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Nutritional status of Iowa State College women: VI. Factors contributing to variability in basal metabolism

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NUTRITIONAL STATUS OF IOWA STATE COLLEGE WOMEN
VI. FACTORS CONTRIBUTING TO VARIABILITY IN BASAL METABOLISM

by

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I. ACKNOWLEDGMENTS

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II. INTRODUCTION

The literature on basal metabolism is full of figures on the percentage deviation of observations from certain set standards but, until recently, practically nothing has been written about the normal variability present in the basal metabolism. Little attempt has been made to understand what is perhaps one of the foremost characteristics of all biological phenomena. The paucity of data on variability probably is due to the persistence of the early concept of basal metabolism as some one lowest figure. The tenacity with which this idea has been held may be found in the recent discussion of Means (1937) on the value of the basal metabolic rate in which he says:

> It should be remembered that basal metabolic rates are never too low (except when a technical error or inward leak in the apparatus occurs or when the subject goes to sleep). All the factors which tend to make a reading inaccurate tend to make it too high: food, failure to eat properly, emotion, fever and so forth. Therefore, a single low reading has more significance than a single high one. (p. 146)

It has remained for Boothby and Berkson of the Mayo Foundation to develop a truly workable definition of basal metabolism:

> The phrase "basal metabolism" as well as the German term "Grundumsatz" was of advantage in the early days of investigation of the energy of metabolism in that it emphasized the necessity of carefully excluding all determinations not carried out under the strictly standard conditions which are intended to exclude the effects of the influence of food, previous exercise, muscular movement, mental and physical irritation, fear, restlessness and the elevation of body temperature as well as

> extremes of environmental temperature. Unfortunately the use of the term has led in recent years to the almost subconscious acceptance of the erroneous idea that of any two or more determinations carried out on the same individual the lowest or the lower group of such a series were the correct ones and that the higher ones were vitiated by the presence of some unknown disturbing factor. Variability is a universal biological phenomenon, it must be taken account of by proper statistical methods and not excluded by a predetermined selection of results.----Only by such a treatment can one hope to correct the erroneous notion that there is a single lowest "basal" metabolism for each individual, and to emphasize the fact that metabolism is a variable quantity that can be standardized but not absolutely fixed. (Boothby, et al. 1936, pp. 468-9).

The same group has expounded further the necessity for the clarification of our understanding of the definition of "basal metabolism" and the recognition and acceptance of a phenomenon which has always been an integral part of it:

> ------as Krogh has stated, it might have been better to have used the term "standard metabolism" for the entire concept has been confused by the implications of the term "basal" and the ideas it embodies. From the truth that basal metabolism is generally lower than metabolism measured under "non-basal" conditions has grown the fallacious idea that basal metabolism is <u>lowest</u> metabolism. From the truth that basal metabolism is less variable than metabolism measured under uncontrolled conditions has insidiously grown an attitude toward basal metabolism as a quantity which is <u>fixed</u>. These erroneous ideas are never given explicit statement but they are tacit implications in a considerable amount of work, even important work by the best authorities. We wish to emphasize --- that "basal metabolism" as an actual observation is one made under certain defined standard conditions, conditions which while well considered and soundly established are nevertheless to a considerable degree arbitrary; even if these conditions are rigidly adhered to, the measurement will be <u>variable</u>, even as is any biological observation. It follows at once that there is no one <u>lowest</u> metabolism that has a prerogative to be considered <u>the</u> basal metabolism over any other measurement of metabolism made under standard conditions. ----- Once the aspect of variability of metabolism is clearly grasped and deliberately accepted problems will present themselves, the solution of which will be immediately enlightening,

> and other old problems will be seen in a different view. Thus in the analysis of basal metabolism data due regard must be given to the variable character of the data as well as for its central character. (Boothby, Berkson and Plummer, 1937.)

One cannot help but feel the aptness of the suggestion of a new viewpoint to be gained on old problems as well as new problems when the concept of variability has been accepted. The failure to recognize variation as a characteristic of basal metabolism may well be responsible for much of the confusion and contradiction present in reported studies. Each investigator has drawn conclusions on the basis of his own restricted observations without due allowance for the effect which normal variation might have on those conclusions.

Lewis (1936) likewise has called attention to the problem of variability and to the fact that one must be clear in that which he defines as basal metabolism. Because of variability a distinction should be made between what Lewis has called minimum metabolism which is the hypothetic value approached in a long series of values by the lowest value of the series and basal metabolism which is that most representative value of the subject's state under defined conditions of basality.

A clear understanding of the implications of the term basal metabolism and an appreciation of the concept of variability are fundamental to a consideration of the metabolism of college women. Perusal of the literature of the past twenty years on the basal metabolism of women in the college and immediate pre-college years has focused attention on two points: the first observation is that this age group has shown basal metabolic rates which are consistently lower than those predicted from standards formed by earlier workers and confusion has arisen from the numerous attempts to explain these deviations from standards; the second observation is that great variability is found in basal metabolic tests made on women of college age.

