

# Standards for Working-Surface Heights and Other Space Units of the Dwelling

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## SUMMARY

### INFORMATION CONCERNING STUDY

The object in this study is to supply some of the information required in setting up standards for the dimensions of parts of the house that are used mainly by women. These standards are of use in the design of houses built for rent or sale as well as those planned for owner occupancy, and in the dimensioning of commercial cabinets, sinks, chairs, and other articles of equipment.

Body measurements and preferred activity heights of 312 Oregon and 250 Washington women were recorded and studied. Of the 562 women cooperating in the study, 57.3 per cent lived on farms or in villages of less than 2,500 population. Those whose chief occupation was keeping house for their own families constituted 79.7 per cent of the entire group. These full-time homemakers averaged 21 years in housekeeping experience and their households averaged 3.5 persons. This group is representative of homemakers in Oregon and Washington with respect to factors associated with variations in dimensions of space units of a dwelling that are suited to the physical requirements of homemakers.

### CONCLUSIONS

The average homemaker, judging from the results of this study, prefers a sink set so that its floor is  $32\frac{1}{2}$  inches from the floor of the room. When the sink is set at a height of  $32\frac{1}{2}$  inches, however, the counters level with the sink rim are too high to be ideal for mixing and beating. Hence a work surface lower than the sink rim should be planned. The best height for this surface is 32 inches.

The sink should be shallow. The counters on a level with the rim of a shallow sink are more useful as work tables than are those of deep sinks, and sitting at the shallow sink is more comfortable.

The rim of the front of the sink should be as narrow as construction requirements permit so that as much of the sink bowl as possible comes within reach of the worker. The depth of reach from outer edge to points of finger tips when the average worker stands upright with arms stretched forward is only 12 inches.

### SUMMARY—*Continued*

The thickness of a table top and the construction beneath it is limited by the distance between the top of the thighs and the upper-forearm. This measure is  $3\frac{1}{2}$  inches for the average homemaker.

A built-in ironing board should be set so that its top is  $32\frac{1}{2}$  inches from the floor.

The cutting-table height preferred by the average cooperator was  $35\frac{1}{2}$  inches. The preferred sewing-table height for use while seated was 24 inches.

The optimum height for a kitchen planning desk is 25 inches. This height allows 2 inches for the table top and construction below it.

Seating arrangements for the kitchen should include a chair that permits the occupant's feet to rest on the floor with no pressure under the knees, and a stool or chair with footrest for work at the sink. It should be possible to adjust the height of the ironing board to permit the worker to use either the chair or the stool.

The sink stool should be adjustable as to height to permit the worker easily to change her position. It should be possible to adjust the height of the footrest to correspond to that of the seat.

The average cooperator chose a sink height 3.5 inches higher than that of her sink at home. Home equipment is more often too low than too high for rolling pastry, but the reverse is true for beating. For the average homemaker the usual dining table is too low for use as a cutting table by about 5 inches.

The majority of cooperators would be well served by equipment planned for the average cooperator. In the case of the height of the sink, three-fourths of the preferred heights vary from the average by not more than  $1\frac{1}{2}$  inches.

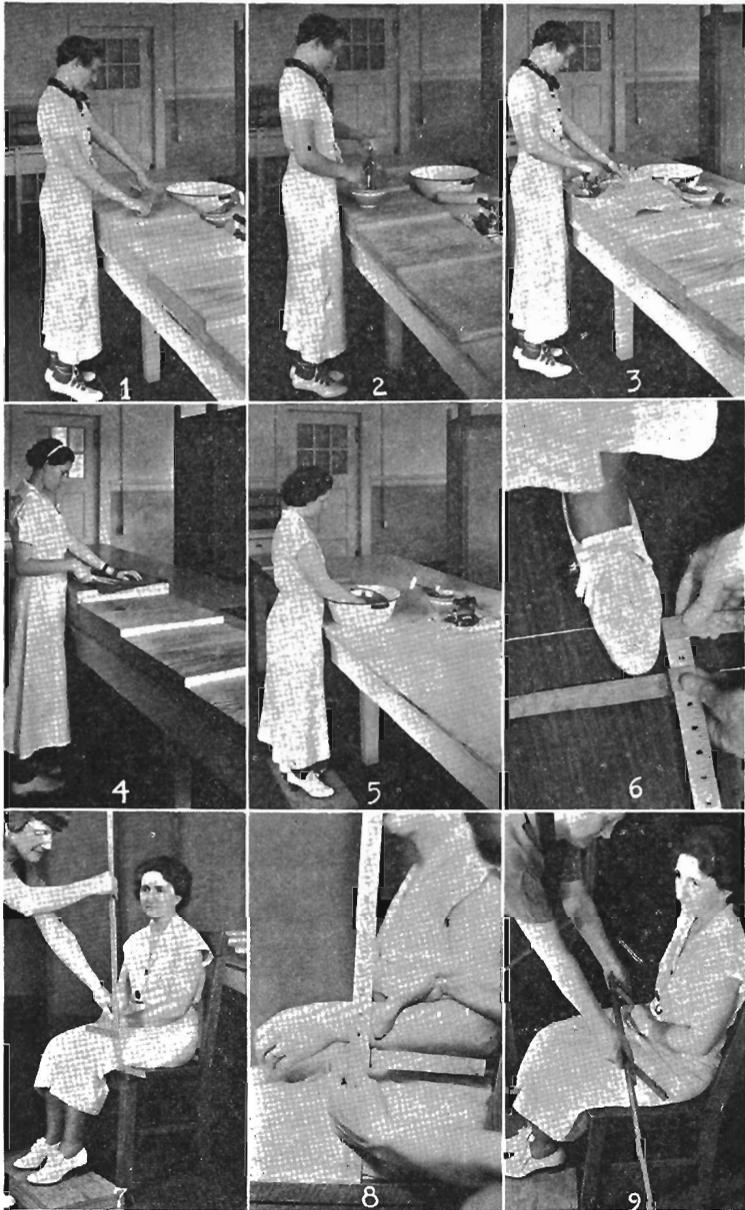


Plate I. VARIOUS ACTIVITY TESTS AND BODY MEASUREMENTS.

The subject was given utensils and directed to continue the activity (rolling, beating, ironing, dishwashing, and cutting), until she could decide upon the most comfortable height (1-5). Toe-room was determined by measuring the part of the foot (6) which extended over the chalk lines shown in (1). Pictures (7, 8, and 9) show method of taking measures for height of thighs over seat, height of under-forearm, and breadth of thighs, respectively.

# Standards for Working-Surface Heights and Other Space Units of the Dwelling\*

By

MAUD WILSON, EVELYN H. ROBERTS, RUTH THAYER

## PURPOSE OF STUDY

THE object in the study described in this publication is to supply some of the information required in setting up standards for the dimensions of the parts of the house that are used mainly by women.

Designers of kitchen cabinets and other articles of household equipment have been handicapped by lack of information concerning the requirements of the majority of homemakers. Housekeepers used to protest that sinks were placed too low; now it is not uncommon to find that they are too high. What is the sink height that will suit the largest proportion of homemakers, and how large is this proportion? If the sink is placed at the right height, are counters level with its upper edge convenient for use as work tables? These and many other points of similar nature must be decided before proposed space standards for dwellings are acceptable to homemakers.

For the benefit of most householders it is important that houses be built for average, rather than individual requirements. The use of the data on the requirements of the average woman would help the designers of commercial cabinets and houses built for rent or sale to dimension their products with confidence and precision. It would benefit housing consumers by increasing the chances that a homemaker will be able to buy or rent a house that is dimensioned to suit her. The data are of potential value also to architects in planning houses for owner occupancy and to manufacturers of equipment made in different sizes or adjustable in height.

The study was undertaken cooperatively by investigators at the Oregon and Washington Agricultural Experiment Stations. In Washington the study is one of a series dealing with economy and efficiency in the utilization of time and money in household operation. In Oregon the study is a part of a larger one dealing with housing requirements from the standpoint of family needs.

## SCOPE OF STUDY AND METHODS USED

The following paragraphs give a description of the data collected and a synopsis of the procedure followed in obtaining it.

1. An analysis was made of the uses of houses and their equipment to determine what parts should be dimensioned primarily for the convenience of women. This analysis formed the bases of selection for the dimensions included in this study.

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\* A more complete report of this investigation with the same title is available by inter-library loan or from the authors.



Included in the study were measurements required for:

- (1) Optimum heights of kitchen sink and work tables, worker standing.
- (2) Optimum height of ironing board, worker standing.
- (3) Optimum height of sewing table, worker standing.
- (4) Maximum heights of shelves, knobs, hooks, and closet rod, where used mainly by women.
- (5) Minimum width (front to back) of work table.
- (6) Minimum toe space at base of cabinet.
- (7) Maximum height of drawer from floor.
- (8) Minimum distance between upper and lower cabinets.
- (9) Height of kitchen planning desk, table, and ironing board, used by worker while seated.
- (10) Maximum distance between top of table or desk and bottom of "apron" (strip of wood below top).
- (11) Optimum height and width of stool for use at sink.
- (12) Optimum height and width of chair.
- (13) Maximum height of base of lower pane of window permitting worker to see her own yard while standing and while seated.

2. It was decided to base decisions concerning heights of working surfaces on the choices of cooperators. Conceivably all might be calculated from body measures, but it seemed to be a more direct mode of procedure to find out what women want in the way of working heights, conditioned as they are by habit, state of health, and other factors.

3. Consideration was given to the postures required in doing kitchen work, ironing, and sewing. Representative processes were selected for the tests. These included: washing dishes with pan in bottom of sink, beating with a rotary beater, rolling with a rolling pin, ironing a garment, and cutting out a sleeve using a paper pattern (Plate I).

4. Based on observations made of postures that the worker assumes in performing the tasks chosen for the tests, body measurements were selected for which correlations were thought to have possible significance. These included measures taken when standing and when sitting. Measures taken when standing included: height of top of head, of eyes, of shoulder, of elbow, of wrist, of thumb, of fingertip, of under part of forearm (elbow at right angle), and of hip. Measures taken when sitting included: height of top of head, height of under part of forearm, height of thigh above seat of chair, distance from floor to point under knee, length of thigh, and breadth across thighs. Other measurements included: breadth at shoulders, at elbows (bent at right angles), and at hips; distance to thumb tip with one hand and with both hands upstretched; distance to fingertips when arms are stretched forward at height chosen by cooperator for rolling; length and thickness of foot at point where it was extended forward from the line marking the front edge of the kitchen cabinet (Plate II).

Certain other data were selected for recording that were thought to have possible value in explaining variations in activity measures chosen by cooperators. These included size of family and years of housekeeping experience, weight, use of glasses at work, and heights of working surfaces now used at home.

5. Articles of equipment were selected for the use of cooperators when deciding upon activity heights. These included: pans, beater, rolling pin, flatiron, and scissors; a device for increasing and decreasing the height of the work table; and measuring apparatus.

6. Measurements were made in Oregon and Washington, with frequent comparisons of methods of procedure.

Objectives in summarizing and analyzing the data were to show the statistical "pattern"—averages and degree of dispersion—for each preferred height and for each dimension calculated from body measures; to consider for specific measures the factors related to variations among cooperators; to make specific recommendations concerning the dimensions of various parts of the house and its equipment; and to show the percentage of the cooperators in this study for whom requirements would be met by each recommendation.

Examination was made of the literature dealing with body measurements, posture standards, and selected working heights. Building specifications were also examined for standards used by architects. The most pertinent references are mentioned in the following discussion.

## COOPERATORS IN THE STUDY

In the selection of cooperators the aim was to secure a representative sample with respect to height-weight, years of homemaking experience, and location of home, whether urban or rural. All women selected were white, spoke English, and belonged to the middle-income class. Data were obtained for 312 Oregon and 250 Washington women.

Of the total group 57.3 per cent were from rural homes. Homemaking was the full-time occupation of 80 per cent of the cooperators. The other cooperators were clubhouse cooks, teachers, and students. Families ranged from one to nine. More homes of two, three, and four members were included in this study than exist in the population at large. The 1930 census figures for average size of families were 3.25 for Oregon and 3.32 for Washington (7). The averages for 312 Oregon and 250 Washington households were 3.38 and 3.66 respectively.

Body measurements for the 562 cooperators are given in Table 1. The averages for the two states are similar, indicating close correspondence in selection of cooperators and in technique of measurement. The average cooperator was 65.2 inches tall. If three extreme cases are omitted, the range in stature is from 59.0 to 71.6 inches, or a difference of 12.6. Similarly wrist heights range from 30 to 37 inches, with an average of 33.1 inches.

In contrast the average for stature of college women as reported by Diehl (3) was 63.7 inches. The difference of 1.5 inches may be explained by the fact that the Oregon-Washington women were measured in their working shoes. In weight the latter group are 23 pounds heavier than the college girls. In Figure 1, the data for the cooperators as to standing height and weight are compared with data on 210 women of "Old American" stock as reported by Hrdlicka (5). The two groups are similar as to distribution of stature, when allowance is made for the fact that the women in this study were measured in shoes whereas the others were without.

