	62.25	64	63	64.5	65	63	63.75	63.5	65
Bust	33	33	33	33	33	33	33	33	33	33	33	33	33	33.5	33	33	33	33	33	33	33	33	33	34	34
Neckline	13.5	14	14	13	13.5	13	14	14.5	13.5	14	13.25	13.25	14	13.25	12.5	13.5	13.5	13	13.25	13.25	13.5	13.75	13.5	14	15
Shoulder line	4.5	4.5	4.75	4.75	4.88	4.75	4	4.75	4	4.75	4.25	4.25	4.25	5	4.6	4	4.38	4.5	4.6	4.5	4.75	5.12	5.12	4.75	4.5
Shoulder to underarm in front	7.5	8.5	7.75	7.75	8	8.25	7.75	8	7.75	8	7.5	7	8	7.75	7.75	7.5	7.5	8	7.25	8	8	7.5	8	7.75	8.5
Shoulder to underarm in back	7	7	7.5	7.5	7.5	8	7.25	8	7.25	7.75	8	7.5	7.25	7.5	6.75	8	7.75	7.75	7.5	7.5	7.25	7.5	7.5	8.5	7.5
Chest line	11	12	12.75	12	12.5	12	12.75	13.75	12.6	14.88	13.25	11.25	12.12	12.25	12.36	13.5	12.75	12.25	12	12.75	12	12.75	13	12.25	11.36
Chest to shoulder at armscye	3.75	4.12	3.36	3.88	4	4.12	3.88	4	3.88	4	3.6	3.5	4	3.88	3.88	3.75	3.75	4	3.6	4	4	3.75	4	3.88	4.25
Chest to shoulder at neck	4.36	5.5	5	4.75	5.12	5.88	4.5	4.75	4.6	5.12	4.25	4.12	4.5	5.12	4.75	4.25	4.25	4.75	4.5	4.36	4.6	5	5.25	5.25	5
Arm circumference	12	10.75	11.5	11.25	12.5	12.5	11.75	11.5	13.5	11.5	11.5	11.5	11.75	12	11	11.75	12.25	11	11	11.5	12.5	11.5	11.75	12.5	12
Height of sleeve cap to shoulder	5.25	5.75	5.6	5.5	5.25	6	5.88	5.6	5.75	6.25	6.25	5.5	5.75	5.75	5.25	5.88	5.35	5.5	5.12	6	5.25	5.36	5	5.75	6.25
Width of sleeve cap	7	6.5	6.5	6.75	6.75	7.25	6.6	7.25	7	6.75	7	6.75	6.5	7	6	6.75	6.88	6.5	6.5	7	7	6.5	6.5	7.25	7
Cap height from width of cap to shoulder	3	2.75	2.75	2.88	3	3	3.12	3.12	2.6	3.12	3.75	2.75	2.75	3	2.6	2.75	3	2.75	2.75	3	2.6	3	3	3.25	3
Outer arm length	23	22	24.5	24	23	25	24.5	25.5	23.5	24.5	25.75	24	25.5	25	24	25	23.5	24	24.75	25	24.5	23.5	23	25.5	23.75
Inner arm length	16	16	17	17	16	18	19	19.5	17.5	18	19	18	19	19	18	19	17.75	18	18	19	17.5	17	17.36	17	18
Width of back	12	13	14.5	12.6	13	15	12.88	14	14.12	14.25	13.25	13.75	13.88	14.5	13.25	11.75	14.25	13.36	13	12.5	14	14	14	14.5	14.5
Width of back to shoulder at armscye	3.25	4	3	3.25	3.5	3.5	3.75	3.5	3.6	3.5	4	3.5	3.12	3.88	3.25	3	3.26	3.88	3.75	3.5	3	3	3	4	2.75
Width of back to shoulder at neck	6.25	6.25	5.5	6	6.25	6	6	6.25	6.25	6	5.75	5.75	5.8	6.75	5.12	5.25	5.5	6.6	6.25	5.75	5.88	5.75	6.36	7	5.75

Table I. Concluded.