One problem which must be recognized in considering a lack of correlation between observed and predicted values for basal metabolism of this age group is that the range 17 to 22 years represents one of the least adequately surveyed age intervals in the field of practical basal metabolism due to the comparative dearth of data for this group at the time when classical reference standards were formulated. It is the methods used in tentatively bridging this gap in experimental observations which have given rise to predictions contradictory and confusing in practice (Stark, 1933). Gustafson and Benedict (1928) believe that colleges have an unusual opportunity to secure the cooperation of subjects for basal metabolism tests. College subjects should be satisfactory as material on which to base a standard since none of the factor of apprehension, due to the clinical situation found in certain present standards, (Boothby and Sandiford; Mayo Foundation) would be operating. Certain irregularities may be present which are peculiar to this age group; others may be attributed to the college environment.

One would be interested in the possible measurement of these effects, if any, on basal metabolism.

Many attempts have been made to explain the discrepancy between observed and predicted basal metabolism. Most of these explanations have centered about one of two hypotheses: prediction standards have been set too high, or there is a fairly widespread, low grade, chronic undernutrition present among college women. The interpretations of a number of investigators, whose conclusions rest primarily on the manipulation and selection of data, have been in accord with the latter view. More work needs to be done with the problem itself. Definite efforts have to be made to determine the presence or absence of undernutrition by objective measurements, and these measurements in turn correlated with the basal metabolism. At the present time body weight is often interpreted as an expression of undernutrition. Many college women have been observed to be somewhat underweight as compared with present height and weight standards. It is possible that this is an expression of undernutrition; however, the stage of the maturation process in the women of college age has not been carefully considered. Observations of these young women suggest that they are lean rather than undernourished. Though the usual adult fat pads are lacking, their muscle structure seems to be satisfactory. From these observations one believes that the underweight could be a sign of lack of maturity rather than any true undernutrition. Continued unsuspected growth may be an unrecognized variable.

The second explanation of the discrepancy between observed and predicted heat production, that the standards established for women of this age are too high, may be held for later consideration with one comment: Stark (1930) has questioned whether the metabolism for this period should be predicted by the same methods that have proved suitable for adults, or whether such subjects should be considered as growing children.

In the past the concept of variability has been presented but no one has grasped it as a tool to use in elucidating the discrepancies which have troubled and confused investigators. No one has realized or at least no one has developed the implications of this concept. Too often the variability which is particularly noticeable in women of early college years has been dismissed as poor technic and has been covered up by the repetition of tests with the selection of only those figures which agreed within an arbitrarily set range so that the natural variability characteristic of the measurement of a biological process has been overlooked. A methodical attack with objective statistical methods on factors which might enter into the instability of the basal metabolism of this age group should be productive of increased understanding of the whole problem.

This study attempts first to present a picture of the basal metabolism of the college woman, as she lives in her normal surroundings, unrestricted by artificially superimposed restraints, except the post absorptive state. To our knowledge it will be the first study made in which the college woman has been observed so completely unhampered by restrictions. This study also presents the largest section of a normal college population so far recorded. It is, secondly, an attempt to segregate and evaluate some of the factors entering into the variability of the basal metabolism of college women, and to clarify to some extent the existing lack of parallelism between standards and current observations on college women. Because of the first and most important objective it has not been feasible to plan the experiment in the form of a design from which the effects of certain factors on variability may be obtained most advantageously and with the greatest statistical ease. This is an admitted disadvantage. However, such a design is incompatible with obtaining the physiologic objective of the basal metabolism of a college woman in her usual environment. If the present study accomplished nothing more than a picture of the basal metabolism of the college woman as she lives with such side lights as may be thrown on related problems, the author would feel it has been a worthwhile undertaking. However, even without this design, though necessarily at greater effort and less directly, some indication has been gained as to the place of certain factors in the variability of the metabolism of college women.

III. REVIEW OF LITERATURE

A. Basal Metabolism Studies on College Women

Twenty basal metabolism studies which include women of college age have been published since 1920. The data of these investigations have been summarized previously (Young, 1937). Immediately one observed the lack of information given in these reports concerning the subject's environment during measurement, which makes it difficult to compare the results obtained by different investigators. Likewise, the method of selection of data and the number of observations made may have entered into the interpretation of the final results.