Considerable difference in weight is noted. A group more nearly comparable in age with the cooperators of this study is reported by Boyer and Gray (2). They averaged 136 pounds in weight, which is eight pounds less than the average cooperator, but average heights are nearly identical when correction for shoes is made.

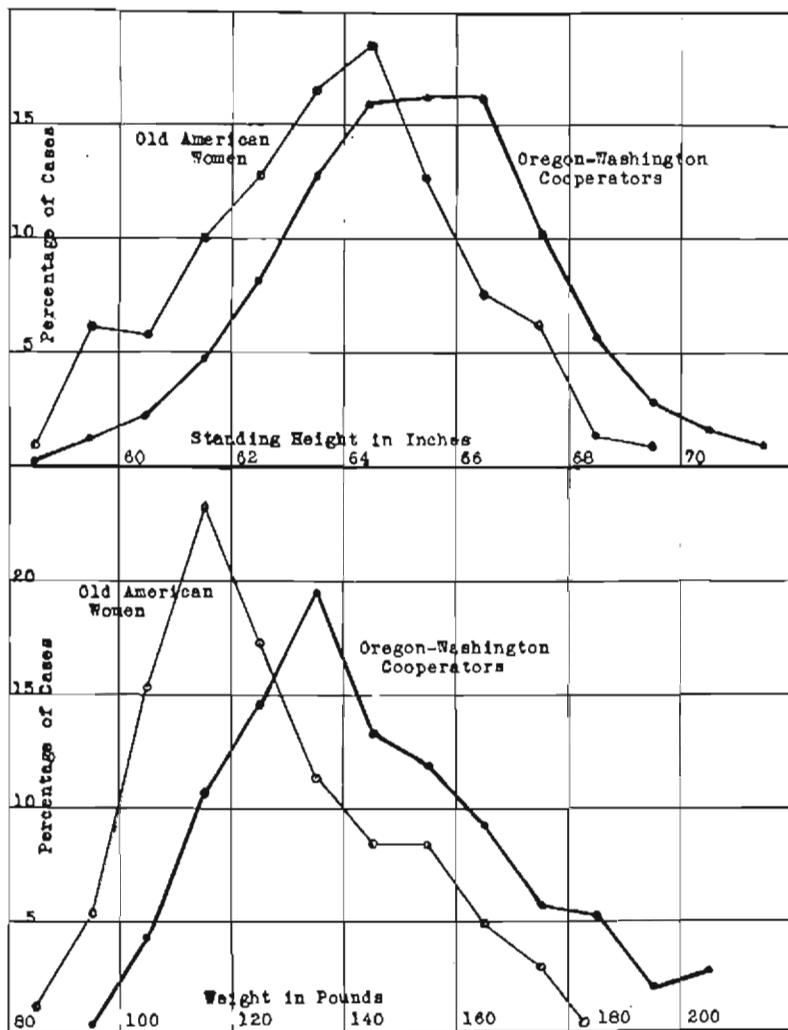


Figure 1. Comparison in stature and weight of Oregon-Washington cooperators with women of Old American stock as reported by Hrdlicka (5). The former group were fully clothed; the latter were measured in a minimum of clothing and without shoes. The two groups are similar in height distribution, the horizontal differences being the added height of the shoe heel. There is also marked similarity in the weight-distribution curves, with a horizontal difference of ten to twenty pounds.

Some architectural specifications for store-counter heights, door widths and heights, etc., are based on the measurements of the average male figure (4). This average man is approximately four inches taller, at least two inches taller at the shoulder, and has an arm four inches longer than the corresponding measures of the average cooperator of this study. Sometimes advertising pamphlets on kitchen design, stoves, and other equipment, recommend heights for kitchen equipment apparently designed for men, as the values are identical with those architectural specifications for commercial installations where male help is used.

Table 1. BODY MEASUREMENTS OF COOPERATORS

Averages of certain body measurements of 312 Oregon and 250 Washington cooperators, with range of values.

| Measure                                    | Average for cooperators |               |               | Range of values |
|--|-------------------------|---------------|---------------|-----------------|
|  | Oregon                  | Washington    | All           |                 |
|  | Pounds                  | Pounds        | Pounds        | Pounds          |
| Weight .....                               | 142                     | 145           | 144           | 95—242          |
| <i>Distance to floor, subject standing</i> | <i>Inches</i>           | <i>Inches</i> | <i>Inches</i> | <i>Inches</i>   |
| Top of head .....                          | 65.1                    | 65.2          | 65.2          | 57.6—74.0       |
| Eye .....                                  | 61.0                    | 61.2          | 61.1          | 54.0—69.0       |
| Shoulder .....                             | 53.6                    | 54.0          | 53.8          | 47.5—60.3       |
| Elbow .....                                | 41.7                    | 42.0          | 41.9          | 36.7—47.7       |
| Wrist .....                                | 33.2                    | 32.9          | 33.1          | 28.8—37.3       |
| Thumb .....                                | 28.6                    | 28.4          | 28.5          | 24.5—32.5       |
| Fingertip .....                            | 26.5                    | 26.0          | 26.3          | 22.0—31.5       |
| <i>Distance to seat, subject sitting</i>   |                         |               |               |                 |
| Top of head .....                          | 33.8                    | 33.0          | 33.5          | 29.0—40.0       |
| <i>Distance to floor, subject sitting</i>  |                         |               |               |                 |
| Under knee .....                           | 16.7                    | 17.3          | 17.0          | 13.0—19.1       |

## REPRESENTATIVE CHARACTER OF GROUP STUDIED

The data on the 562 women were analyzed by various statistical methods. The group appear to be representative of the homemakers of the Pacific Northwest. Distributions of the cooperators with respect to various body measures approximate the normal curve (Figure 2). Averages of groups of 50 cooperators check very closely, indicating either or both that the methods used gave uniform results or that further sampling was unnecessary. Average body measures are similar to those resulting from other investigations.

## HEIGHTS FOR WORKING SURFACES

### Average heights

The average height specified by cooperators for dishwashing was 32.3 inches. This may be considered the average height for the bottom of the sink, as more of the time spent at the sink is given to dishwashing than to any other single task.

Average heights for rolling and beating were 33.7 and 31.6 inches respectively. The average height for ironing, 32.6 inches, is practically

that of the bottom of the sink (32.3). The preferred height for cutting is higher than those for other processes, 35.4 inches (Table 2).

Equipment used in the tests for rolling, beating, and ironing brought the hands of the worker 1.8, 11.0, and 5.0 inches from the table respectively. That is, the hands of the average cooperator were 35.5 inches from the floor when rolling, 42.6 when beating, and 37.6 inches when ironing, when these activities were performed on surfaces of average preferred heights.

It is evident that working surfaces on a level with the sink rim are too high for mixing processes when the sink is installed at a height convenient for dishwashing, and that the dining table is a poor makeshift for a cutting table so far as height is concerned.

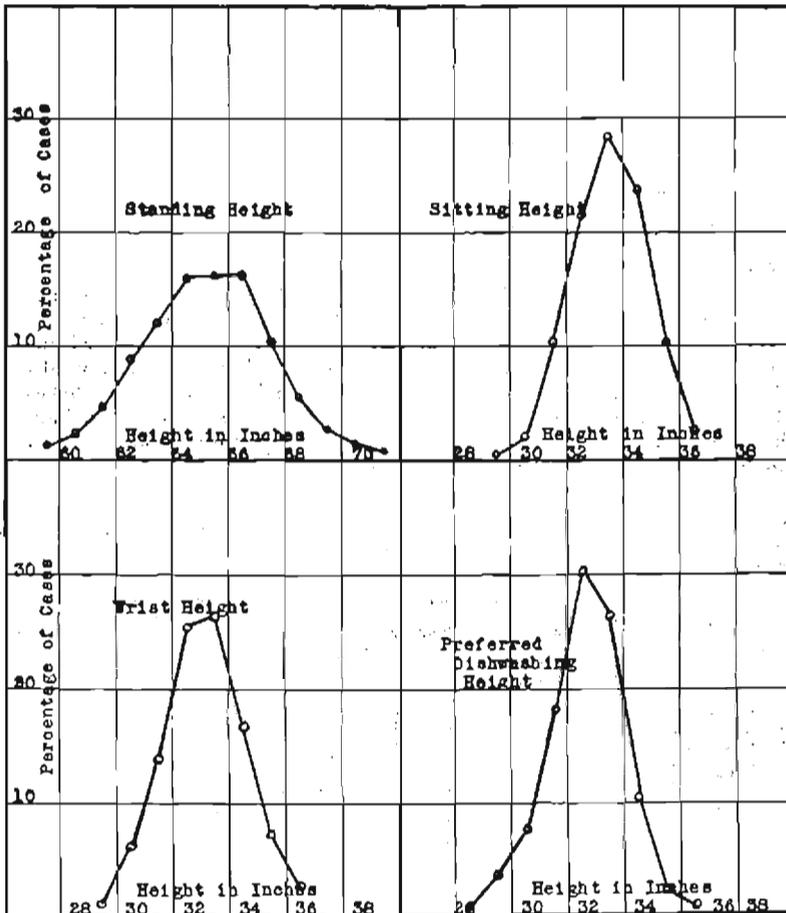


Figure 2. Normalcy of four frequency distributions of standing height, sitting height, wrist height, and preferred dishwashing height. These values were plotted to show the regularity of the distributions, whether body measurements or preferred heights, as a method of evaluating the data obtained.

The explanation of the differences in preferred heights may be found in a consideration of the postures required by the processes. The lowest selected surface is that for beating, a process which requires the operator to exert considerable pressure to hold the beater stable, but which does not require reaching. Next in order are dishwashing and ironing, for which it is important to be able to assume an upright posture because the position of the worker is maintained for comparatively long periods. For rolling, a still higher surface is preferred because the arms are stretched forward. As cutting involves reaching as far as the arm can be extended, this activity is carried on at the highest level.

Table 2. AVERAGE PREFERRED HEIGHTS

Number of cooperators making each test, and average preferred height chosen by Oregon and Washington cooperators for the working surfaces used in rolling with a rolling pin, beating with a rotary beater, washing dishes, and cutting out garments using a paper pattern.

| Activity          | Number of cooperators making test | Average preferred height |
|-------------------|-----------------------------------|--------------------------|
|                   |                                   | Inches                   |
| Rolling .....     | 562                               | 33.7                     |
| Beating .....     | 475                               | 31.6                     |
| Dishwashing ..... | 562                               | 32.3                     |
| Ironing .....     | 475                               | 32.6                     |
| Cutting .....     | 362                               | 35.4                     |

#### Variation in preferred heights

The data included in Table 3 suggest that the majority of cooperators would be well served by working surfaces designed for the average. Two-thirds of those making the rolling tests chose heights of at least 32 inches but less than 35 inches; two-thirds chose beating heights between 30 and 33 inches; and three-fourths chose dishwashing and ironing heights between 31 and 34 inches. Preferences as to cutting heights vary more than do those for other measures, but more than half of those making the test chose heights falling between 34 and 37 inches.

Table 3. VARIATION IN PREFERRED HEIGHTS

Cooperators classified with respect to heights preferred for rolling with a rolling pin, beating with a rotary beater, washing dishes, ironing, and cutting out garments using a paper pattern.

| Height           | Number of cooperators choosing heights for specified activity |           |             |           |           |
|------------------|---|-----------|-------------|-----------|-----------|
|                  | Rolling   | Beating   | Dishwashing | Ironing   | Cutting   |
|                  | Per cent  | Per cent  | Per cent    | Per cent  | Per cent  |
| *26 inches ..... | .....   | 1 0.2     | .....       | .....     | .....     |
| 27 inches .....  | .....   | 5 1.1     | .....       | .....     | .....     |
| 28 inches .....  | .....   | 11 2.3    | 2 0.4       | .....     | .....     |
| 29 inches .....  | 1 0.2   | 18 3.8    | 18 3.2      | 6 1.3     | .....     |
| 30 inches .....  | 7 1.2   | 86 18.1   | 43 7.6      | 33 6.9    | .....     |
| 31 inches .....  | 38 6.8  | 133 28.0  | 102 18.2    | 81 17.1   | 6 1.7     |
| 32 inches .....  | 80 14.2   | 104 21.9  | 170 30.2    | 133 28.0  | 17 4.7    |
| 33 inches .....  | 167 29.7  | 70 14.7   | 148 26.3    | 135 28.4  | 57 15.7   |
| 34 inches .....  | 140 24.9  | 33 7.0    | 59 10.5     | 57 12.0   | 65 18.0   |
| 35 inches .....  | 76 13.5   | 9 1.9     | 13 2.3      | 20 4.2    | 66 18.2   |
| 36 inches .....  | 34 6.1  | 3 0.6     | 6 1.1       | 9 1.9     | 68 18.8   |
| 37 inches .....  | 9 1.6   | 1 0.2     | .....       | .....     | 40 11.1   |
| 38 inches .....  | 7 1.2   | 1 0.2     | 1 0.2       | 1 0.2     | 25 6.9    |
| 39 inches .....  | 1 0.2   | .....     | .....       | .....     | 11 3.0    |
| 40 inches .....  | 1 0.2   | .....     | .....       | .....     | 4 1.1     |
| 41 inches .....  | 1 0.2   | .....     | .....       | .....     | 2 0.5     |
| 42 inches .....  | .....   | .....     | .....       | .....     | .....     |
| 43 inches .....  | .....   | .....     | .....       | .....     | 1 0.3     |
| 44 inches .....  | .....   | .....     | .....       | .....     | .....     |
| Totals .....     | 562 100.0   | 475 100.0 | 562 100.0   | 475 100.0 | 362 100.0 |

\* 26.0 inches and less than 27.0 inches. Subsequent groups similarly defined.