Subject	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
Age (years)	22	22	18	21	18	18	19	18	18	20	20	18	21	19	20	20	21	21	19	19	20	22	20	19	20
Weight (pounds)	125	116	125	128	130	125	130	130	127	124	124	110	130	128	123	130	116	129	130	127	130	130	130	130	130
Height (inches)	64.75	64.5	65	63.5	64.75	61.5	63.5	64	64.5	63.5	63	64.5	64	64.5	64	64	62	61.5	55	64	65	62	63	65	63.75
Bust	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34	34
Neckline	13.75	13	14	13.5	14	13.25	14.25	13.5	14	14	13.5	13	14.25	13.75	13.75	14.5	13.75	13.5	13.5	14	14.5	13.5	14	14	13.25
Shoulder line	4.12	4.36	4.25	4.36	4.5	4.5	4.5	5	4.12	4.88	4.36	4.75	4.36	4.36	4.75	5	4.5	4.5	4.36	5	4.75	4.75	5	4.36	4.25
Shoulder to underarm in front	8	7.25	7.75	7.75	7.5	8	8.5	8.5	7.5	8	7.5	7.75	7.5	7.5	7.5	8	7.5	8.5	7.5	8.5	8.5	8.5	8.5	8	8
Shoulder to underarm in back	7	7	7.5	8	8	7	8	7	7.5	7.5	8	7	7.25	7.25	7.25	7	7	8.	7.5	8	7.5	8	7	8	7.5
Chest line	13.5	13.25	12	13.6	13	12.75	12.5	13.25	13	12.75	11.88	12.75	11.75	12.6	13.6	13	12	12.25	13	13	12	13.5	12.12	13	13.25
Chest to shoulder at armscye	4	3.6	3.36	3.88	3.75	4	4	4	3.75	4	3.75	3.88	3.5	3.75	3.75	4	3.75	4.5	3.75	4.25	4.25	4.25	4.25	4	4
Chest to shoulder at neck	4.5	4.36	4.5	4.5	4.5	4.5	5.25	4.6	4.5	5.5	4.25	4.75	4.36	4.5	4.75	5	5	5	4.75	5.12	5.12	5	5.25	5	4.5
Arm circumference	12	11.5	12.5	12.75	11.75	12.5	12.5	12.5	12.5	12.5	12	10.5	11.5	12	11.5	11.5	11.75	13.5	12.5	12	12.5	13	12.5	12.5	12.5
Height of sleeve cap to shoulder	6	5.75	5.25	5.75	5.6	5.6	5.75	5.25	6	5.25	5.36	5.5	5.6	5.6	4.88	5.25	5.25	5.6	5.5	5.75	5.75	5.5	5.5	5.6	6
Width of sleeve cap	7	6.36	6.88	6.6	7	6.25	7	7	7	7	7	6.88	7	7	6.75	6.5	6.88	7.75	7	7.25	6.75	7.5	7.25	6.88	6.75
Cap height from width of cap to shoulder	3	2.6	2.75	3	3.12	2.88	2.75	3	3	2.75	2.36	2.88	3	3	2.5	2.75	3.25	3.25	2.88	3.25	2.75	3.5	3	3	2.75
Outer arm length	24.5	25.5	24.25	24	25.75	24	25.5	24	24.5	24.25	23.5	25	24	24.5	24.5	25	23	22	25.5	24	24.5	25	23.5	25	25
Inner arm length	18	19	18.75	17.25	19	18	18.5	18	18	18	18.5	18.75	17	18.5	18.5	18	17	16	18.5	17.5	18.5	18	17	18	19.5
Width of back	12	13.36	13.36	13.75	14	12.5	13.75	13	12.75	14.6	13.36	13.88	16	14	13.25	14.5	14.12	13.75	13	14.25	16.12	12	15.36	14.75	13.12
Width of back to shoulder at armscye	3.5	3.5	3.75	3.5	4	4	3.5	4	3.6	3.25	3	3	3.5	3.6	3.12	3	3.75	3.75	3.5	3.5	2.75	4	3	3.5	3
Width of back to shoulder at neck	5.88	6	6.5	6.36	6.36	5.88	5.88	6.5	6.6	5.75	5	5.75	6	6	5.5	6.12	6.75	6.12	5.75	6.5	5.75	6.88	6	6	5.12

Table II. The minimum, maximum and mean measurements of one hundred college women.

	Min.	Max.	Mean
Age (years)	18	29	20
Weight (pounds)	110	130	120
Height (inches)	61	65	63.5
Bust	31	34	33
Neckline	12.25	15.	13.55
Shoulder line	3.75	5.25	4.88
Shoulder to under-arm in front	7.25	8.5	7.7
Shoulder to under-arm in back	6.5	8.5	7.37
Chest line	11	14.88	12.33
Chest to shoulder at armscye	3.5	4.25	3.84
Chest to shoulder at neck	4.12	5.25	4.7
Arm circumference	10.25	13.5	11.51
Height of sleeve cap to shoulder	4.75	6.25	5.52
Width of sleeve cap	6	7.75	6.83
Cap height from width of cap to shoulder	2.5	3.72	2.86
Outer arm length	22	25.75	23.7
Inner arm length	16	19.5	17.94
Width of back	11	16.12	13.31
Width of back to shoulder at armscye	2.75	4.25	3.5
Width of back to shoulder at neck	5	7	5.99

A preliminary study had been made of 25 fitted muslin dresses having set in sleeves to determine the position of the width of the back line. A line was drawn through the underarm seam of the sleeve at the armscye following a thread of the material. This line marked the base of the cap. The sleeve cap height was indicated as a perpendicular erected from the base of the cap to the highest point on the armscye. The width of the sleeve cap was placed $\frac{1}{2}$ inch above the mid-point of the sleeve cap height. Through this point a line was drawn parallel to the base of the cap. The distance from the intersection of the cap width and back armscye to the shoulder was measured. The measurement found was compared to one-half the back armscye. In no case did the width-of-the-back-line vary more than .75 inch from the mid-point of the back armscye, while in three fifths of the cases the points coincided.

Four commercial patterns of size 34 inches bust measure designated by Pattern I, II, III and IV, and varying in price from $0.15 to $0.75 were chosen for comparison with certain proportions of 100 college women. The patterns were of simple line, without shoulder or underarm darts, and having set-in sleeves. The style was similar in

each pattern. The selection of the size of the pattern was on the basis of bust measure rather than age in years as the selection of the group of subjects was based in part on the bust measure. Size 34 inches bust measure was chosen because the width of the back and the chest lines corresponded more closely to the mean width of the back and the chest line. It was found that some makes of patterns do not offer a size 32 inch bust measure but offer the design in the misses size range.

All parts of the patterns not having a definite bearing upon the investigation were discarded.

After the removal of seam allowances, lines were marked on the pattern to correspond with the established lines on the figure. The chest line was drawn through the mid point of the front armscye perpendicular to the center front. Perpendiculars from the shoulder at the neck and at the armscye were dropped to the chest line. A line was drawn through the shoulder at the armscye parallel to the chest line, forming a right angled triangle. At the base of the sleeve cap a horizontal line was drawn passing through the armscye at the underarm seam. A perpendicular was erected to the highest point on the cap and became the

entire cap height. The cap width was drawn parallel to the base and $\frac{1}{2}$ inch above the mid-point of the sleeve cap height. These measurements were recorded in Table III, and a summary showing the minimum, maximum and mean is to be found in Table IV.

Table III. The measurements (in inches) of four commercial patterns.

Pattern	I	II	III	IV
Size	34	34	34	34
Shoulder line	4.6	5.15	4.5	4.5
Shoulder to underarm in front	8.25	7.36	7.75	8.88
Shoulder to underarm in back	7.75	7.36	7.75	7.75
Under arm line to waist line	9.25	7.88	8	7.6
Chest line	14	12.6	13.36	13.25
Chest to shoulder at armscye	4.12	3.73	3.88	4.4
Chest to shoulder at neck	5.88	6.12	5.68	5.5
Width of backline	14	12.88	13.75	14.5
Shoulder to width of backline at armscye	3.75	3.68	3.75	3.75
Shoulder to width of backline at neck	5.75	5.68	5.75	5.75
Waist line	32	31	37.25	35.5
Sleeve length	25	23	24	24.25
Cap length	5	4.25	5.44	5.25
Cap width	6.25	5.6	6.5	6.25

Table IV. The minimum, maximum and mean measurements (in inches) of four commercial patterns.