Most previous studies have been made to correlate basal metabolism with some other factor such as altitude (McKittrick, 1936), menstruation (Blunt and Dye, 1921; McCord, 1939), diet (Coons, 1931a, 1932, Hetler, 1932), season (Gustafson and Benedict, 1928), sleep (Benedict and Crofts, 1925), climate (Tilt, 1935), or iodine content of the soil (Remmington and Culp, 1931). A more limited group of investigations (McKay, 1928, 1930; Stark, 1932, 1933, and 1935) have been undertaken purely for the purpose of evaluating standards. The experimental situation in practically all of these studies has been modified in some way from normal living conditions, either in insistence on a given number of hours sleep or in quantitative or qualitative restriction of the previous food intake or activity.

In all studies reported with the exception of Rogers (1939), it was noted (Young, 1937) that the average observed oxygen consumption fell below the prediction for the subject studied. In general the standard proposed by Aub and DuBois (1915) or this standard modified by Boothby and Sandiford (1922 and 1929), or the extrapolated Harris and Benedict standard (1919) has been used for comparison. The latter appeared to be a somewhat more successful standard for these ages, judged on the basis of a lower percentage deviation of the observed from the predicted heat production. The new Mayo Foundation standards proposed in 1936 by Boothby, Berkson and Dunn give somewhat lower predictions for this age group. In the one study of college women in which this standard has been applied, the deviation from prediction was less than the Harris-Benedict standard by approximately 1.5 to 2 percent (Rogers, 1939).

B. Factors Contributing to Variability in Observed Basal Metabolism

1. Some factors inherent in the metabolic process itself and affecting its conditions of measurement.

a. Interindividual and intraindividual variability.

(1). Origin of concept. The idea of variability in the basal metabolism of an individual or between different individuals had a rather vague beginning expressed in terms of range of observed deviations from an average. Blunt and Dye (1921) report for their subjects that the daily variations in individuals were great, ranging from 7.4 to 28.8 percent or an average of 13.2 percent. This is slightly less than the average of 18.9 percent which Benedict found in a group of individuals observed five days or more. Blunt justifiably suggested that erroneous conclusions can be drawn from metabolism observations unless measurements are made on more than one day. One of Hafkebring and Collett's women (1924) showed an average variation of ±4 percent, the other varied from a +5 to -6.3 percent. The maximum variations respectively were +12.8 and -8.5 and +8.8 and -14.4 percent. Benedict and Crofts, (1928) observed that the variations in basal metabolism of an individual upon whom measurements have been made repeatedly over many years are by no means so wide as variations between different individuals, and yet it cannot be said that each individual has a fixed basal metabolism. The first investigator to attempt to apply a statistical measure to this variability was Wishart (1927) who showed that, even under the best possible conditions of technique and cooperation of subjects, fluctuations from day to day of more than ten percent frequently will be observed in the same subject. He further reported that the day to day variability in metabolism when one observation per diem is made may be expressed by a coefficient of variation of about four or five, i. e., in a series of tests, the minimum and maximum values may differ by as much as 30 percent. Apparently, the metabolism of women, particularly those individuals not living a strictly routine life is especially subject to variability. DuBois (1930a) believes this is due at least partially to the menstrual cycle. The variability so ascribed is not great, not present in all women and the maxima and minima do not always come at the same phases of the cycle. McKay (1930) commented on the daily fluctuation she observed in the basal metabolism of her college women. In five young women studied in detail, the maximum variations above the minimum were 14, 14, 21, 27 and 29 percent although in terms of extreme variation from the average the deviations were somewhat less: 7, 8, 12, 13 and 14 percent respectively.

Stark's (1932) experience with college age people showed that a large majority of well controlled tests would agree within five percent while there would always be a few larger differences.

For repeated tests on the same individual most results would fall within 10 to 15 percent. Since this variability was almost equally likely to be above or below the first value obtained, the effect of training could not be the sole explanation of the variability within an individual. Stark concluded, however, that for the normal group, at least, it is not necessary to expect quite as large a range of intraindividual variability as interindividual variability. This view is in accord with the more extensive work published later by the Mayo Foundation.

Lewis (1936) observed that whether for reasons inherent in the nature of the physiologic process itself or because of difficulties in obtaining a truly basal level, a series of determinations of basal metabolisms on an individual subject presents a range of variability greater than the error known to be in the actual technical processes involved in measurement, (i.e., error of apparatus plus errors involved in calculation of results). Repeated observations on 13 of Lewis' subjects gave figures which varied more than ten percent and which could not be explained as an observed or inferred non-basal relaxation. Lewis accounted for this variability within the individual first, by the experimental error in the technic or apparatus, and secondly, by changes in the metabolic level of the subject. It must be borne in mind that in actual practice the completeness of repose is necessarily an arbitrary judgment, since there are no entirely satisfactory objective standards by which it can be measured. Thus it becomes apparent that there is a certain range of variability in the metabolic level of any subject when the test is made under standard basal conditions, which is beyond the control of the experimental situation as it is at present defined. The actual limits of this range are unknown and probably vary for different subjects. Within the range, values near the middle area occur most frequently while both minimum and maximum values occur with less frequency. The extent of deviation from average values in a series of tests differs appreciably among subjects; for instance, some give readings agreeing closely, and show this consistent level early in a series, while others show wide variability in a short series of observations.