A graphic representation of the character of the relationship between preferred working-surface heights and body measures is given in Figure 3. This graph shows the tendency of short women to select relatively high working surfaces and of tall women to select relatively low ones.

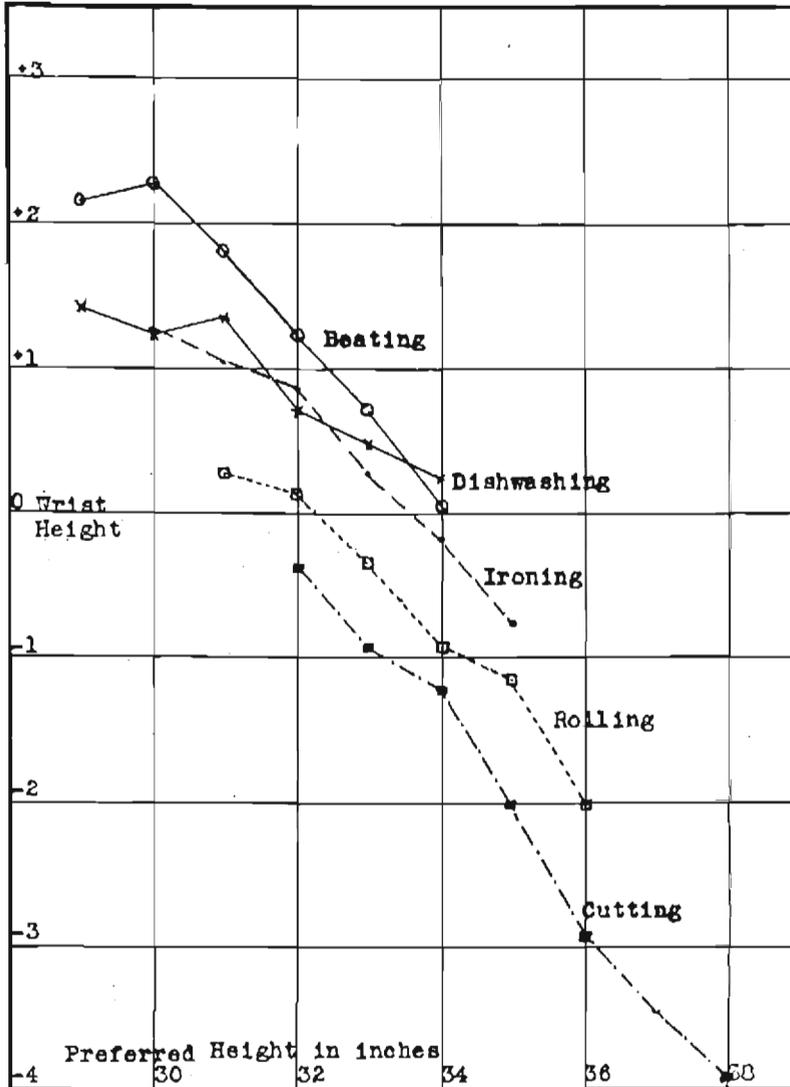


Figure 3. Differences between average preferred activity heights and average wrist heights (based on column six of Table 17). There is a marked tendency for the shorter women to select working levels higher than their wrist heights (points on the left of the 32-inch vertical line) and for the taller women to select levels lower than their wrist heights (points on right of 34-inch vertical line). Cooperators selecting working heights fairly close to averages had wrist heights within a plus or minus one inch of these preferred levels (central portion of figure).

Suggestions by home economists concerning methods of determining working-surface heights often assume a relationship between a specific body measure, as stature, and the most comfortable height for a kitchen sink or work table. To test the usefulness of rules of this type, the cooperators with similar wrist heights, 32.0 and less than 33.0, were classified with respect to their preferred heights for rolling, beating, dishwashing, ironing,

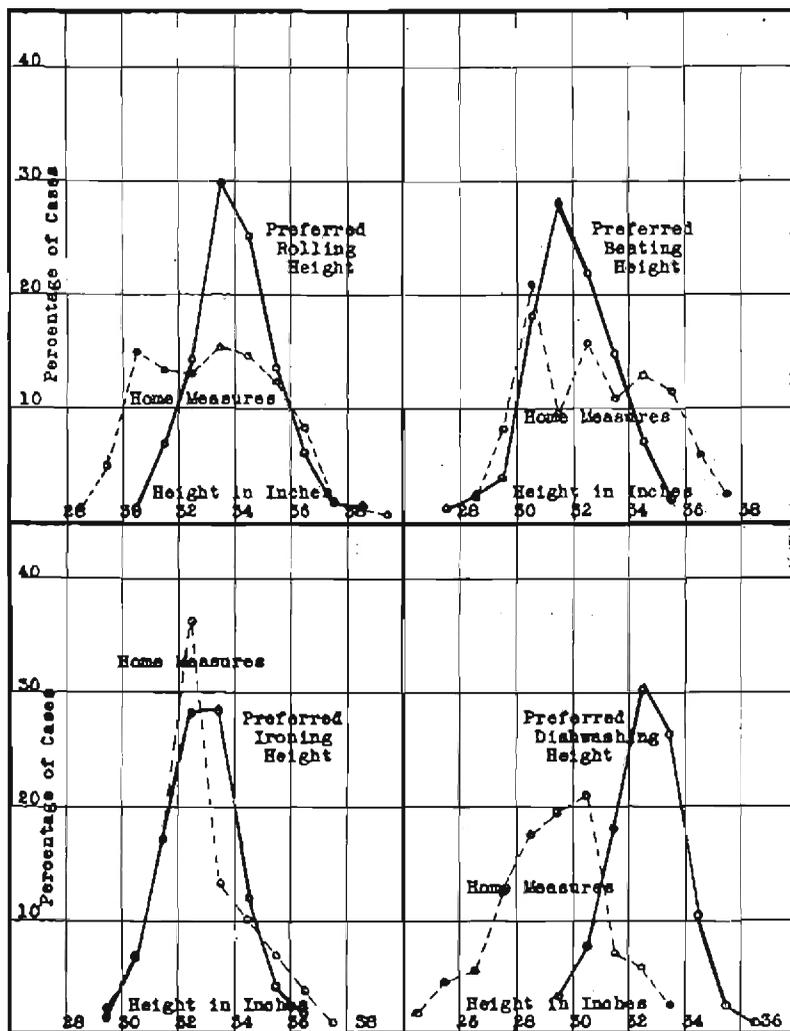


Figure 4. Comparison of frequency distributions for preferred activity heights with their corresponding home measures (Tables 14 and 23). Ironing heights found in homes agreed most closely with preferred heights, possibly because of the adjustability of ironing boards. The greatest difference is in the pair of curves for the dishwashing height, the preference indicating levels 3 to 4 inches higher than those in actual use.

and cutting. It was found that the range for this limited group was only slightly less than for the entire group of cooperators, indicating that in a considerable percentage of cases working-surface heights derived from body measures could not be expected to coincide with preferred heights.

A possible explanation of the range in preferred working heights lies in differences in age and experience, with their concomitants in posture, thickness of body, habit of work, and use of bifocals. An analysis was made to note whether or not older women tend to choose sink heights that are lower or higher, compared with their standing heights, than do younger women. It was found that two-thirds of the older women had selected dishwashing heights that were relatively high. It would appear that sinks in houses or apartments to be used mainly by older women should be placed slightly higher than for the average woman.

#### Equipment in homes of cooperators

In making the dishwashing test in the laboratory, more than 90 per cent chose sink heights greater than those at home. Less than ten per cent of the cooperators selected dishwashing heights within one inch of the sink heights in their homes.

It is not surprising to find that differences are less marked between the chosen heights and heights of the home equipment used for rolling, beating, and ironing, than between the preferred dishwashing height and that of the home sink, because the housekeeper has more freedom in adjusting the heights of the former to suit her needs. Almost one-fourth of the women reporting on this point had a place to roll out pastry that was within an inch of the height considered ideal for the purpose, and almost one-third had a work surface for beating that came within that range. Home equipment is more often too low than too high for rolling, but the reverse is true for beating.

Cooperators are better equipped for ironing than for any other of the tasks, so far as height of surface is concerned. Almost 40 per cent reported ironing boards within an inch of the preferred height (Table 4).

#### Upper and lower limits for working-surface heights

The comparison of preferred heights with home equipment given in Table 4 leads to the question of upper and lower limits which the housekeeper will "tolerate." In the study recorded in Table 5 each cooperator was instructed to determine the greatest and the least height at which she thought she could work without muscle strain. Ironing was not included because of the close correlation of preferred heights and home equipment. Nor was beating included, because the homemaker can easily carry her bowl to the surface in the kitchen that is most nearly satisfactory.

The determination of upper and lower limits is of significance in relation to the selection of a house to rent. Obviously the most important consideration is that of the height of the sink because the range of tolerance is not great for this working height and because dishwashing is a process that is not readily transferred to another surface.

The data in Table 5 emphasize the desirability of installing the working surfaces of a house built to sell or rent at the heights required by the average homemaker. Ninety-two per cent of the cooperators taking the

tolerance test could use a rolling height of 33.5 inches, 82 per cent a dishwashing height of 32.5 inches, and 97 per cent a cutting height of 35.5 inches, measures which approximate those selected as optimum by the average cooperators in this study (Table 1).

Table 4. DIFFERENCE BETWEEN HOME AND PREFERRED HEIGHTS

Distribution of cooperators in respect to difference between preferred height and height of home equipment: (a) rolling, and pastry board, (b) beating, and work table, (c) dishwashing, and bottom of sink, (d) ironing, and ironing board.

| Difference in inches between preferred height and height of equipment at home | Percentage of cooperators classified as to difference |                            |                                    |                               |
|---|---|----------------------------|------------------------------------|-------------------------------|
|   | a. Rolling, and pastry board                          | b. Beating, and work table | c. Dishwashing, and bottom of sink | d. Ironing, and ironing board |
|   | <i>Per cent</i>                                       | <i>Per cent</i>            | <i>Per cent</i>                    | <i>Per cent</i>               |
| <i>Preferred height greater by—</i>   |   |                            |                                    |                               |
| 9—11 inches.....  | .....   | .....                      | 0.7                                | .....                         |
| 7—9 inches.....   | .....   | .....                      | 8.0                                | .....                         |
| 5—7 inches.....   | 2.8   | 1.1                        | 19.2                               | 0.4                           |
| 3—5 inches.....   | 17.4  | 3.7                        | 32.4                               | 4.5                           |
| 1—3 inches.....   | 31.0  | 20.4                       | 28.9                               | 24.5                          |
| 0—1 inch.....   | 6.3   | 10.4                       | 3.5                                | 12.3                          |
| <i>Preferred height same as home equipment</i>                                |   |                            |                                    |                               |
| Difference zero.....  | 9.8   | 11.2                       | 3.8                                | 15.2                          |
| <i>Preferred height lesser by—</i>  |   |                            |                                    |                               |
| 0—1 inch.....   | 7.7   | 8.2                        | 2.1                                | 10.4                          |
| 1—3 inches.....   | 19.8  | 21.6                       | 1.4                                | 30.1                          |
| 3—5 inches.....   | 4.2   | 15.6                       | .....                              | 2.6                           |
| 5—7 inches.....   | 1.0   | 7.1                        | .....                              | .....                         |
| 7—9 inches.....   | .....   | 0.7                        | .....                              | .....                         |
| <b>SUMMARY:</b>   | <i>Per cent</i>                                       | <i>Per cent</i>            | <i>Per cent</i>                    | <i>Per cent</i>               |
| Preferred height greater than home equipment.....                             | 57.5  | 35.6                       | 92.7                               | 41.7                          |
| Preferred height less than home equipment.....                                | 32.7  | 53.2                       | 3.5                                | 43.1                          |
| Difference none, or less than 1 inch....                                      | 23.8  | 29.8                       | 9.4                                | 37.9                          |

Table 5. LIMITS IN HEIGHT SUITED TO THE INDIVIDUAL

Upper limit, lower limit, and optimum working-surface height preferred by selected cooperators for rolling with a rolling pin, washing dishes, and cutting out garments; and proportion of selected cooperators for whom average height for all cooperators would be suitable.

| Activity       | Number of cooperators | Choice of selected cooperators |               |               |  |               | Proportion of selected cooperators whose upper limit was more and lower limit less than average preferred height of all cooperators* |
|----------------|-----------------------|--------------------------------|---------------|---------------|--|---------------|--|
|                |                       | Average height                 |               |               | Difference between average preferred height and limits |               |  |
|                |                       | Preferred                      | Upper limit   | Lower limit   | Upper limit  | Lower limit   |  |
|                |                       | <i>Inches</i>                  | <i>Inches</i> | <i>Inches</i> | <i>Inches</i>  | <i>Inches</i> | <i>Per cent</i>  |
| Rolling.....   | 89                    | 34.2                           | 37.7          | 31.7          | 3.5  | 2.5           | 92.1   |
| Dishwashing .. | 88                    | 32.3                           | 33.4          | 30.5          | 1.1  | 1.8           | 81.8   |
| Cutting.....   | 87                    | 36.2                           | 37.8          | 32.1          | 1.6  | 4.1           | 96.6   |

\* Average preferred height for all cooperators (Table 1): Rolling.....33.7 inches  
Dishwashing.....32.3 inches  
Cutting.....35.4 inches

### Comparison with results of Iowa study

Average heights of working surfaces chosen by cooperators in this study were shown to be similar to those for Iowa State College women (6) when allowance is made for the tendency of older women to choose relatively high surfaces.