	Min.	Max.	Mean
Size	34	34	34
Shoulder line	4.5	5.15	4.69
Shoulder to underarm in front	7.36	8.88	8.06
Shoulder to underarm in back	7.36	7.75	7.65
Underarm line to waist line	7.6	9.25	8.18
Chest line	12.6	14	13.30
Chest to shoulder at armscye	3.73	4.4	4.03
Chest to shoulder at neck	4.74	6.12	5.5
Width of backline	12.88	14.5	13.78
Shoulder to width of backline at armscye	3.68	3.75	3.74
Shoulder to width of backline at neck	5.68	5.75	5.73
Waist line	31	37.25	33.93
Sleeve length	23	25	24.06
Cap length	4.25	5.44	4.98
Cap width	5.6	6.5	6.15

INTERPRETATION

In order that a comparison might be made between certain body measurements, as well as between body measurements and those of commercial patterns, it was necessary to apply some measure of central value to the physical measurements collected. The arithmetic mean seemed to be the measure which would be of greatest value since previous studies have shown that physical measures vary only slightly from this norm (La Fleur, 1931). This makes improbable the occurrence of cases showing extreme deviations from the average which would unduly affect the mean.

It was assumed that the shoulder slope as measured on the front of the subject was indicative of the back shoulder slope. It is recognized that the difference in the slope of the front and back shoulder will vary with square shouldered and sloping shouldered figures. The slope may also be affected by the posture of the subject. The mean of a large number of measurements made up of all types of figures would tend to lessen the importance of the few values which showed wide variation from the central tendency and would necessarily be of value in drawing con-

clusions. In the preliminary study made by Anderson to which reference has been made, some indication of the relation between the front and back shoulder slope is given. As a result of her study of certain measurements of 38 subjects she found that the mean depth of the front shoulder and the back shoulder was in the ratio of 1:3.5.

With the establishment of a relation between the depth of the front and back shoulder either shoulder depth might be compared with the height of the sleeve cap to determine whether a relation may exist between these two measures.

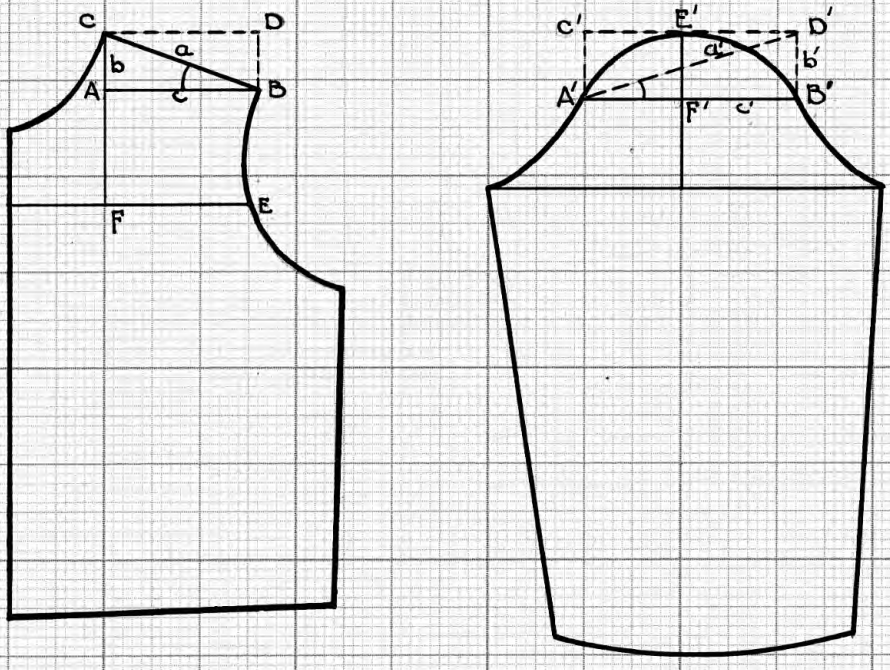
In this investigation, however, a comparison was made of two right angled triangles, one made by the front shoulder line and its depth, and another made by the length and width of the sleeve cap. Figure 1 illustrates the waist front and the sleeve used in the study and presents graphically the means of comparison. Figures 2 and 3 present a comparison of the four commercial patterns with the mean proportions of 100 subjects.

To find the slope of the shoulder, a line from the top of the shoulder at the neck was drawn perpendicular to the chest line and expressed by C F. A line from the tip of the shoulder was also drawn perpendicular to the chest line

and was expressed by B E. A line from the top of the shoulder at the armscye was drawn parallel to the chest line and expressed by A B. A line C D from the shoulder at the neck was drawn parallel to A B. Line B E was extended to meet C D at D.

In the rectangle formed by lines A B, A C, C D, and D B, the shoulder line C B was the diagonal of the rectangle and hypotenuse of the right angled triangle. This was expressed by a. Line A C represented the depth of the shoulder line and was expressed by b. The shoulder line formed angle A B C which may be measured by the ratio of its opposite side b, to its adjacent side c. In the present study this ratio defines the "slope of the shoulder".