(2). The concept--definition of terms. It is Boothby and Berkson who deserve credit for defining variability in basal metabolism in the most objective studies thus far published (Boothby, Berkson and Plummer, 1937; Berkson and Boothby, 1936 and 1938). Since their terminology unquestionably will be met again and again it is not amiss to pause and define the terms which this group coined. According to Boothby and Berkson (1936) at least three factors make up variability in basal metabolism: first, intraindividual variability; second, interindividual variability; and third, the inaccuracy of the prediction formula itself. Of the latter factor, they state that in view of the considerable variation in metabolism among individuals of the same sex, age, stature and weight, the variations of observed metabolism from values predicted by formulae are also bound to be considerable. As a corollary, the differences in the precision of alternative formula fitted to individuals by consistent methods and using the same variable will be small, since the inaccuracy of the formulae contributes only a small part to the total discrepancy between the predicted and observed values.

Intraindividual variability is defined as the variability of repeated determinations for the same person. It may be further subdivided into two fractions: intradaily intraindividual, that is for successive observations within the same day, and from day to day, that is the intraindividual variability of metabolism observed on successive days. Interindividual variability is the variability of the mean metabolism for different subjects of the same sex and age. There is further a total interindividual variability for subjects of the same sex and age, weight and stature which is composed of the summation of two parts: the variability inherent in repeated observations on the same person (the intraindividual variability) plus the variability of the "characteristic" or the mean metabolism of different individuals (the interindividual variability). How much individuals differ from one another apart from their own inherent variability is of considerable biologic interest.

(3). Methods of measurement. Boothby and Berkson used the Gaussian curve and the standard deviation for statistical analysis of variability. Calories per square meter per hour was the unit of expression chosen. The total interindividual variability was based on single observations of the basal metabolism of 828 females used in formation of the Mayo Foundation standards. The group was divided into two parts (1) those under twenty, and (2) those twenty years and over. In each case the deviations of observed metabolism from standard mean metabolism were assembled into a frequency distribution, the standard deviation was determined and the form of the distribution studied. Each distribution was in accord with the Gaussian curve. The relative variability, i.e., standard deviation expressed as a percentage of the mean, or coefficient of variation was also figured.

The intraindividual variability was determined by using ten females, 18 to 53 years who were tested a maximum of 15 times within an interval of not more than three months for any particular subject. Then the standard deviation of the daily observations of each subject about the observed mean for that subject was calculated. Deviations of each observation from the subject's mean were gathered into a single distribution and the standard deviation corresponding to the combined groups was calculated. For the intradaily intraindividual variability, successive observations were continued on each subject on a given day until a definite number of observations had been compiled usually two to nine.

Each observation was expresssed as a deviation in calories per square meter per hour from the mean for that day.

The relationship between these variabilities expressed as the standard deviation, is given by the equation:

$$\sigma_t^2 = \sigma_i^2 + \sigma_I^2$$

where σ_t is the total interindividual variability; σ_i the intraindividual variability; and σ_I the interindividual variability of the individual means. When σ_t and σ_i have been determined by the methods indicated above, σ_I may be obtained by subtraction on the basis of the relation expressed in the above equation.

(4). Magnitude of interindividual and intraindividual variabilities. The total interindividual variability measured as the standard deviation was: women under 20 years, 2.98 calories per square meter per hour (6.8 percent of the mean); women 20 and over, 2.42 calories per square meter per hour (6.9 percent of the mean). (Berkson and Boothby, 1938.) The total interindividual variability in terms of calories per square meter per hour was greater for males than females and also greater for younger than for older ages.

The intraindividual variability from day to day for women was 1.61 calories per square meter per hours (4.7 percent of the mean). This was somewhat greater than for men (1.33 calories per square meter per hour or 3.5 percent of the mean); the higher figure for women was attributed by Boothby and Berkson to the probability of the disturbing influence of the menstrual cycle. It must be understood, they pointed out, that this does not imply that the intraindividual variability is the same for all ages and does not itself vary from person to person. On the contrary, there is convincing evidence that the variability depends on what may be called "nervous stability" as well as on training for metabolism tests. They calculated that Blunt and Dye's (1921) 17 women subjects studied daily for one month showed a variability (expressed as standard deviation) equal to 1.55 calories per square meter per hour (4.5 percent of the mean for the entire group). Wishart's (1925) one female studied under conditions of a normal diet had a variability measured as coefficient of variation of 5.2 percent. Griffith et al.'s (1929) observation that women showed greater variation than men confirmed the Mayo conclusions since for three women studied, the standard deviation equalled 1.34 calories per square meter per hour (4.0 per cent of the mean). Ten women observed by Rubenstein (1937) for changes of body temperature and metabolism during the menstrual cycle gave a standard deviation equal to 1.62 calories per square meter per hour (4.9 percent of the mean). It was a common observation that training reduces intraindividual variability.