### Application to design of equipment

There are three points of application of the results of this study to the design of kitchen cabinets; namely, the determination of heights for stock cabinets and those installed in houses built for rent or sale, the desirable range in heights of commercial units, and the development of a procedure for determining optimum heights for cabinets suited to an individual woman.

**STOCK KITCHEN CABINETS.** Judging from requirements of cooperators in this study, the sink height suited to the needs of the average homemaker is 32.5 inches. Optimum heights for rolling and beating are 33.5 and 31.5 inches respectively.

These averages indicate the desirability of a working surface for mixing operations that is lower than the upper sink rim. A good height for this lower surface is 32 inches, which is only half an inch higher than the optimum height for beating. It is about an inch lower than the average preferred height for rolling, allowing for a pastry board placed on top of the working surface, but this is well within the upper and lower limits for rolling noted in Table 5.

If it is not feasible to include in the kitchen ensemble a cabinet having its working surface below that of the sink rim, a sliding pastry board should be incorporated in the cabinet at a height of 33.5 inches. It should be so well braced that it can be used without removal from its slot. It is also desirable in this situation to use a shallow sink. If the sink in an ensemble of this type is five or more inches deep, possibly the best compromise is to set it so that the bottom of the sink (inside) is 31 inches from the floor.

It is desirable that the front edge of the sink should be as narrow as construction requirements permit. If the rim of the sink at the front is 3 inches or more in width, however, the sink should be set somewhat higher than the standard (32.5 inches) because the worker must hold her arms at an angle from her body that is greater than is the case where the rim of the sink is narrow.

**CABINETS DESIGNED FOR INDIVIDUALS.** Kitchen ensembles in houses planned for owner occupancy are often made up of commercial units. A pedestal sink giving a choice of two heights, 31 and 34 inches, 96 per cent of the time would come within one and one-half inches of the height preferred by the individual (Table 3). A sink giving choice of three heights—30, 32, and 34 inches—would make it possible 96 per cent of the time to purchase a sink of a height that varies not more than an inch from that preferred by the individual.

For maximum usefulness a kitchen-cabinet unit intended for a food-preparation (mixing) table should come in 30-inch and 33-inch heights if made in two sizes, and in 30-inch, 32-inch, and 34-inch heights if made in three sizes.

Any formula for determining a height of a working surface that is based on body measures may be expected to give answers that for a certain proportion of homemakers fail to approximate preferred heights. There is a possibility that a working height arrived at by formula might be more satisfactory through a long period of use than one that is the result of a few minutes' consideration in a test. Granted that the measure chosen by the homemaker is really her optimum height, however, it appears that the best procedure for a woman who wants working-surface heights built to suit her is to wash dishes, and to do other common tasks, using tables of varying heights until she can decide which one is best for each process. This can be done in her own home, but it is more satisfactory if she can do it with laboratory equipment such as was provided for the cooperators in this study. This equipment could be installed at little expense in home-demonstration centers and by home-service departments of stores, public utilities, and newspapers, and these agencies would be rendering a valuable service to the prospective home builder in providing a place where the homemaker might try various levels.

In these tests it is desirable for the homemaker to determine upper and lower limits as well as most suitable heights, and to modify her optimum measures in the direction of the average. Most homes are for sale, sooner or later, and obviously salability is increased by consideration of the needs of the majority of families.

The palm test, upon which reliance has been placed in so many recommendations of home economists, is probably more satisfactory than a rule for determining heights from body measures, as in this test the hands are brought forward into working position. It may be that when allowance is made for the variation among the tasks of the homemakers in the distance of the hands from the table, the palm test is as satisfactory as those in which the homemaker goes through the motions of the process. The comparison of working-surface heights derived by these two methods will constitute the subject of a later inquiry.

**IRONING BOARD.** A portable board not adjustable in height will come within an inch of meeting the requirements of 98 per cent of the cooperators if made in three heights, 30, 32, and 34 inches (Table 3). These heights are also desirable for built-in boards adjustable for height, where possible adjustments are limited to three. A non-adjustable built-in board in a house for rent or sale may be set at 32.5 inches.

**CUTTING TABLE.** A height of 35.5 inches is the most useful one for a cutting table, judging from the results of this study. In a house where working surfaces have been planned for the average woman, the homemaker is less likely to be suited by the cutting table than by the kitchen cabinets and sink (Table 3).

## DIMENSIONS BASED ON HEIGHT OF REACH

### Dimensions included

The height of reach with one hand was measured to the thumb tip. By experimentation it was determined that at this point an object could be grasped between thumb and fingers.

In a cabinet with no set-back, shelves for articles that can be grasped with one hand at the front of the shelf, as books and packaged cereals,

may be on a level with the thumb tip when one arm is upstretched. If it is necessary to use both hands, however, or to grasp the object at a point above the edge of the shelf, or to reach into the space, the height of reach taken to the wrist is a better measure for maximum height.

Knobs, latches, etc., may be placed at the height of the thumb tip with one arm upstretched, unless one must reach over a cabinet. A closet rod may be 2 inches higher than the height of the thumb tip, assuming a rod not over 2 inches thick and a garment hanger of the type now commonly used.

#### Height of reach: Averages and variations

For the 562 women who cooperated in this study, the height of reach with one arm when measured to thumb tip varied from 69 inches to 96 inches with an average of 79.6 inches, 94 per cent of the cases lying between 73 and 85 inches. Height of reach measured to the wrist varied from 65 to 90 inches, with an average of 75.5 inches. Variations in reach are shown in Table 6.

Table 6. VARIATION IN HEIGHT OF REACH

Distribution of 562 cooperators in respect to distance from floor to thumb tip and to wrist when one arm is upstretched, and of 200 cooperators in respect to shoulder height plus arm length to thumb tip.

| Distance     | Cooperators with specified height of reach |                            |                                    |                     |                                |                     | Percentage of 200 cooperators with specified shoulder plus arm length to thumb tip |          |
|--------------|--|----------------------------|------------------------------------|---------------------|--------------------------------|---------------------|--|----------|
|              | Number, measuring to thumb tip             | Number, measuring to wrist | Percentage, measuring to thumb tip |                     | Percentage, measuring to wrist |                     |  |          |
|              |  |                            | Per cent                           | Cumulative per cent | Per cent                       | Cumulative per cent |  | Per cent |
| *65 inches.. | ....                                       | 3                          | ....                               | ....                | ....                           | 0.5                 | 100.0  | ....     |
| 66 inches..  | ....                                       | 2                          | ....                               | ....                | ....                           | 0.4                 | 99.5   | ....     |
| 67 inches..  | ....                                       | 5                          | ....                               | ....                | ....                           | 0.9                 | 99.1   | ....     |
| 68 inches..  | ....                                       | 9                          | ....                               | ....                | ....                           | 1.6                 | 98.2   | ....     |
| 69 inches..  | 1  | 15                         | 0.2                                | 100.0               | 2.7                            | 96.6                | 0.5  | ....     |
| 70 inches..  | 3  | 24                         | 0.5                                | 99.8                | 4.2                            | 93.9                | 0.5  | ....     |
| 71 inches..  | 1  | 34                         | 0.2                                | 99.3                | 6.1                            | 89.7                | ....   | ....     |
| 72 inches..  | 8  | 51                         | 1.4                                | 99.1                | 9.1                            | 83.6                | 1.0  | ....     |
| 73 inches..  | 16   | 62                         | 2.9                                | 97.7                | 11.0                           | 74.5                | 3.5  | ....     |
| 74 inches..  | 13   | 70                         | 2.3                                | 94.9                | 12.4                           | 63.5                | 5.5  | ....     |
| 75 inches..  | 28   | 60                         | 5.0                                | 92.6                | 10.7                           | 51.1                | 7.5  | ....     |
| 76 inches..  | 37   | 79                         | 6.6                                | 87.6                | 14.1                           | 40.4                | 9.0  | ....     |
| 77 inches..  | 51   | 55                         | 9.1                                | 81.0                | 9.8                            | 26.3                | 12.0   | ....     |
| 78 inches..  | 61   | 35                         | 10.9                               | 71.9                | 6.2                            | 16.5                | 10.0   | ....     |
| 79 inches..  | 70   | 22                         | 12.4                               | 61.0                | 3.9                            | 10.3                | 10.5   | ....     |
| 80 inches..  | 56   | 16                         | 10.0                               | 48.6                | 2.9                            | 6.4                 | 9.5  | ....     |
| 81 inches..  | 74   | 7                          | 13.2                               | 38.6                | 1.2                            | 3.5                 | 11.5   | ....     |
| 82 inches..  | 49   | 5                          | 8.7                                | 25.4                | 0.9                            | 2.3                 | 8.5  | ....     |
| 83 inches..  | 39   | 2                          | 6.9                                | 16.7                | 0.3                            | 1.4                 | 2.5  | ....     |
| 84 inches..  | 22   | 3                          | 3.9                                | 9.8                 | 0.3                            | 1.1                 | 2.5  | ....     |
| 85 inches..  | 11   | 2                          | 2.0                                | 5.9                 | 0.4                            | 0.6                 | 1.5  | ....     |
| 86 inches..  | 8  | ....                       | 1.4                                | 3.9                 | ....                           | ....                | 2.5  | ....     |
| 87 inches..  | 6  | ....                       | 1.1                                | 2.5                 | ....                           | ....                | 1.0  | ....     |
| 88 inches..  | 2  | ....                       | 0.3                                | 1.4                 | ....                           | ....                | 1.5  | ....     |
| 89 inches..  | 1  | ....                       | 0.2                                | 1.1                 | ....                           | ....                | ....   | ....     |
| 90 inches..  | 4  | 1                          | 0.7                                | 0.9                 | 0.2                            | 0.2                 | ....   | ....     |
| 91 inches..  | ....                                       | ....                       | ....                               | ....                | ....                           | ....                | ....   | ....     |
| 92 inches..  | ....                                       | ....                       | ....                               | ....                | ....                           | ....                | ....   | ....     |
| 93 inches..  | ....                                       | ....                       | ....                               | ....                | ....                           | ....                | ....   | ....     |
| 94 inches..  | ....                                       | ....                       | ....                               | ....                | ....                           | ....                | ....   | ....     |
| 95 inches..  | ....                                       | ....                       | ....                               | ....                | ....                           | ....                | ....   | ....     |
| 96 inches..  | 1  | ....                       | 0.2                                | 0.2                 | ....                           | ....                | ....   | ....     |
| Totals..     | 562  | 562                        | 100.0                              | ....                | 100.0                          | ....                | ....   | 100.0    |

\* 65.0 inches and less than 66.0 inches. Subsequent groups similarly defined.