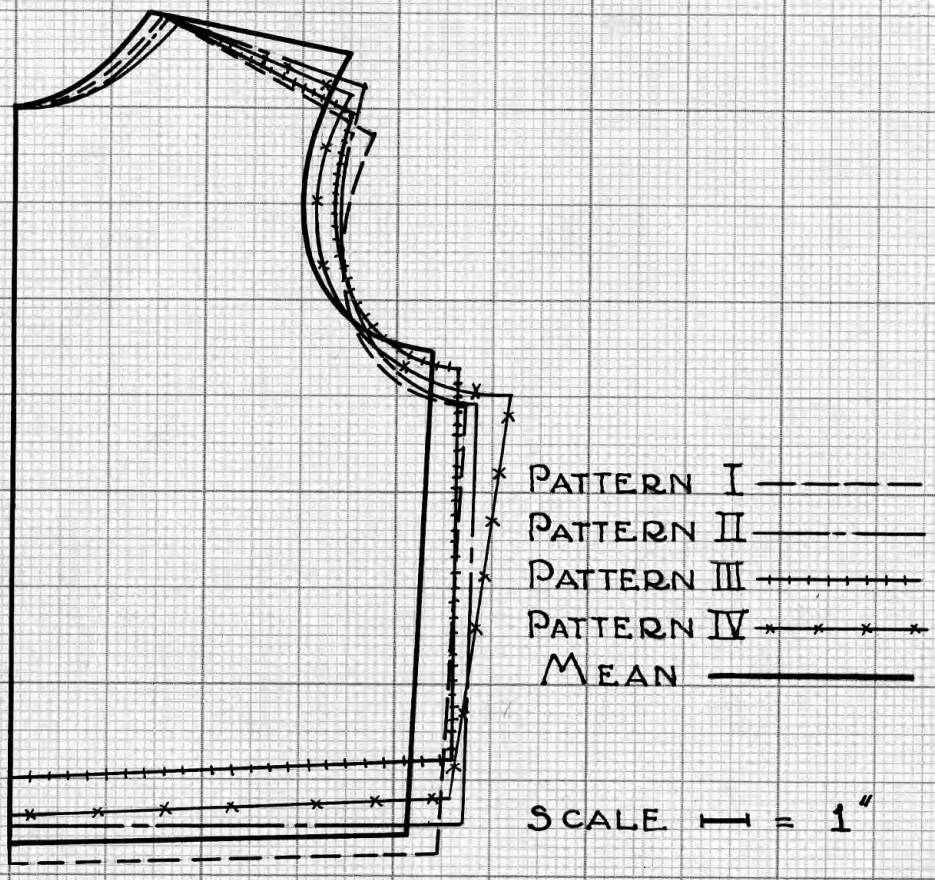
The width of the cap of the sleeve was drawn so as to coincide with the chest line and was expressed by A' B'. The height of the cap E' F' was drawn perpendicular to A' B' at the highest point on the sleeve cap. A rectangle was then constructed with A' B' as its base and E' F' as its height. The diagonal A' D' of the rectangle A' B' C' D' formed the angle D' A' B' which is measured by the ratio of B' D' to A' B' or by b' to c', and is designated as the "height of the cap".



WAIST FRONT SLEEVE

FIGURE 1.

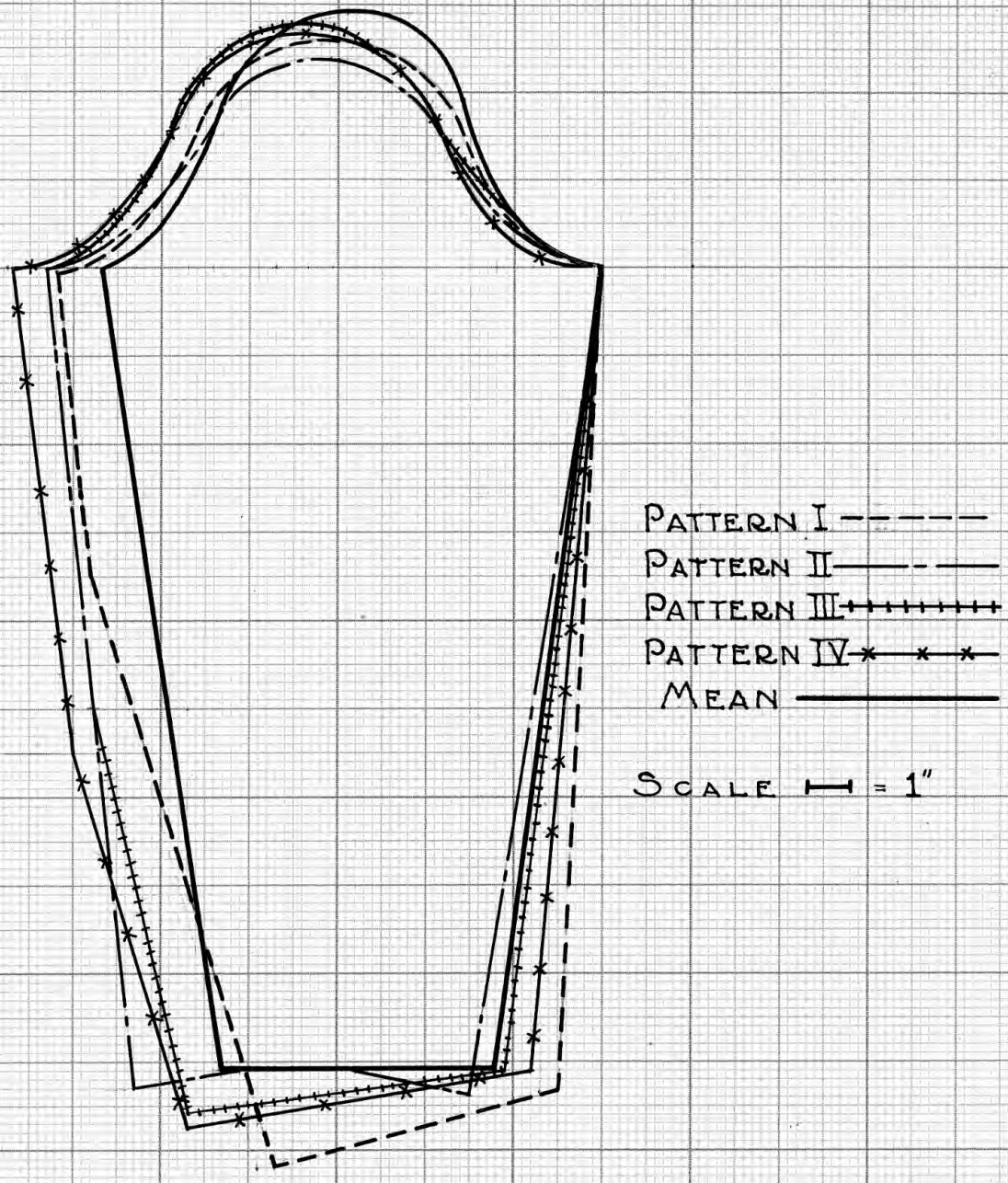
A COMPARISON OF THE ANGLES FORMED BY THE SLOPE OF THE SHOULDER AND HEIGHT OF THE SLEEVE CAP.