The <u>intradaily intraindividual variability</u> reported by Berkson and Boothby (1938) for 18 men and 1 woman gave an average standard deviation equal to one calorie per square meter per hour (3.0 percent of the mean). For the first two or three successive observations in the day there was a decrease in metabolism amounting on an average to about 0.4 calories per square meter. Then there was a rapid and continuous rise to above the initial value, so that at the seventh observation the increase in metabolism was about 0.4 calories per square meter above the mean. It was postulated that the initial lowering was due to increasing adjustment to basal conditions; as time passed, restlessness tended to raise the metabolism.

Berkson and Boothby (1938) obtained the interindividual variability for women by difference from the equation given above. The standard deviation equalled 1.81 calories per square meter per hour (5.2 percent of the mean). Males showed both a greater absolute and greater relative interindividual variability than did females.

<u>b. Factors which contribute to the variability in college women.</u>

<u>(1). Effect of age.</u> No statistical studies have been reported in which an analysis has been made to establish the significance of differences in basal metabolic rates at the college ages. The metabolism predicted by all standards in terms of calories per square meter per hour is highest at 17 years and drops from year to year until 20 years.

(2). Effect of state of nutrition. Perhaps more than any other one factor, the state of nutrition has been considered in relation to the basal metabolic rate of the college student. The interpretations of a number of investigators have been that the lower basal metabolic rates observed are correlated with a fairly wide-spread low-grade chronic undernutrition resulting from a popular tendency toward a reduction in total food ingested. In 1932, Coons and Schiefelbusch compiled figures for total calories and protein in the diets of college women during the years 1894 to 1930 and pointed out that either the methods of calculation used by earlier workers were grossly in error, or else the present tendency of women is in the direction of a habitually lower food consumption. Protein ingestion was lowered proportionally more than caloric intake. They tentatively concluded that many "average" weight women are suffering from subnormal nutrition which is not manifest in extreme weight variations but which is sufficient to depress the basal metabolism.

Other studies may be cited in support of this view. It has been known since the early work of Magnus-Levy (DuBois, 1916) that undernutrition causes a profound alteration in basal metabolism. Lusk (1921) called attention to the cases of Loewy and Zuntz, who experienced drastic reductions of diet during the war and who showed greater decreases in metabolism than in weight. Benedict's (Lusk, 1921) young men on semi-starvation diets lost less than 10 percent of their body weight, but at the same time showed a 16 to 27 percent lowering of their basal metabolism. One of the most striking results of Benedict's experiment with Mr. Levanzin who fasted for 31 days, was a marked reduction in basal metabolism (Benedict, 1916).

More closely related to the present problem, however, are the observations dealing with milder degrees of undernutrition. Blunt, et al. (1926) observed that underweight girls tended to show a low or normal basal metabolism in terms of total calories, calories per square meter, or calories per centimeter while the rate was high if computed in terms of calories per kilogram. Coons (1931a) confirmed this finding. According to Conklin and McClendon (1930) a deficient diet decreased the basal metabolic rate as well as the duration of menstruation and the length of the menstrual cycle. Although Hetler (1932) found no definite interrelationships between protein intake and basal metabolism she suggested the possibility that the lowered protein intake of women is a causative factor in the lowering of basal metabolism. Johnston and Maroney (1936) observed a definite lowering of basal heat production in children on submaintenance diets. Basal metabolism in most instances could be brought from low to average levels with a high protein intake. Talbot (1936) concluded that there is a close relationship between the heat production of girls from birth to 20 years of age and their body weights. His review of basal metabolism studies on girls gave evidence that a liberal diet, especially a diet liberal in protein, tended to increase metabolism while a low protein diet tended to decrease it. More recently, Rogers (1939) observed a somewhat higher basal metabolic rate in her college students than has been reported in most cases (0.4 percent average deviation, Mayo Foundation standards). She likewise observed that the average weight of the students was relatively high. The food intake seemed adequate in calories, vitamins and minerals; 15 percent of the total caloric intake was derived from protein. Rogers concluded that the excellent quality and quantity of the food intake might well be a factor in the relatively high average basal metabolism obtained. In opposition to these reports, Tilt (1935) could observe no consistent relationship between the basal metabolism and the protein or caloric intake.