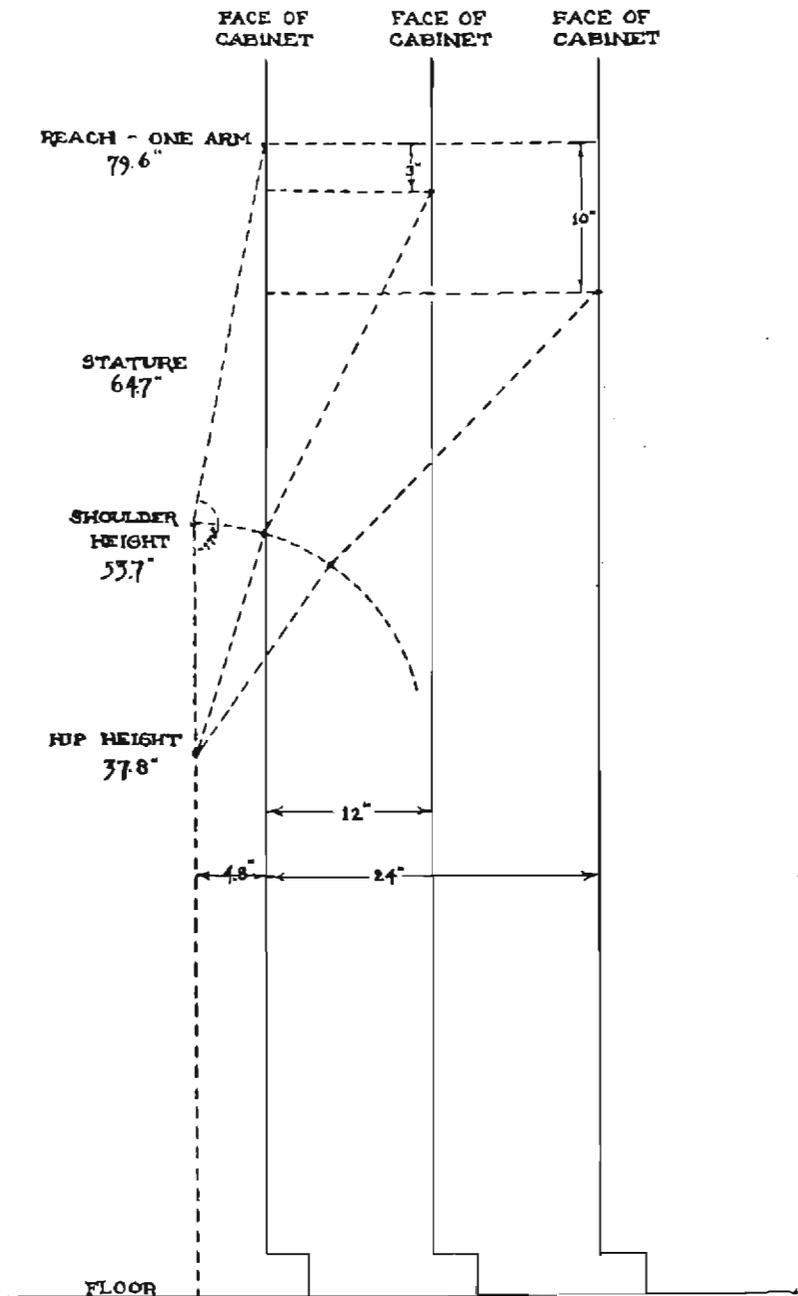


Figure 5. Differences in maximum height of reach where there is no set-back in the face of the cabinet, and where there are set-backs of 12 and 24 inches. Body measures, including angle at which arm is held, are averages of 200 cooperators selected at random. It was assumed that the slant of the arm would remain the same, the body being bent at the hip. The maximum height of reach is 3 inches less over a 12-inch and 10 inches less over a 24-inch set-back than on a vertical line.

Usually it is possible to assign light-weight, easily grasped articles to the highest shelf in a storage cabinet. Occasionally it is desirable to store on a high shelf articles (such as piles of plates) for the removal of which both hands must be used. To determine the height of shelf that is suitable for such storage, height of reach with both arms upstretched was measured. This measure is less than height of reach with one arm upstretched, occasionally by as much as 1.5 inches but more often by an inch or less.

#### Height of reach over obstruction

In arriving at the maximum height of shelves, knobs, etc., it is necessary to note whether the worker must reach over an obstruction or not. A kitchen work counter is not usually more than 24 inches wide. The storage cabinet above it is usually not more than 12 inches.

Figure 5 shows the difference in height of reach with one hand when the body is not bent at the hip, and when bent over counters 12 inches and 24 inches wide. The body measures used are the averages for 200 cooperators selected at random. The figure shows that the slant of the arm when upstretched is approximately ten degrees from the perpendicular. When this slant is maintained and the body is bent forward at the hips until the thumb tip touches the face of a cabinet 12 inches back of the first position, the height of the thumb tip is approximately 3 inches less than that of the original measure. In reaching over a 24-inch cabinet the difference is approximately 10 inches.

#### Application to design

STOCK CABINETS AND HOUSES BUILT FOR RENT OR SALE. Table 7 lists the specific measures that may be estimated from the data on height of reach of homemakers, the heights for each that would be most useful in planning

Table 7. DIMENSIONS BASED ON HEIGHT OF REACH

Maximum distances from floor of shelf surfaces, knobs, etc., estimated from height of reach of cooperators.

| Item   | Suggested height *                   |                                      |                                      |
|--|--------------------------------------|--------------------------------------|--------------------------------------|
|  | Suited to 60 per cent of cooperators | Suited to 80 per cent of cooperators | Suited to 99 per cent of cooperators |
|  | Inches                               | Inches                               | Inches                               |
| <i>Shelves for books, light-weight utensils, or packaged groceries</i> |                                      |                                      |                                      |
| No. obstruction .....  | 79                                   | 77                                   | 72                                   |
| 12-inch obstruction .....  | 76                                   | 74                                   | 69                                   |
| † <i>Shelves for stacks of plates, glasses, hats, or bedding</i>       |                                      |                                      |                                      |
| No. obstruction .....  | 74                                   | 72                                   | 67                                   |
| 12-inch obstruction .....  | 71                                   | 69                                   | 64                                   |
| ‡ <i>Knobs, etc.</i>   |                                      |                                      |                                      |
| No. obstruction .....  | 79                                   | 77                                   | 72                                   |
| 12-inch obstruction .....  | 76                                   | 74                                   | 69                                   |
| 24-inch obstruction .....  | 69                                   | 67                                   | 62                                   |
| Closest rod .....  | 81                                   | 79                                   | 74                                   |

\* Height given is lower limit when cooperators are classified by one-inch differences.

† Assume that both hands will be needed to grasp objects, also that they may need to be grasped at a point above edge of shelf. This measure can also be used for shelves intended for objects likely to be placed behind one another, such as goblets.

‡ Knobs and latches for upper cabinets; switches and controls for lights, fans, ventilators; window locks; hooks.

a house for sale or rent, and the proportion of cooperators in this study that would be suited by each height. These values should be reduced somewhat if used in planning dwellings to be occupied mainly by elderly women.

**HOUSES PLANNED FOR OWNER OCCUPANCY.** In designing a house for an individual family, a simple procedure for determining approximate maximum heights for the convenience of the homemaker is to obtain her height of reach with one arm upstretched and her distance from wrist to thumb tip, and to use these measures as the basis for dimensions as the average height of reach was used in Table 7. Following is a summary of this procedure:

- Shelves for books, light-weight utensils, or packaged groceries.
  - No obstruction—Height of shelf is height of reach measured to thumb tip.
  - 12-inch obstruction—Height of shelf is height of reach measured to thumb tip, minus 3 inches.
- Shelves for stacks of plates, glasses, cans, bedding, or hats.
  - No obstruction—Height of shelf is height of reach measured to wrist.
  - 12-inch obstruction—Height of shelf is height of reach to wrist, minus 3 inches.
- Knobs, latches, controls.
  - No obstruction—Height is that of measure of height of reach to thumb tip.
  - 12-inch obstruction—Height is that of height of reach to thumb tip, minus 3 inches.
  - 24-inch obstruction—Height is that of height of reach to thumb tip, minus 10 inches.
- Closet rod
  - No obstruction—Height of rod is that of height of reach to thumb tip, plus 2 inches.

## DIMENSIONS BASED ON EYE LEVEL

### Dimensions included

- Dimensions based on the eye level of the homemaker include:
  - Maximum height of drawer or shelf requiring vision.
  - Minimum distance between upper and lower parts of kitchen cabinet.
  - Maximum height of base of kitchen window to afford view of immediate foreground.

In utilizing the height of the eye as the basis for determining these dimensions it is necessary to make allowance for posture and distance to obstruction. The worker will direct her vision downward when she is examining the contents of a drawer, working at a cabinet, or watching children at play in the yard. She will probably be able to stand close to a chest of drawers, but may be separated from a window by the width of a cabinet. She may want a view of the yard as she sits at work at a table in the kitchen or dining room, as well as from the sink.

### Height of eyes from floor: Averages and variations

The distance of the eye level from the floor for the 562 cooperators in this study averaged 61.1 inches. This measure varied from 54 inches to

69 inches, but 72 per cent of the cooperators were included in a range of 59.0 inches to 63.9 inches. Seventy per cent measured 60 inches or more (Table 8).

Table 8. COOPERATORS CLASSIFIED WITH RESPECT TO HEIGHT OF EYES FROM FLOOR, MEASURED WHEN STANDING.

| Height           | Number of cooperators |          |                     |
|------------------|-----------------------|----------|---------------------|
|                  |                       | Per cent | Cumulative per cent |
| *54 inches ..... | 1                     | 0.2      | 100.0               |
| 55 inches .....  | 6                     | 1.1      | 99.8                |
| 56 inches .....  | 12                    | 2.1      | 98.7                |
| 57 inches .....  | 22                    | 3.9      | 96.6                |
| 58 inches .....  | 53                    | 9.4      | 92.7                |
| 59 inches .....  | 72                    | 12.8     | 83.3                |
| 60 inches .....  | 92                    | 16.4     | 70.5                |
| 61 inches .....  | 90                    | 16.0     | 54.1                |
| 62 inches .....  | 86                    | 15.3     | 38.1                |
| 63 inches .....  | 64                    | 11.4     | 22.8                |
| 64 inches .....  | 34                    | 6.1      | 11.4                |
| 65 inches .....  | 15                    | 2.6      | 5.3                 |
| 66 inches .....  | 11                    | 2.0      | 2.7                 |
| 67 inches .....  | 3                     | 0.5      | 0.7                 |
| 68 inches .....  | .....                 | .....    | .....               |
| 69 inches .....  | 1                     | 0.2      | 0.2                 |
| Total .....      | 562                   | 100.0    | .....               |

\* 54.0 inches and less than 55.0 inches. Subsequent groups similarly defined.

The eye level at sitting height averaged 29.4 inches for all cooperators in the study. For 200 selected cooperators this measure varied from 25 to 35 inches, but 72 per cent were included in a range of 28.0 to 30.9 inches. Sixty-eight per cent measured 29 inches or more (Table 9).

Table 9. COOPERATORS CLASSIFIED WITH RESPECT TO HEIGHT OF EYES FROM FLOOR, MEASURED WHEN SITTING.

| Height           | Number of cooperators |          |                     |
|------------------|-----------------------|----------|---------------------|
|                  |                       | Per cent | Cumulative per cent |
| *25 inches ..... | 1                     | 0.5      | 100.0               |
| 26 inches .....  | 8                     | 4.0      | 99.5                |
| 27 inches .....  | 18                    | 9.0      | 95.5                |
| 28 inches .....  | 37                    | 18.5     | 86.5                |
| 29 inches .....  | 62                    | 31.0     | 68.0                |
| 30 inches .....  | 45                    | 22.5     | 37.0                |
| 31 inches .....  | 22                    | 11.0     | 14.5                |
| 32 inches .....  | 5                     | 2.5      | 3.5                 |
| 33 inches .....  | 1                     | 0.5      | 1.0                 |
| 34 inches .....  | .....                 | .....    | .....               |
| 35 inches .....  | 1                     | 0.5      | 0.5                 |
| Total .....      | 200                   | 100.0    | .....               |

\* 25.0 inches and less than 26.0 inches. Subsequent groups similarly defined.

### Application to design

In Table 10 there are given dimensions derived from the measure for height of eyes from floor, and the proportions of cooperators in this study that would be suited by each dimension.

In estimating the maximum height of a shelf that is visible its entire width, it was assumed that the eye height might be raised an inch by

Table 10. HEIGHTS OF EQUIPMENT WHERE VISIBILITY IS A FACTOR, ESTIMATED FROM MEASURES OF HEIGHT OF EYES FROM FLOOR

| Item  | Dimensions suited to specified percentage of cooperators |                      |                      |
|---|--|----------------------|----------------------|
|   | At least 60 per cent                                     | At least 80 per cent | At least 99 per cent |
|   | <i>Inches</i>  | <i>Inches</i>        | <i>Inches</i>        |
| Maximum height of shelf visible for entire width.....                               | 61   | 60                   | 57                   |
| Maximum height of drawer.....   | 59   | 58                   | 55                   |
| Maximum height of lower edge of window pane (see text for complete description).... | ....   | ....                 | ....                 |
| Worker standing before a cabinet 24 inches wide.....                                | 47   | 46                   | 43                   |
| Worker seated at table. Eyes 24 inches from wall.....                               | 35   | 34                   | 33                   |

stretching the neck. In estimating that of a drawer it was assumed that the eye level might be dropped an inch.