WAIST FRONT
SIZE 34 BUST

FIGURE 2

COMPARISON OF SAME SIZE PATTERN IN FOUR COMMERCIAL MAKES WITH THE MEAN MEASUREMENTS OF 100 WOMEN.



SLEEVE
SIZE 34 BUST
FIGURE 3.

COMPARISON OF SAME SIZE PATTERN IN FOUR COMMERCIAL MAKES WITH THE MEAN MEASUREMENTS OF 100 WOMEN.

The relationship which existed between the slope of the shoulder and height of the sleeve cap for any one subject was then expressed by b:c::b':c'.

Since angles may be compared by their degrees or by their tangents the latter method was chosen to express the slope relation between each respective cap height and shoulder slope of the physical measurements. The calculations of the tangents of angles, and the degrees of the angles are found in Table V while Figure 4 shows the graphic expression of these relations based on the tangents. The shoulder slope had a regular line of regression from .39 to .10, but the cap tangent oscillated between .33 and .49 when plotted against its shoulder tangent.

The arithmetic mean of the tangents of the angles, and that of the degrees of the angles was found from the algebraic equation $M=\frac{\Sigma m}{N}$ when M represents the mean, Σm is the summation of the values of the individual observations, and N the number of cases studied.

The mean of the tangents of the angles as calculated from measurements of the shoulder slope and sleeve cap height of 100 women were compared with similar measures of 4 commercial patterns.

Table V. Calculations of the shoulder slope and cap height in inches, degrees, and tangents of angles based on measurements of one hundred college women.

Subject	1	2	3	4	5
Shoulder depth (inches)	.75	.88	.5	.75	1
Slope relation	.37	.76	.34	.47	.56
Shoulder tangent	.1	.2	.1	.1	.2
Cap tangent	.4	.3	.3	.3	.3
Shoulder angle (degrees)	9	17	6	9	12
Cap angle (degrees)	27	22	20	23	22

Subject	6	7	8	9	10
Shoulder depth (inches)	.88	.88	1	.5	.6
Slope relation	.47	.30	.56	.31	.31
Shoulder tangent	.2	.1	.2	.1	.1
Cap tangent	.4	.4	.4	.4	.4
Shoulder angle (degrees)	15	8	14	8	8
Cap angle (degrees)	26	28	24	25	28

Subject	11	12	13	14	15
Shoulder depth (inches)	1	.6	1	.5	.75
Slope relation	.77	.44	.54	.25	.43
Shoulder tangent	.2	.2	.1	.1	.1
Cap tangent	.4	.3	.3	.4	.4
Shoulder angle (degrees)	14	13	12	9	11
Cap angle (degrees)	26	23	23	24	22

Subject	16	17	18	19	20
Shoulder depth (inches)	.6	.88	1	1.25	.75
Slope relation	.43	.45	.5	.53	.38
Shoulder tangent	.2	.1	.2	.2	.2
Cap tangent	.4	.4	.4	.4	.4
Shoulder angle (degrees)	14	11	11	14	10
Cap angle (degrees)	25	25	24	26	26

Subject	21	22	23	24	25
Shoulder depth (inches)	1.25	1.75	.88	.88	.6
Slope relation	.64	.44	.32	.46	.38
Shoulder tangent	.3	.1	.2	.1	.1
Shoulder angle (degrees	21	10	14	10	7
Cap angle (degrees)	25	24	29	23	23

Table V . Continued.

Subject	26	27	28	29	30
Shoulder depth (inches)	.88	1.36	.75	1	1
Slope relation	.5	.4	.4	.54	.56
Shoulder tangent	.1	.3	.1	.2	.2
Cap tangent	.3	.4	.4	.3	.4
Shoulder angle (degrees)	11	18	8	12	11
Cap angle (degrees)	22	25	24	23	26

Subject	31	32	33	34	35
Shoulder depth (inches)	1.15	.62	1	.88	.12
Slope relation	.55	.33	.66	.46	.57
Shoulder tangent	.2	.1	.3	.1	.2
Cap tangent	.4	.4	.4	.3	.4
Shoulder angle (degrees)	14	7	22	9	17
Cap angle (degrees)	24	24	26	22	24

Subject	36	37	38	39	40
Shoulder depth (inches)	.75	.61	1.25	.75	.65
Slope relation	.47	.68	.71	.34	.67
Shoulder tangent	.1	.1	.3	.1	.2
Cap tangent	.3	.4	.4	.4	.4
Shoulder angle (degrees)	10	8	17	8	17
Cap angle (degrees)	23	24	25	26	25

Subject	41	42	43	44	45
Shoulder depth (inches)	.75	.62	.75	1	.61
Slope relation	.44	.37	.38	.48	.37
Shoulder tangent	.1	.1	.1	.2	.1
Cap tangent	4	4	.4	.4	.4
Shoulder angle (degrees)	9	8	9	12	8
Cap angle (degrees)	26	24	24	27	24

Subject	46	47	48	49	50
Shoulder depth (inches)	1.12	.75	.75	1	1
Slope relation	.27	.17	.5	.56	.69
Shoulder tangent	.2	.2	.1	.2	.2
Cap tangent	.3	.3	.3	.4	.3
Shoulder angle (degrees)	14	12	10	13	12
Cap angle (degrees)	23	22	22	24	22

Table V . Continued.