The impression is thus gained that the consensus favors the idea that the observed lower basal metabolic rate of college women may be related to undernutrition. However, this conclusion rests primarily on the subjective interpretations of the experimenters previously mentioned. A satisfactory solution awaits the achievement of some tangible and objective measure of what constitutes good nutrition. This problem, as every informed person knows is not an easy one to solve. To this end the participants in the North Central States Cooperative Project on the Nutritional Status of College Women have put their efforts for the past five years. What will be forthcoming remains to be seen. When, if ever, we have that measuring device, then, and only then, can we answer conclusively the basal metabolic question. An attempt will be made here to correlate certain possible criteria of nutritive state with the observed metabolic rate.

<u>(3). Effect of degree of maturation</u>. One wonders how much of the effect which has been attributed to under-nutrition may not more properly belong to the lack of maturation or the varying degrees of maturation of the college women. The stage of the maturation process in the women of college age has not been carefully considered, as maturation, of course, is a very difficult thing to measure in any objective terms, and is a process which is extremely variable from individual to individual at a given age. It seems increasingly certain that perhaps continued unsuspected growth in young college women may be a very important factor in variability in observed basal metabolic rates. Lucas and Pryor (1933) found a relationship between body build or width-length index and basal metabolism. The important relationship between growth and the basal metabolic level is emphasized by Talbot (1937). He believes speed of growth, and particularly extra growth in height to be the primary factor in the elevation of metabolism at puberty; as this growth in height ceases there is a tendency for basal

metabolism to become lower. This observation is particularly interesting since some college girls who have been observed over two or more years show definite height increases indicating that growth has not ceased. Thus, the degree of maturation of the college girls may well be a factor contributing to the variability observed in basal metabolism. Surely the problem is of sufficient importance to warrant further investigation.

(4). Effect of degree of relaxation. The degree of relaxation of the subject at the time of observation is an intangible condition which cannot be measured objectively. Yet, the degree to which the individual relaxes is probably one of the contributing factors to the variability observed in metabolism, both in a given individual measured at different times and from individual to individual. Neither, unfortunately, can many of the conditions which contribute to the capacity to relax be measured. But it seems certain, as Wishart has pointed out, that the daily fluctuations in the metabolism of a given individual may be considerably diminished by living an extremely routine life. The lives of most college women may hardly be called routine. Rogers (1939) felt that the great range in basal rates of her students who were considered normal in every way might raise the question whether they were in true basal state during the tests and yet the student whose range seemed much too high or too low was unconscious of any emotional disturbance and seemed to the investigators to be in basal condition. In contrast to the college student, somewhat older people, members of the faculty and young faculty wives rarely showed a variation of more than a few percent, even when tested at intervals over a period of months. Rogers concluded that it seem probable that the more settled manner of living of the non-student group might account for the more uniform basal rate of that group. Henry (1930) previously had suggested the probability that some of the normal variation in basal rate is due to the emotional state of the individual tested. The lability of the emotions of college students is readily recognized by anyone with even a superficial acquaintance with them.

(5). Effect of phase of the menstrual cycle. Most of the factors dealt with so far have applied in a specific manner to the variability in metabolism of women of college age. The influence of the menstrual cycle, if any, affects the metabolism of women throughout the reproductive years. DuBois (1930a) summarized the trend of opinion as to the effect of the menstrual cycle in this fashion: the variability due to the menstrual cycle is not great, not present in all women, and the maxima and minima do not always come at the same phases of the cycle.

It will be remembered that the Mayo Foundation attributed the increase in intraindividual variability found in women over that in men to the influence of the menstrual cycle. Blunt and Dye (1921) from a series of 216 observations on the basal metabolism of 17 women, including one or more menstrual cycles for 14 of the group, concluded that there was no definite change in basal metabolism during menstruation. This conclusion was reached from the fact that the average of intermenstrual and menstrual observations was almost the same and that no rhythmic periodic variation in metabolism could be detected. Wakeham was perhaps the first to show the tendency toward a high metabolism in the premenstrual period and a fall during menstruation. Benedict and Finn (1928) reported the study of one female subject over a period of years whose average oxygen consumption during menstruation was three percent lower than for the intermenstrual periods. Rogers and Fleming (1928) concluded from experiments on seven normal women that the lowest point in the metabolic cycle comes during or immediately following the menstrual period.

Hafkesbring and Collett in a long series of 96 experiments on one subject and 80 on another observed a premenstrual rise and intermenstrual minimum. Hitchcock and Wardwell made 800 tests on 27 women following them through at least two complete menstrual cycles. Of the 20 women selected as a basis for their report, 14 showed a lowering of their basal metabolism during the menstrual period, one had no change. In five of the subjects the fall averaged 5.16 percent, a value statistically significant. There was also an intermenstrual drop averaging 5.03 percent occurring on the twelfth to twenty-third day. Since ovulation seems to occur on the fourteenth to twenty-eighth day following the onset of menstruation, Hitchcock and Wardwell believed that there is some relationship between the two phenomena.