The procedure followed in determining the maximum distance of the base of a window from the floor is shown in Figure 6. It was assumed that satisfactory supervision of children at play would be possible if the ground were visible at a point 12 feet from the house.

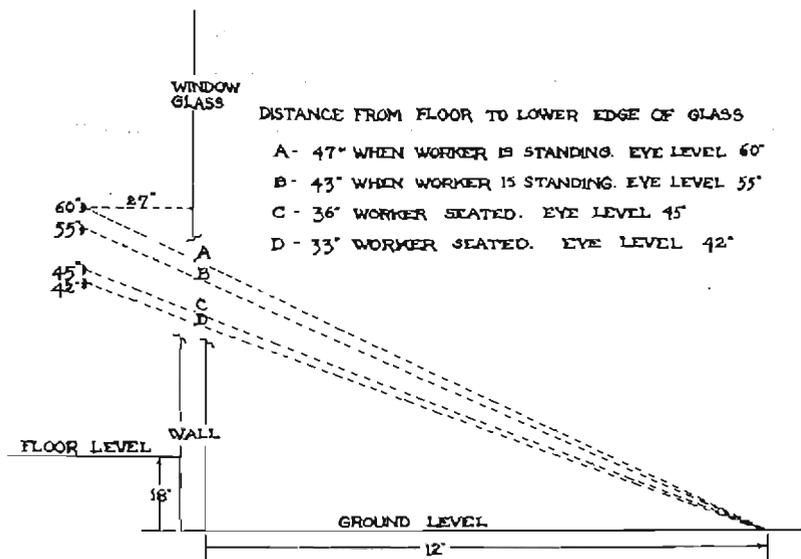


Figure 6. Maximum height of base of window permitting view of ground 12 feet from house, for worker standing and for worker sitting. To suit 60 per cent of all cooperators the base of the lower pane of the window should be at least 47 inches from the floor for the worker standing and 36 inches for the worker seated (Points A and C). To suit 99 per cent, these dimensions should be 43 inches and 33 inches respectively (Points B and D).

Construction details assumed were:

- Difference between floor and ground level, 18 inches.
- Wall thickness, 6 inches.
- Window set midway between inner and outer faces of wall.
- Top of sill 2 inches below bottom of glass.
- Outer sill sloped so as to present no interference to vision on line through lower edge of glass.

In arriving at the eye level of the seated worker, 16 inches was added to the sitting height. This is the height of a chair whose front edge is less by one inch than the height-under-knee measure of the average cooperator. This procedure does not take into account the slope of a chair toward the back, which in a work chair would be slight.

The diagram shows that to suit 60 per cent of all cooperators the base of the lower pane of glass should be not more than 47 inches from the floor for the worker standing and 35 inches for the worker seated. To suit 99 per cent these dimensions should be 43 inches and 33 inches respectively.

The minimum distance between a working surface on a level with the sink rim and a cabinet above it was estimated for the average cooperator. The procedure is illustrated by Figure 7. It was assumed that it is desirable for objects placed at the back of the working surface to be visible when the worker is standing so that the plane of the eyes is on a level with the front edge of the lower cabinet.

Data used in this calculation were:

- Height of eyes 60 inches. This is about one inch less than the eye level of the average cooperator, and allows for the posture of the head while at work.
- Height of work counter 37 inches, that of the rim of a sink 6 inches deep set 31 inches from the floor.
- Width of upper cabinet 12 inches.
- Width of lower cabinet 24 inches.

Figure 7 shows that when these measures are used, the minimum distance between the two cabinets is about 11.5 inches. When this is increased to 12 inches, an object 4 inches in diameter (as a fruit jar) placed at the back of the work table is within range of vision to the extent of 5 inches.

## SEATING ARRANGEMENTS FOR USE WHILE DOING HOUSEWORK

### Types and standards

Washing dishes and preparing vegetables often require sufficiently long periods of time to make it practical for the worker to seat herself at the sink while doing them. Hence a stool that can be used at the sink is a desirable article of kitchen equipment. Other seating arrangements desirable for use while doing housework are a chair low enough to permit one to hold a pan in one's lap, and a chair or stool to use while ironing.

Since the sink is fixed at standing height, obviously the sink stool must be higher than the chair. Conceivably the ironing board might be adjustable at heights permitting the use of either the sink stool or the low chair. At best the position of the worker seated at the sink is not a comfortable

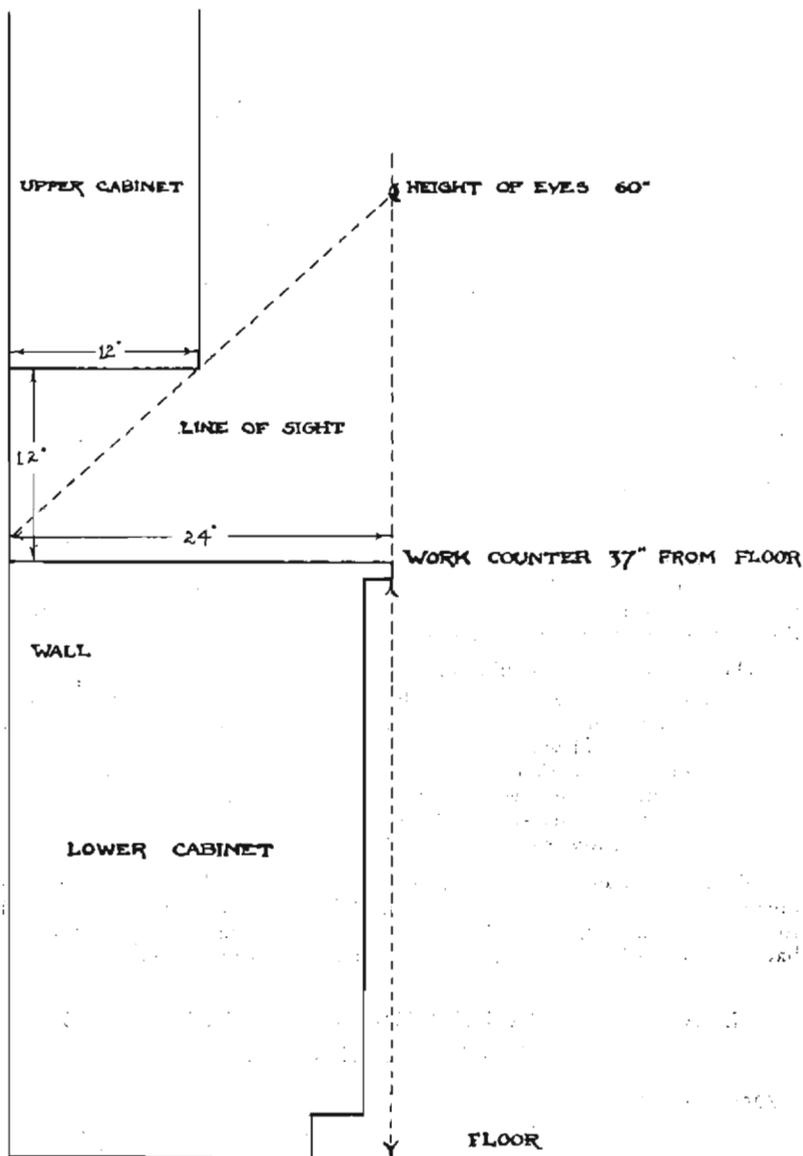


Figure 7. Minimum distance between upper and lower cabinets. The eye level is that of the average cooperator in this study, minus 1-inch allowance for posture. The work-counter level is that of the upper rim of a sink 5 inches deep, set 32 inches from the floor.

The diagram shows that an upper cabinet 12 inches wide should be at least 12 inches above a 24-inch work counter to insure view of objects at the back of it.

one. Possibly the best compromise is to gauge the height of the stool so that the worker's forearms are on a level with the sink rim. This will make it possible to work without raising the shoulders. Since this height will not permit the feet to rest on the floor, a footrest should be provided.

A seat should be low enough to make sure that there will be no pressure under the knees from its front edge. The difference between maximum seat height and the under-knee height of the user depends upon the thickness of the thigh, but it should be at least an inch (1).

#### Body measures on which dimensions are based

The height-under-knee measure varied from 13 to 19 inches, with 70 per cent of the 562 cooperators included in a range of 16 to 17.9 inches. The average was 17.0 inches (Table 11).

Table 11. COOPERATORS CLASSIFIED AS TO MEASURE FOR HEIGHT UNDER KNEE

| Height                 | Number of cooperators |          |
|------------------------|-----------------------|----------|
|                        |                       | Per cent |
| 13.0—13.4 inches ..... | 1                     | 0.2      |
| 13.5—13.9 inches ..... | .....                 | .....    |
| 14.0—14.4 inches ..... | 3                     | 0.5      |
| 14.5—14.9 inches ..... | 6                     | 1.1      |
| 15.0—15.4 inches ..... | 16                    | 2.8      |
| 15.5—15.9 inches ..... | 49                    | 8.7      |
| 16.0—16.4 inches ..... | 64                    | 11.4     |
| 16.5—16.9 inches ..... | 109                   | 19.4     |
| 17.0—17.4 inches ..... | 128                   | 22.8     |
| 17.5—17.9 inches ..... | 94                    | 16.7     |
| 18.0—18.4 inches ..... | 71                    | 12.6     |
| 18.5—18.9 inches ..... | 15                    | 2.7      |
| 19.0—19.4 inches ..... | 5                     | 0.9      |
| 19.5—19.9 inches ..... | 1                     | 0.2      |
| Total .....            | 562                   | 100.0    |

For the 562 cooperators the measure for breadth of thighs at sitting height averaged 15.7 inches. The measure varied from 11 to 22 inches, but 70 per cent were included in a range of 14.0 to 16.9 inches (Table 12).

Table 12. COOPERATORS CLASSIFIED AS TO MEASURE FOR BREADTH OF THIGHS MEASURED WHEN SITTING

| Breadth           | Number of cooperators |          |
|-------------------|-----------------------|----------|
|                   |                       | Per cent |
| * 11 inches ..... | 1                     | 0.2      |
| 12 inches .....   | 7                     | 1.2      |
| 13 inches .....   | 48                    | 8.5      |
| 14 inches .....   | 137                   | 24.4     |
| 15 inches .....   | 141                   | 25.1     |
| 16 inches .....   | 120                   | 21.4     |
| 17 inches .....   | 62                    | 11.0     |
| 18 inches .....   | 32                    | 5.7      |
| 19 inches .....   | 8                     | 1.4      |
| 20 inches .....   | 2                     | 0.4      |
| 21 inches .....   | 3                     | 0.5      |
| 22 inches .....   | 1                     | 0.2      |
| Total .....       | 562                   | 100.0    |

\* 11.0 inches and less than 12.0 inches. Subsequent groups similarly defined.

### Application to Design

**HEIGHT OF SEAT.** The work chair of the average cooperator should be not more than 16 inches high at the point just back of the front edge where it is highest. A chair of this height, however, would suit only 40 per cent of the cooperators in this study (one to two inches less than the height-under-knee measure). To suit 80 per cent of them a choice of three heights would be required, 14, 15, and 16 inches. The addition of a 17-inch chair would accommodate an additional 15 per cent. An adjustable chair should have a range of 14 to 17 inches.

**WIDTH OF SEAT.** To provide adequate support for the body it appears that a chair should be not more than two inches narrower than the breadth-of-thigh measure. Based on this standard a chair 14 inches wide would meet the requirements of about half of the cooperators in this study. A choice of a 14-inch or a 16-inch width would suit 80 per cent of them. If a choice of three widths were possible—13, 15, and 17 inches—the requirements of 96 per cent of the cooperators would be met.

**HEIGHT OF STOOL.** The data in Table 15 indicate that in many cases the cooperator would not be able to get her legs under a sink when the stool is dimensioned so that the under part of her forearm is on a level with the sink edge. This indicates the desirability of a kitchen stool that is readily adjustable as to height. Sometimes the task done at the sink is of a character that would cause the worker to adjust the height so that the position of the hands was as favorable as possible. At other times it might be set lower, giving more room for her knees. The adjustment should, of course, change the height of the footrest correspondingly.

If the stool is not adjustable, a height that brings the under-forearm of the worker on a level with the sink rim is perhaps as comfortable as any.\* Table 13 shows the distribution of 200 cooperators (100 from each of the two states cooperating in this study) with respect to the height of a stool estimated from this measure. The front of the sink (six inches deep) was assumed to measure seven inches from the rim to the under side of the bottom.

Thirty inches is the most useful single even-number height for a stool to be used at a sink seven inches deep, judging from the data in Table 13. This measure varies not more than an inch from the individual stool heights of almost half of the 200 cooperators included in the distribution. A stool made in two heights, 29 inches and 31 inches, would meet this standard for almost three-fourths of them, while one made in three heights—28, 30, and 32 inches—would take care of all but about one-tenth.