Subject	51	52	53	54	55
Shoulder depth (inches)	.61	1.38	1.64	.81	1.12
Slope relation	.31	.35	.23	.42	.49
Shoulder tangent	.1	.3	.2	.1	.2
Cap tangent	.4	.4	.4	.3	.4
Shoulder angle (degrees)	8	18	14	9	13
Cap angle (degrees)	26	25	25	23	26

Subject	56	57	58	59	60
Shoulder depth (inches)	1.76	.62	.75	.72	1.12
Slope relation	.30	.37	.90	.51	.55
Shoulder tangent	.3	.1	.3	.1	.2
Cap tangent	.4	.4	.4	.3	.4
Shoulder angle (degrees)	22	8	22	11	14
Cap angle (degrees)	24	28	25	22	27

Subject	61	62	63	64	65
Shoulder depth (inches)	1.5	.62	.5	1.24	.87
Slope relation	.32	.36	.30	.74	.45
Shoulder tangent	.1	.1	.1	.3	.1
Cap tangent	.4	.4	.4	.4	.4
Shoulder angle (degrees)	8	8	6	18	11
Cap angle (degrees)	27	24	25	26	25

Subject	66	67	68	69	70
Shoulder depth (inches)	.5	.5	.75	.9	.36
Slope relation	.55	.26	.38	.46	.5
Shoulder tangent	.2	.1	.1	.1	.1
Cap tangent	.4	.4	.4	.4	.3
Shoulder angle (degrees)	13	8	9	11	11
Cap angle (degrees)	24	25	24	24	23

Subject	71	72	73	74	75
Shoulder depth (inches)	.6	1.25	1.25	1.37	.75
Slope relation	.31	.55	.55	.67	.53
Shoulder tangent	.1	.2	.2	.2	.1
Cap tangent	.3	.4	.4	.4	.4
Shoulder angle (degrees)	8	14	14	17	9
Cap angle (degrees)	22	27	27	26	26

Table V . Concluded.

Subject	76	77	78	79	80
Shoulder depth (inches)	.5	.76	.26	.62	.75
Slope relation	.29	.33	.53	.30	.37
Shoulder tangent	.1	.1	.2	.1	.1
Cap tangent	.4	.4	.3	.4	.4
Shoulder angle (degrees)	6	10	12	8	9
Cap angle (degrees)	26	24	22	27	26

Subject	81	82	83	84	85
Shoulder depth (inches)	.5	1.25	.6	.75	1.5
Slope relation	.24	.29	.49	.35	.45
Shoulder tangent	.1	.1	.2	.1	.1
Cap tangent	.4	.3	4	.4	.3
Shoulder angle (degrees)	6	6	11	8	10
Cap angle (degrees)	27	23	26	26	23

Subject	86	87	88	89	90
Shoulder depth (inches)	.5	.87	.86	.75	1
Slope relation	.24	.22	.48	.41	.54
Shoulder tangent	.1	.1	.2	.1	.2
Cap tangent	.3	.4	.4	.4	.3
Shoulder angle (degrees)	8	10	11	10	12
Cap angle (degrees)	19	24	26	26	22

Subject	91	92	93	94	95
Shoulder depth (inches)	1	1.25	.5	1	.87
Slope relation	.47	.51	.52	.49	.26
Shoulder tangent	.2	.3	.3	.2	.2
Cap tangent	.4	.4	.4	.4	.4
Shoulder angle (degrees)	12	22	22	12	12
Cap angle (degrees)	24	28	24	24	24

Subject	96	97	98	99	100
Shoulder depth (inches)	.87	.75	1	1	.5
Slope relation	.63	.59	.50	.54	.26
Shoulder tangent	.3	.3	.2	.2	.1
Cap tangent	.4	.4	.4	.4	.4
Shoulder angle (degrees)	22	22	12	13	6
Cap angle (degrees)	24	27	24	26	24