Griffith, et al., confirmed the above findings, since he observed the highest metabolism in the premenstrual period and the lowest during the menstrual days. The average difference, however, was only 2.7 percent. Conklin and McClendon (1930) observed that in nine of ten women studied, the basal metabolism tended to reach its lowest level following menstruation and its highest level preceding menstruation. The average difference was only 3.5 percent. A later study from the same laboratory gave a difference of 3.7 percent (McClendon, et al., 1931). One woman observed over a long period by Sandiford, Wheeler and Boothby gave an average change of 2.7 percent. They believed that such small changes were due to varying degrees of relaxation dependent on mental status and physical discomfort.

Stark (1933) divided the menstrual cycle into five day periods. The average basal metabolic rates of her student subjects during these periods were: five days of menstruation, -2.21 percent; successive five day periods, -2.13,+1.96, +1.48, -1.06 and -1.15 percent respectively. There was no evidence of premenstrual rise since highest observations were in the midmenstrual period. McCord (1939) reported that in her college women, metabolism dropped as menstruation approached, rose thereafter and then became fairly low again preceding the next period. Of 16 normal young women studied by the method of vaginal smears, the average metabolic rates were found to be slightly lower during the preovulation phase of the cycle than during the premenstrual phase (Rubenstein, 1937).

(6). Effect of smoking. One interesting note on the effect of smoking on the basal metabolism of men was given by Dill. Oxygen consumption remained unchanged in some subjects, in others it increased as much as 10 or 15 percent. Dill believed that though the increase may be of small magnitude, it indicated that subjects for basal metabolism tests should not smoke the morning the test is to be made. There seems to have been no attempt to compare the level of basal metabolism of habitual smokers and non-smokers.

(7). Effect of coffee drinking. Hackett (1931), using 30 normal college women attempted a comparison of the basal metabolic rate of coffee drinkers and non-coffee drinkers. Fifteen of the students had never drunk coffee, 15 drank it daily. The coffee drinkers averaged 53.16 calories per hour, the non-coffee drinkers 50.19 calories per hour. One interesting side light to this report is the experimenter's comment that considerable difficulty was encountered in finding 15 young women of normal weight who were coffee drinkers; many otherwise possible subjects were underweight. Wang and Hawks (1929) reported that coffee and tea increased the heat production of six diabetic patients who were free from glycosuria, from 12 to 23 percent. Schoen and Karbisch found the injection of caffein subcutaneously caused an increase in the energy production of 15 to 20 percent. Schumal, et al., (1929) likewise reported that coffee raised the metabolic rate. Benedict and Carpenter have found that coffee acts as a stimulus to the metabolism, the increment resulting from the ingestion of 325 grams of coffee infusion amounting on an average to eight percent for several hours.

2. Some factors entering the experiment after completion of the actual measurement.

a. Method of selection of data: number of observations. As previously emphasized "normal" basal metabolism does not consist of some one definite figure for each height, weight and age combination, but rather a range within which the normal individuals in a group will fall. One of the most confusing problems encountered in attempting to compare observations of different experimenters on the same age group is the wide diversity of methods of selection of data used which in turn leads to a great variation in the number of observations made on a single individual. More important, there is a tendency to report only those figures which check within a certain percentage set by the experimenter. Thus the variability found in basal metabolism observations is lost. No one general principle of selection seems to be followed and, in fact, some experimenters seem to contradict themselves within a statement on the method they employ. In general two approaches have been used: the clinical and the physiological. The clinical people, headed by Boothby, are interested in the wide deviations which are more apt to be pathological. They want standards built on conditions which are comparable to those followed in a clinic, since clinical use constitutes one of the principal applications of basal metabolism standards.

Boothby, Berkson and Dunn (1936) admirably express the clinical point of view:

> The calculations used for the erection of our standards have been made from the first determination made for the individual, unless at the time of test and before the calculation, it was noted as "unsatisfactory" for reason of restlessness, observable nervous tension, or an elevated temperature. Even in cases in which several observations were made either on the same or different days, the first only was used for this study. In consequence, the element of training is excluded from our normal standards even as it is in clinical application or it would of necessity be in a comparative study of any large group of individuals. It would be beside the point to define a physiologic normal which was set up under conditions which might appear theoretically ideal, and then apply that standard to the different conditions which must obtain in nearly any type of investigation which utilizes a large number of individuals.

.........Where a mean of several determinations is used, the value is slightly lower than the mean of the first determination for many similar individuals. If one departs from the practice of using a single determination made under standard conditions, the number of determinations should be strictly identical for each individual. That this condition would limit most investigations to a few individuals is obvious, and therefore, we consider that a standard should be built on a single determination.