The distance from the seat to the footrest is also given in Table 13. The percentage distribution of cooperators follows very closely that given in Table 11, when one inch is subtracted from the under-knee measure. For the 28-inch and 29-inch stools, this measure should be 15 inches; for the 30, 31-, and 32-inch stools, 16 inches.

\* It may be remarked in passing that the discomfort of sitting at the sink is often needlessly increased by the addition of an "apron" or wide strip of wood below the rim. The space in front of the sink bowl should be open. There should also be leg and foot room below the sink.

Table 13. HEIGHT OF KITCHEN STOOL AND POSITION OF FOOTREST

Cooperators classified for height of stool for use at a kitchen sink measuring 7 inches from rim to under side of bottom, and for distance from seat of stool to footrest.

| Height of stool  | Number of cooperators with a given measure from seat of stool to footrest |           |           |           |           |           |           | Total |
|------------------|---|-----------|-----------|-----------|-----------|-----------|-----------|-------|
|                  | 12 Inches   | 13 Inches | 14 Inches | 15 Inches | 16 Inches | 17 Inches | 18 Inches |       |
| *24 inches ..... | 1   | ....      | ....      | ....      | ....      | ....      | ....      | 1     |
| 25 inches .....  | ....  | 1         | ....      | 1         | ....      | ....      | ....      | 2     |
| 26 inches .....  | ....  | 1         | 1         | ....      | 2         | ....      | ....      | 4     |
| 27 inches .....  | ....  | ....      | 2         | 2         | ....      | 1         | ....      | 5     |
| 28 inches .....  | ....  | 1         | 6         | 9         | 8         | ....      | ....      | 24    |
| 29 inches .....  | ....  | ....      | 12        | 18        | 11        | 3         | ....      | 44    |
| 30 inches .....  | ....  | ....      | 1         | 16        | 23        | 8         | ....      | 48    |
| 31 inches .....  | ....  | ....      | ....      | 9         | 23        | 7         | ....      | 39    |
| 32 inches .....  | ....  | ....      | 1         | 3         | 10        | 4         | ....      | 18    |
| 33 inches .....  | ....  | ....      | 1         | 2         | 5         | 1         | 1         | 10    |
| 34 inches .....  | ....  | ....      | ....      | ....      | ....      | 1         | ....      | 1     |
| 35 inches .....  | ....  | ....      | ....      | ....      | ....      | 2         | 1         | 3     |
| 36 inches .....  | ....  | ....      | ....      | ....      | ....      | 1         | ....      | 1     |
| Totals .....     | 1   | 3         | 24        | 60        | 82        | 28        | 2         | 200   |

\* 24.0 inches and less than 25.0 inches. Subsequent groups similarly defined.

Sinks deeper or shallower than seven inches would require correspondingly higher or lower stools. To make it possible for 75 per cent of the cooperators to obtain stools that bring the under-forearm level not more than an inch above or below the sink rim, there would need to be available on the market stools of even-number heights from 27 to 32 inches. To meet this standard for 90 per cent, the choice of stool heights would range from 26 to 33 inches. This range emphasizes the desirability of the adjustable type of stool.

## PLANNING DESK AND TABLES FOR SEATED WORKER

### Dimensions included

The kitchen planning desk should be dimensioned for the convenience of the homemaker when seated comfortably. Other articles of equipment that are sometimes dimensioned for the seated worker are the mixing table, sewing table (basting, pinning), and ironing board.

### Body measures and application to design

**HEIGHT OF KITCHEN PLANNING DESK.** The optimum height of the planning desk is that of the under-forearm\* when the worker is seated on a chair one inch lower than her under-knee measure (1). This measure was obtained for 200 cooperators by adding the under-forearm-to-seat measure to that of a chair (under-knee height minus one inch) (Table 14). The measure varied from 21.8 to 28.5 inches, with an average of 24.8 inches. A height of 25 inches would vary from the optimum of more than half the cooperators by not more than one inch.

Table 14 includes also a distribution of cooperators with respect to the distance from the floor to the top of the thighs, allowing a two-inch margin for the thickness of the table top. It is clear that for some cooper-

\* The Bennett standard was modified by substituting forearm for elbow, as in the adult woman the forearm is sometimes fleshy (1).

ators there is less than two inches difference between the top of the thighs and the under-forearm. This difference is shown in Table 15.

**HEIGHT OF MIXING TABLE, IRONING BOARD, AND SEWING TABLE.** The height of the mixing table and ironing board should not be less than that of the top of the thighs of the seated worker, plus two inches for thickness of the table and construction below it. This standard is the minimum possible with ordinary wood construction, but it is still too high for the most comfortable arm movement.

This measure averaged 23.4 inches for 200 cooperators (Table 14). A table 24 inches high would meet the requirements of two-thirds, and a table 26 inches high, 99 per cent of the cooperators.

Table 14. HEIGHT OF WORKING SURFACE FOR SEATED WORKER

Distribution of 200 cooperators in respect to distance from floor to under-forearm and to distance from floor to top of thigh plus two inches. The latter measurement determines the minimum table height for a seated worker.\*

| Distance         | Number of cooperators, measuring from floor to under-forearm |          | Number of cooperators, measuring to top of thighs plus 2 inches |       | Cumulative per cent |
|------------------|--|----------|---|-------|---------------------|
|                  |  | Per cent | Per cent  |       |                     |
| 120 inches ..... | .....  | .....    | 6   | 3.0   | 3.0                 |
| 21 inches .....  | 1  | 0.5      | 16  | 8.0   | 11.0                |
| 22 inches .....  | 12   | 6.0      | 47  | 23.5  | 34.5                |
| 23 inches .....  | 42   | 21.0     | 63  | 31.5  | 66.0                |
| 24 inches .....  | 59   | 29.5     | 50  | 25.0  | 91.0                |
| 25 inches .....  | 53   | 26.5     | 16  | 8.0   | 99.0                |
| 26 inches .....  | 21   | 10.5     | 2   | 1.0   | 100.0               |
| 27 inches .....  | 11   | 5.5      | .....   | ..... | .....               |
| 28 inches .....  | 1  | 0.5      | .....   | ..... | .....               |
| Total .....      | 200  | 100.0    | 200   | 100.0 | .....               |

\* Adding two inches to distance from top of thigh to floor allows for thickness of table top. Both distances were determined for worker seated on a chair one inch less in height than her under-knee measure.

† 20.0 inches and less than 21.0 inches. Subsequent groups are similarly defined.

**DISTANCE FROM TABLE TOP TO BOTTOM OF APRON.** Ideally the thickness of the table top and the construction below it should not be greater than the distance between the under-forearm and the top of the thighs. For the 562 cooperators in the study this measure varied from minus .4 inch to more than 7 inches, with an average of 3.3 inches. To suit at least three-fourths of the cooperators the table construction should not measure more than 2.5 inches in thickness (Table 15).

**MINIMUM WIDTH OF SPACE FOR THIGHS.** The minimum space between table legs is based on the measurement for breadth of thighs at sitting height given in Table 12. A space 18 inches wide will afford adequate thigh room for at least 60 per cent of the cooperators; a width of 19 inches for 80 per cent; and 22 inches for 99 per cent of them. This allows 2 inches beyond the breadth of the body itself.

**MINIMUM WIDTH OF KITCHEN PLANNING DESK.** The minimum width for the kitchen planning desk is the measure for breadth of body across elbows, plus 4 inches (Table 16). The average was 23.1 inches. A table 24 inches wide would meet the needs of two-thirds of the cooperators, and a 29-inch table of 99 per cent of them.

Table 15. DISTANCE FROM TOP OF THIGH TO FOREARM

Distribution of 562 cooperators in respect to distance between top of thigh and under part of forearm when worker is seated.

| Distance                            | Number of cooperators,<br>measuring from top of<br>thigh to under-forearm |          |                        |
|-------------------------------------|---|----------|------------------------|
|                                     |   | Per cent | Cumulative<br>per cent |
| -0.5 to -0.1 inches inclusive ..... | 1   | 0.2      | 100.0                  |
| 0.0-0.4 inches .....                | 3   | 0.5      | 99.8                   |
| 0.5-0.9 inches .....                | 8   | 1.4      | 99.3                   |
| 1.0-1.4 inches .....                | 16  | 2.9      | 97.9                   |
| 1.5-1.9 inches .....                | 41  | 7.3      | 95.0                   |
| 2.0-2.4 inches .....                | 68  | 12.1     | 87.7                   |
| 2.5-2.9 inches .....                | 71  | 12.6     | 75.6                   |
| 3.0-3.4 inches .....                | 95  | 16.9     | 63.0                   |
| 3.5-3.9 inches .....                | 84  | 15.0     | 46.1                   |
| 4.0-4.4 inches .....                | 64  | 11.4     | 31.1                   |
| 4.5-4.9 inches .....                | 47  | 8.3      | 19.7                   |
| 5.0-5.4 inches .....                | 32  | 5.7      | 11.4                   |
| 5.5-5.9 inches .....                | 18  | 3.2      | 5.7                    |
| 6.0-6.4 inches .....                | 8   | 1.4      | 2.5                    |
| 6.5-6.9 inches .....                | 5   | 0.9      | 1.1                    |
| 7.0-7.4 inches .....                | 1   | 0.2      | 0.2                    |
| Total .....                         | 562   | 100.0    | .....                  |

Table 16. MINIMUM WIDTH OF KITCHEN PLANNING DESK

Distribution of 562 cooperators in respect to minimum width of table required by a seated worker. Measure obtained by adding 4 inches to that of breadth of body across elbows bent at right angles.

| Breadth          | Number of cooperators,<br>measuring breadth of body<br>across elbows, plus 4 inches |          |                        |
|------------------|---|----------|------------------------|
|                  |   | Per cent | Cumulative<br>per cent |
| *17 inches ..... | 1   | 0.2      | 0.2                    |
| 18 inches .....  | 1   | 0.2      | 0.4                    |
| 19 inches .....  | 8   | 1.4      | 1.8                    |
| 20 inches .....  | 58  | 10.3     | 12.1                   |
| 21 inches .....  | 100   | 17.8     | 29.9                   |
| 22 inches .....  | 108   | 19.2     | 49.1                   |
| 23 inches .....  | 111   | 19.7     | 68.8                   |
| 24 inches .....  | 84  | 15.0     | 83.8                   |
| 25 inches .....  | 56  | 10.0     | 93.8                   |
| 26 inches .....  | 20  | 3.6      | 97.4                   |
| 27 inches .....  | 7   | 1.2      | 98.6                   |
| 28 inches .....  | 5   | 0.9      | 99.5                   |
| 29 inches .....  | 2   | 0.3      | 99.8                   |
| 30 inches .....  | 1   | 0.2      | 100.0                  |
| Total .....      | 562   | 100.0    | .....                  |

\* 17.0 inches and less than 18.0 inches. Subsequent groups similarly defined.

## OTHER SPACE UNITS

### Width of working surface

After each cooperator had selected her optimum height for rolling out pastry, she was asked to stand with her body against the table, raise her arms until they were parallel to the table top, and lower them until her fingertips touched the surface.

The average of all cooperators for the distance from the edge of the table to the fingertips was 14.0 inches. Individual amounts varied from 7

to 18 inches, but 76 per cent were within a range of twelve to fifteen inches (Table 17).

Table 17. WIDTH OF WORKING SURFACE

Distribution of 541 cooperators in respect to depth of reach on surface of height selected as optimum for rolling pastry.

| Depth           | †Number of cooperators,<br>measured for reach on surface<br>selected as optimum for<br>rolling pastry |                        |
|-----------------|---|------------------------|
|                 | Number  | Cumulative<br>per cent |
| *7 inches ..... | 1   | 0.2                    |
| 8 inches .....  | 2   | 0.4                    |
| 9 inches .....  | 3   | 0.5                    |
| 10 inches ..... | 9   | 1.7                    |
| 11 inches ..... | 29  | 5.3                    |
| 12 inches ..... | 76  | 14.1                   |
| 13 inches ..... | 98  | 18.1                   |
| 14 inches ..... | 127   | 23.5                   |
| 15 inches ..... | 111   | 20.5                   |
| 16 inches ..... | 53  | 9.8                    |
| 17 inches ..... | 20  | 3.7                    |
| 18 inches ..... | 12  | 2.2                    |
| Total .....     | 541   | 100.0                  |

\* 7.0 inches and less than 8.0 inches. Subsequent groups similarly defined.

† This measure was omitted from the tests of 21 cooperators because of lack of time.

Figure 8 illustrates the arc described by the fingertips when the arm is lowered, the person standing erect. Shoulder height, arm length, and distance from line of shoulder to edge of surface are the averages for 200 cooperators selected at random. Activity heights are the averages of those chosen by all cooperators in the study (Table 1).

The diagram shows that when the depth of reach on the rolling surface is approximately 14 inches, that on the sink bottom is 12 inches and that on a table of the height selected for beating is 10.5 inches.