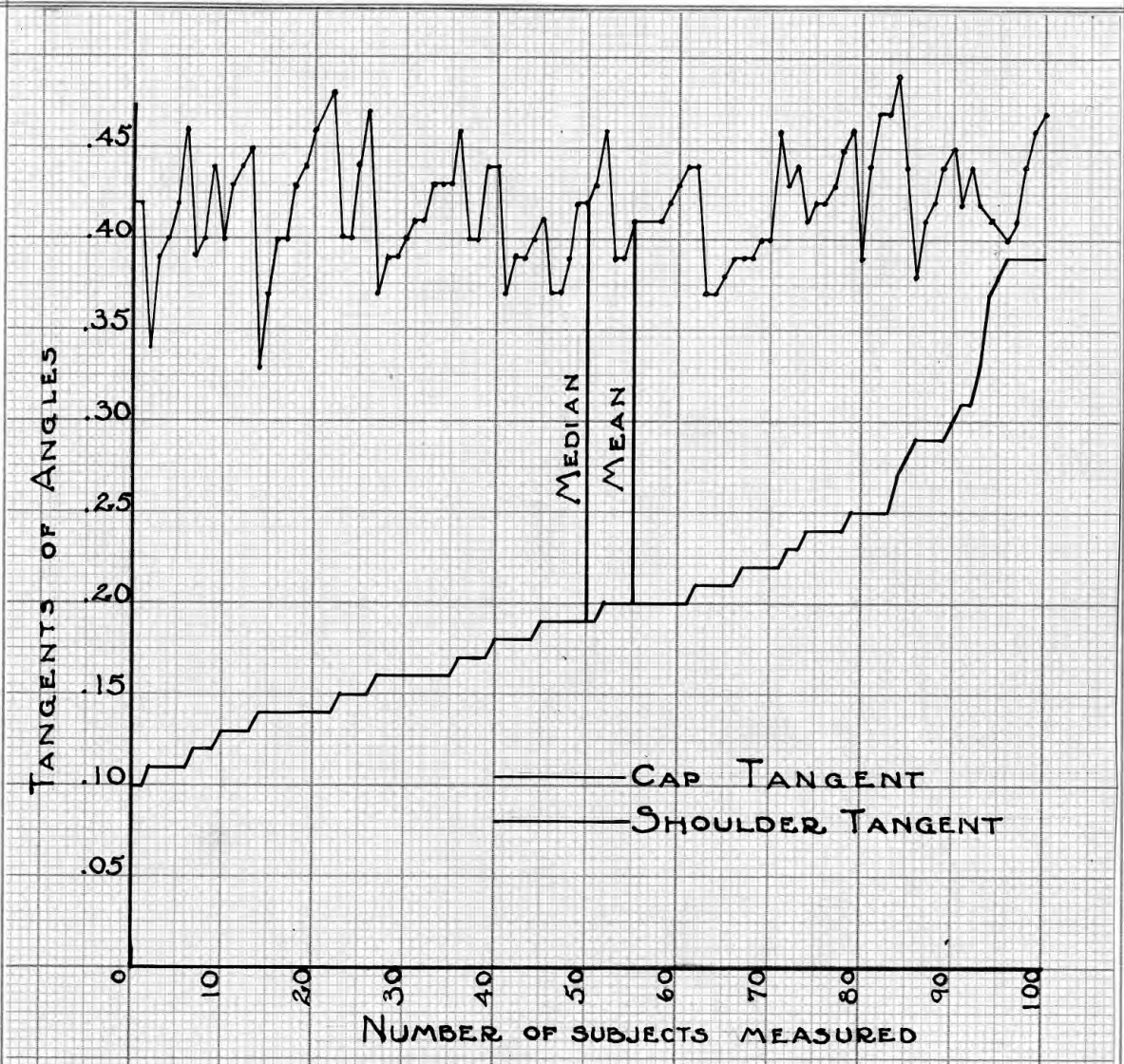


FIGURE 4.

A COMPARISON OF THE CAP TANGENT FORMED BY THE CAP ANGLE AND ITS RESPECTIVE SHOULDER TANGENT FORMED BY THE SHOULDER ANGLE AS FOUND BY MEASURMENT OF 100 WOMEN.

The calculations of the shoulder slope and cap height are found in Table VI and are expressed graphically in Figure 5. Again the cap height oscillated slightly while the shoulder slope had a smooth line of regression.

Table VI. Calculations of the shoulder slope and cap height in inches, degrees, and tangents based on the measurement of four commercial patterns.

Pattern	I	II	III	IV	Mean
Shoulder depth (inches)	1.72	2	2	1.1	1.70
Slope relation	.88	.89	.96	.50	.80
Shoulder tangent	.4	.4	.4	.2	.35
Cap tangent	.4	.4	.4	.4	.40
Shoulder angle(degrees)	24	25	30	12	23
Cap angle (degrees)	29	28	30	30	29

A summary of the calculations of the tangents and angles based on the physical measurements and those of commercial patterns given in Tables V and VI may be found in Table VII.

The mean tangents as obtained from physical measurements compared with the mean of the 4 patterns may be summarized as follows:

	mean shoulder slope	mean cap height
Physical measures	.16	.36
Pattern measures	.35	.40

The shoulder slope is greater in commercial patterns; the sleeve cap height also is greater in commercial patterns but the variation from the mean is not as marked as

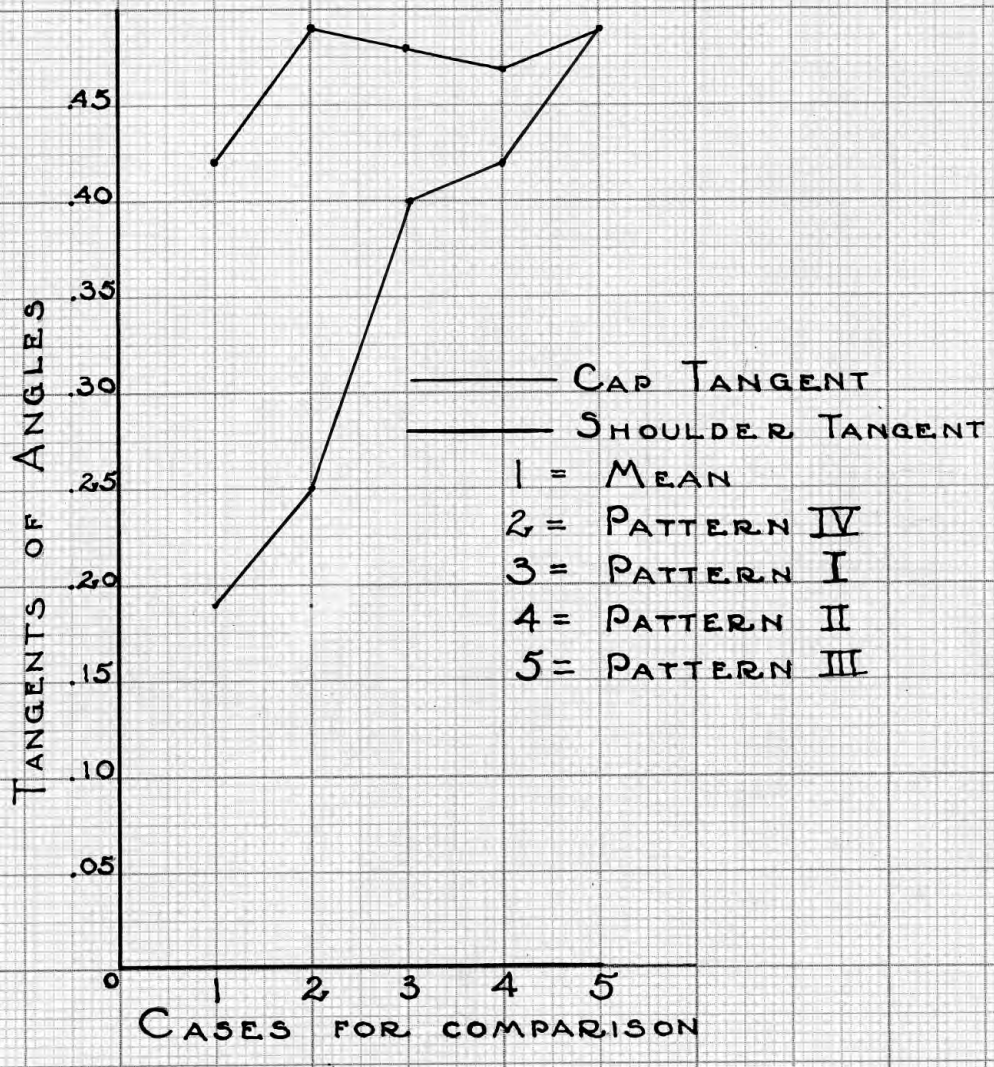


FIGURE 5

A COMPARISON OF THE CAP TANGENT FORMED BY THE CAP ANGLE AND ITS RESPECTIVE SHOULDER TANGENT FORMED BY THE SHOULDER ANGLE OF FOUR COMMERCIAL PATTERNS (SIZE 34 BUST) WITH THE MEAN MEASUREMENT OF 100 COLLEGE WOMEN.

Table VII. The maximum, minimum, and mean of the shoulder depth, tangents of the shoulder slope and cap angle and degrees of the angles.

Measurements of one hundred women

	Max.	Min.	Mean
Shoulder depth (inches)	1.36	.12	.86
Shoulder tangent	.10	.39	.16
Cap tangent	.33	.49	.37
Shoulder angle(degrees)	22	6	.11
Cap angle (degrees)	29	20	24

Four commercial patterns

	Max.	Min.	Mean
Shoulder depth (inches)	2	1.1	1.70
Shoulder tangent	.4	.2	.35
Cap tangent	.4	.4	.4
Shoulder angle(degrees)	30	12	23
Cap angle (degrees)	30	28	29

in the shoulder slope which indicates that the patterns do not conform to physical proportions, and seem to bear no direct relation to each other. A wide variation in the proportions used by different pattern companies is evident from Figures 2 and 3.

The mean of the angles as constructed above were measured in degrees with the following results:

	mean shoulder angle	mean cap angle
Physical measures	11	23
Pattern measures	24	29

This comparison with the angles of commercial patterns was not shown graphically since much the same relation existed as in the comparison of tangents.

An attempt was made to show a relation between the degrees of the angles formed by the shoulder slope and height of the sleeve cap by means of the Pearsonian correlation coefficient formula:

$$r = \frac{\Sigma x y}{\sqrt{(\Sigma x^2)(\Sigma y^2)}}$$

The shoulder slope-angle is expressed by x, and the angle formed by the sleeve cap height by y.

A similar determination was made using the tangents of the angles named. From these calculations the coefficient of correlation for the tangents of the angles was found to be + .0018, and for the degrees of the angles - .164. These results indicate that there is no correlation between the shoulder slope and the height of the sleeve cap since it is universally conceded that the coefficient must be .4 or greater to show dependency between the two. Since no correlation was found to exist between the slope of the shoulder and height of the sleeve cap, the standard deviation was not calculated.

SUMMARY

Certain measurements of 100 college women varying between 61 and 65 inches in height, 110 to 130 pounds in weight, and 31 to 34 inches bust measure, and the measurement of four commercial patterns, size 34 inch bust measure, indicate that:

1. In the measurement of 100 subjects, as the slope of the shoulder increased it approached the average height of the sleeve cap. This is shown when the height of the sleeve cap is plotted against the slope of the shoulder in Figure 4.

2. The angles formed by the shoulder line and sleeve cap in commercial patterns were more nearly equal to each other than to those found in the mean measurement of individuals as shown in Figure 5.

3. The pattern shoulder slopes were greater than the mean shoulder slope as determined by physical measurements. The same can be said for the angles since they vary in general as do their tangents.

	slope	angle
Mean shoulder	.16	11 degrees
Mean pattern shoulder	.35	23 degrees

4. The length of the shoulder line in commercial patterns was less than the length of the established shoulder line.

	Min.	Max.	Mean
Established shoulder line(inches)	3.75	5.25	4.88
Pattern shoulder line (inches)	4.5	5.12	4.68

5. The depth of the shoulder in the commercial patterns was greater than the depth of the established shoulder.

	Min.	Max.	Mean
Pattern shoulder depth(inches)	1.1	2	1.7
Established shoulder depth(inches)	.12	1.36	.86

6. The cap width of the commercial patterns was less than the established cap width.

	Min.	Max.	Mean
Established sleeve cap (inches)	6	7.75	6.83
Pattern sleeve cap (inches)	5.6	6.5	5.92

7. The sleeve cap height of the commercial patterns was less than the established cap height.

	Min.	Max.	Mean
Established cap height (inches)	4.75	6.25	5.52
Pattern cap height (inches)	4.25	5.44	5.03

8. Prices of the patterns studied were not an indication of satisfaction when measured in terms of conformity to, or variation from the mean of body measures. The patterns are ranked as to number. The price and the deviation from the mean of the cap height and mean shoulder

depth are recorded for the respective pattern numbers. Position one in the price column indicates the greatest cost; position one in the measurement column indicates the closest conformity to the mean.

Pattern	Price	Cap height	Shoulder depth
I	1	3	2
II	3	4	4
III	4	1	3
IV	2	2	1

9. To establish the relation which exists between the depth of the front and back shoulder more data should be collected.

10. The data of the measurement of 100 subjects is not sufficient to arrive at definite conclusions but it suggests that there is no correlation between the shoulder slope and height of the sleeve cap.

CONCLUSIONS

1. The slope of the shoulder of the four commercial patterns was greater than the mean established slope of the shoulder.

2. The height of the sleeve cap of the four commercial patterns was less than the mean established height of the sleeve cap.

3. There was no relation between the slope of the shoulder and height of the sleeve cap as the shoulder tangent had a fairly smooth line of regression and the cap tangent oscillated when plotted against it.

4. Commercial patterns need further standardization.

5. The price of the commercial patterns had no influence on their deviation from the mean measurements of the 100 college women.

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