The foregoing data are offered with the thought that they may be useful in arriving at the optimum width required for a working surface intended for specific uses. In making an application of this sort it is necessary to take into account the tools used, whether forward motion is required (as is the case with rolling out pastry), the position of the arms and hands, and the dimensions of containers for supplies that it is desirable to keep in front of the worker.

The measure for minimum width of the food-preparation table is 24 inches when to the average depth of reach at this height, 14 inches, there are added 4 inches for forward motion and 6 inches for the diameter of containers.

The estimated depth of reach at the sink level emphasizes the advantage of a sink with a narrow front edge.

#### Toe space

The table used in the tests for preferred working heights was open underneath. The observer drew a chalk line on the floor 1.5 inches back of a perpendicular dropped from the front edge, and noted whether or not the cooperator stepped across the line any time during the test. If she did, the maximum amount was marked, and the cooperator's foot measured

for length to toe tip from the point where it crossed the line, also for thickness at this point.

About three of each five cooperators stepped across this line some time during the test. The observers thought that this number would probably be greater if the tasks were continued for longer periods because one tends to obtain rest through change of position. It is likely also that the women would have stepped over the line more often if they had been doing routine kitchen work, going frequently from one task to another, than they did in the laboratory where their performance was thoughtful and deliberate.

Of the 130 Oregon women from whom information was received on this point, slightly more than half reported that the cabinets in their home

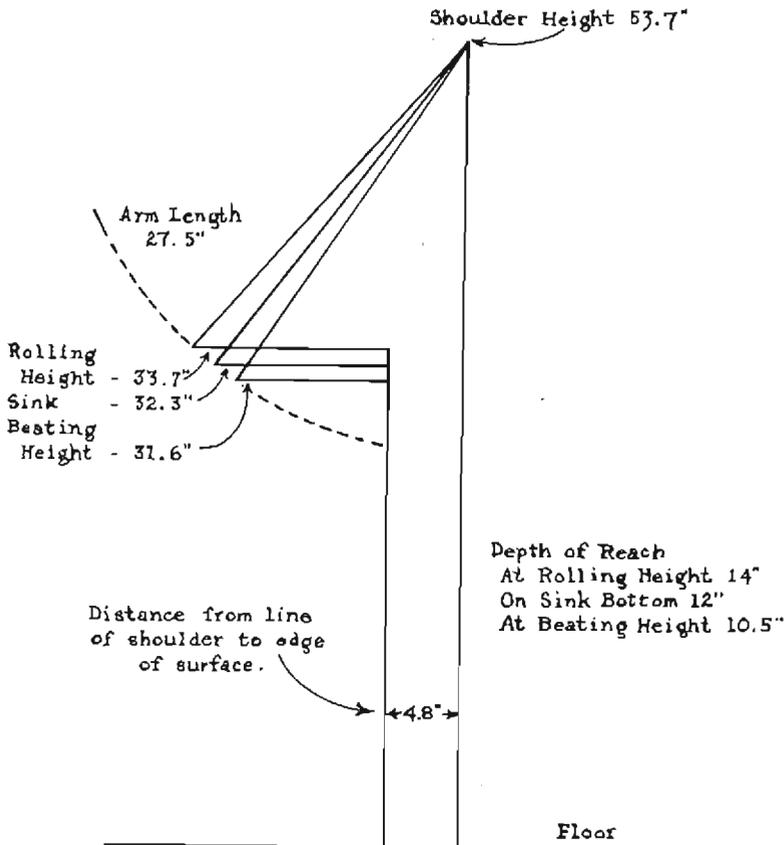


Figure 8. Relation of depth of reach to height of surface. Body measures are the average for 200 selected cooperators. Activity heights are those for all cooperators (Table 14).

The diagram shows that the approximate depth (front to back) of the surface used by the average worker is 10.5 inches at the preferred height for beating, 12 inches at the dishwashing height, and 14 inches at the height desirable for a pastry board.

kitchens were provided with toe-room. The use of toe-room in the laboratory showed no relationship to the presence of toe-room in the home kitchen.

Table 18. MINIMUM DIMENSIONS OF TOE SPACE

Distribution of 192 Oregon cooperators (those requiring some toe-room during test) in respect to length and thickness of foot measured from mark on line with front edge of cabinet.

| Length of foot<br>beyond mark | Number cooperators, measured for<br>thickness of foot |                            |                            |                            |                            |                            | Total |
|-------------------------------|---|----------------------------|----------------------------|----------------------------|----------------------------|----------------------------|-------|
|                               | 0.6<br>to<br>1.0<br>inches                            | 1.1<br>to<br>1.5<br>inches | 1.6<br>to<br>2.0<br>inches | 2.1<br>to<br>2.5<br>inches | 2.6<br>to<br>3.0<br>inches | 3.1<br>to<br>3.5<br>inches |       |
| 0.1—0.5 .....                 | ....  | 1                          | ....                       | ....                       | ....                       | ....                       | 1     |
| 0.6—1.0 .....                 | ....  | 2                          | ....                       | ....                       | ....                       | ....                       | 2     |
| 1.1—1.5 .....                 | 1   | 12                         | ....                       | 2                          | 1                          | ....                       | 16    |
| 1.6—2.0 .....                 | ....  | 20                         | 7                          | 1                          | ....                       | ....                       | 28    |
| 2.1—2.5 .....                 | ....  | 19                         | 11                         | 1                          | ....                       | 1                          | 32    |
| 2.6—3.0 .....                 | ....  | 9                          | 24                         | 4                          | 1                          | 1                          | 39    |
| 3.1—3.5 .....                 | ....  | 4                          | 52                         | 6                          | ....                       | ....                       | 62    |
| 3.6—4.0 .....                 | ....  | ....                       | 6                          | 4                          | ....                       | ....                       | 10    |
| 4.1—4.5 .....                 | ....  | ....                       | 1                          | ....                       | ....                       | ....                       | 1     |
| 4.6—5.0 .....                 | ....  | ....                       | ....                       | ....                       | ....                       | ....                       | ....  |
| 5.1—5.5 .....                 | ....  | ....                       | ....                       | 1                          | ....                       | ....                       | 1     |
| Total .....                   | 1   | 67                         | 101                        | 19                         | 2                          | 2                          | 192   |

The extent to which the feet of cooperators were extended over the line marked the base, and the thickness of the foot at this point, are shown in Table 18. The foot was often extended over the line as much as 3 inches but seldom more than 3.5 inches. Nine of the twelve individuals with toe-room lengths greater than 3.5 inches are taller than the average of all cooperators. Feet were seldom more than 2.5 inches thick at the point where they crossed the mark.

A work cabinet with a solid base should by all means be provided with toe-room not only for the comfort of the worker but also in the interests of shoe economy and the appearance of the base of the cabinet. For the house built to sell or rent an inset should measure at least 4 inches front to back and 3 inches vertically. Where a kitchen is being designed for a tall woman the width may need to be increased to 4.5 or 5 inches. If for a woman with an unusually thick foot, the vertical dimension of the inset may need to be increased to 3.5 inches. These dimensions do not allow for the thickness of a quarter round or other moulding used where floor and cabinet meet. If the upper edge of the inset is rounded or slanting, the vertical measure of the inset may be 2.5 inches rather than 3 inches.

An inset only 2.5 or 3 inches high would, of course, be hard to keep clean. It would be desirable to increase this measure unless vertical space is at a premium. A further aid is a concave moulding used at the back of the inset.

### Passages

Minimum space to pass between built-ins or pieces of furniture of less than elbow height may be estimated from the measure for breadth of body at hips. Space between higher articles may be estimated from the measure across the elbows. Another dimension based on the same measures is that of the minimum distance from the left end of the sink bowl to the place

where the built-in makes a right-angle turn, to allow space for two workers at the sink.

Where two inches "clearance" were added to body measures, the average below-elbow measure was found to be 16.4 inches. A 17-inch space meets the requirement for two-thirds of the cooperators; a 21-inch space for 99 per cent. The average for space between higher cabinets is 21.1 inches. A 22-inch space suffices for two-thirds of the cooperators; a 26-inch space for 99 per cent of them.

## REFERENCE LIST OF STANDARDS

The following dimensions of various space units and equipment have been assembled from previous pages. They are based upon analyses of the preferences and physical requirements of cooperators in this study.

### A. DIMENSIONS SUITED TO REQUIREMENTS OF THE AVERAGE HOMEMAKER.

|  | <i>Inches</i> |
|--|---------------|
| Preferred heights of working surfaces, worker standing   |               |
| Floor of sink .....  | 32½           |
| Mixing table .....   | 32            |
| Pull-out pastry board .....  | 33½           |
| Bottom of sink 5 inches or more deep when sink drainboard is used as mixing table .....  | 31            |
| Ironing board .....  | 32½           |
| Cutting table .....  | 35½           |
| Preferred heights of equipment used by workers seated (2 inches allowed for thickness of table top and clearance above thighs) |               |
| Kitchen planning desk .....  | 25            |
| Mixing table .....   | 24            |
| Ironing board .....  | 24            |
| Sewing table .....   | 24            |
| Maximum distance from top of table (for seated worker) to lower edge of construction below table top .....                     | 3½            |
| Minimum width (side to side) of open space below table for worker seated .....   | 18            |
| Minimum width (side to side) of top of table for worker seated .....   | 24            |
| Minimum toe space  |               |
| Width (front to back) .....  | 4             |
| Height .....   | 3             |
| Maximum height of shelf for articles in frequent use   |               |
| a. No obstruction  |               |
| Shelves for books and light-weight articles .....  | 79            |
| Shelves for plates, hats, bedding .....  | 74            |
| b. Obstruction 12 inches wide (as in reaching over work counter)   |               |
| Shelves for books, etc. ....   | 76            |
| Shelves for plates, etc. ....  | 71            |
| Maximum height of shelf visible throughout entire width .....  | 61            |
| Maximum height of drawer .....   | 59            |
| Maximum height of knobs, latches, switches and controls, locks, hooks  |               |
| No obstruction .....   | 79            |
| 12-inch obstruction .....  | 76            |
| 24-inch obstruction (as in reaching over sink to window latch) .....   | 69            |
| Maximum height of pole in clothes closet .....   | 81            |
| Maximum height of base of window permitting view of yard 12 feet from house  |               |
| Worker standing .....  | 47            |
| Worker seated .....  | 35            |
| Minimum passage  |               |
| Between equipment of less than elbow height .....  | 17            |
| Between cabinets above elbow height .....  | 21            |
| Maximum height of seat of work chair .....   | 16            |
| Minimum width of seat of chair or stool .....  | 14            |
| Height of seat of stool for use at sink  |               |
| Sink 8 inches deep .....   | 31            |
| Sink 7 inches deep .....   | 30            |
| Sink 6 inches deep .....   | 29            |
| Sink 5 inches deep .....   | 28            |

### B. DESIRABLE VARIATIONS IN DIMENSIONS OF ARTICLES AVAILABLE ON THE MARKET, OR IN POSSIBLE HEIGHT ADJUSTMENTS.

|                                       |            |
|---------------------------------------|------------|
| Height of floor of pedestal-type sink |            |
| If two variations .....               | 31, 34     |
| If three variations .....             | 30, 32, 34 |

|  |                |
|--|----------------|
| Height of food-preparation cabinet           |                |
| If two variations                            | 30, 33         |
| If three variations                          | 30, 32, 34     |
| Height of ironing board, worker standing     |                |
| If two variations                            | 31, 33         |
| If three variations                          | 30, 32, 34     |
| Height of ironing board, worker seated       |                |
| If two variations                            | 22, 24         |
| If three variations                          | 21, 23, 25     |
| Height of sewing table, worker seated        |                |
| If two variations                            | 22, 24         |
| If three variations                          | 21, 23, 25     |
| Height of seat of work chair                 |                |
| If three variations                          | 14, 15, 16     |
| If four variations                           | 14, 15, 16, 17 |
| Width of seat of chair or stool              |                |
| If two variations                            | 14, 16         |
| If three variations                          | 13, 15, 17     |
| Height of stool and footrest for use at sink |                |
| Desirable range in heights                   | 26 to 32       |
| Distance of footrest from seat               |                |
| 26-inch and 27-inch stools                   | 15             |
| 28-inch and 29-inch stools                   | 15 and 16      |
| 30-inch, 31-inch, and 32-inch stools         | 16             |

### SUGGESTED TOPICS FOR FUTURE STUDY

1. Space units of the dwelling or articles of equipment used mainly by homemaker, other than those included in this study. These include: kitchen stove, laundry trays, washing machine, sewing machine, ironer, baby table, baby crib, dressing table, rest chair.
2. Equipment and space units of the dwelling for which the requirements of men determine optimum, minimum, or maximum dimensions.
3. Equipment and space units of the dwelling for which the requirements of children determine optimum, minimum, or maximum dimensions.
4. Dimensions of equipment and space units of the dwelling for which the requirements of men and women, or adults and children, must be considered. Examples: dining table, stairs, position of stair-rails, bathroom mirror, bath tub.

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