In various studies there has been a consistent tendency to select the lowest obtainable determination as the most representative. The amount of selection has varied. In some instances it has been extreme. We believe that this accounts at least in part for the fact that most observations fall below ours since we have regularly accepted the first determination, as has been previously explained. Probably there are also other factors involved such as race, regional differences, and climate as well as differences arising from the variations of instruments used; before the precise allocation of these can be attempted some definite determination of the effect of selection will have to be made. (p. 470)

There is one factor in the establishment of the Mayo Foundation standards which must not be overlooked in applying them to a group of college students. Much of the material on which the standards are based consists of observations on individuals who, though free of any disease process known to affect the metabolism, are, nevertheless, clinical patients undergoing a physical examination for possible disease. It should not be forgotten that for the majority of patients there is a factor of apprehension incident to a physical examination in a clinic regardless of how routine the procedure. This factor would be expected to elevate the metabolism somewhat above the average obtained on college students volunteering their services for experimental purposes.

The physiologic point of view of basal metabolism is interested in ideal rates measured under as nearly physiologically perfect "basal" conditions as possible, an ideal state which can never be truly measured. This school of thought is headed by Benedict and his followers. In a personal communication to Professor McKay of the North Central States Cooperative project, Dr. Benedict defines his view as follows:

> It is the practice of the Nutrition Laboratory to make basal metabolism observations on each subject on at least two and preferably three days, not too far apart, perhaps within a period of two weeks. In fact, it is against the principle of the Laboratory to accept one day's measurements only on an individual as indicative of his basal metabolism unless exigencies of the situation make it difficult to secure the cooperation of the subject for repeated measurements. This was the case in a few of our racial studies, but is an admitted defect.
>
> Analysis of results obtained in experiments on one and the same subject show that often the metabolism is higher on the first day of measurement than om the second and third day, especially if it is the

subject's first experience. It would be ideal if the results of repeated tests should agree within about 5%. Certainly, the results from day to day should not exceed 10%. If a period value in any day's measurements is obviously higher than the other period values on that day, we are in the habit of discarding this period value and using the average of the remaining lower period values provided they agree reasonably well with each other. In no instance should one low period value on a given day be accepted as indicative of the metabolism on that day unless it is supported by similarily low period values on other days on the same subject. I would recommend that the average of two or three well agreeing days (agreeing preferably within 5%) should be used rather than selecting the lowest average noted on any one day. Furthermore, it is desirable in studying women not to make the measurements during the menstrual period. We include, as part of our protocols a statement from each woman as to when the last menstrual period occurred so that this factor can be taken into account in the analysis of results.

The specific methods of selection used by various investigators for studies on college age women will be found elsewhere (Young, Table 1, 1937). In most instances it was noted that the Benedict method or some one of its many modifications had been used. In the definition of basal metabolism there seems to be absolutely no justification for throwing out observations without mechanical flaw just because they do not lie within the confines of some arbitrarily set percentage limits. In fact, the surprising thing is not the heterogeneity of results reported in the literature but rather their homogeneity considering the diverse manners in which data have been selected for analysis. The only procedure which seems to have any real justification and the one with which this laboratory is in sympathy, is that involving the use of all data collected under the specified standard conditions of laboratory measurement. We propose to show the effect on the mean metabolism of just a few of the most widely used methods of selection of data.

<u>b. Choice of standards.</u> The amount of deviation between the observed and predicted heat production depends to a considerable extent on the formula or standard used for comparison. Previous to the establishment of the Wisconsin prediction standards (Stark, 1932, 1933, 1935) for this age group the standards proposed for comparison of the metabolism of girls under 21 were as follows: the lower ranges of the Aub and DuBois adult standard (Aub and DuBois, 1917) which expressed expected calories per square meter of body surface in two year age periods from 14 to 20 and the standard recommended in 1923 by Benedict for girls through 18. These two standards differ to a startling extent and the discrepancies are not of the same magnitude for all types of individuals. Stark (1932) found that

the Harris-Benedict figures averaged lower than those of Aub and DuBois and offered a better approximation to findings in normal young women under modern test conditions where the factor of mental unrest was more adequately controlled. More recently the Mayo Foundation Standards (Bothby, et al., 1936) for individuals from 6 to 68 years have been published. For the college age group these standards give somewhat lower predictions than the Harris Benedict standards and thus more closely approximate the observed basal metabolic rates.

Another factor which must be evaluated in the expression of basal metabolism is the choice of unit of body size. Caloric production may be referred to a unit of weight, height or surface area or any other measureable bodily dimension. If surface area is chosen, as it usually is, the accuracy of its estimation will be influenced by the formula used. The DuBois and DuBois formula has been most generally used; in 1929 Boothy and Sandiford used it for figuring surface area in the compilation of their prediction tables.

Berkson and Boothby (1936) recently undertook a comparison of the method of standardizing normal basal metabolism prediction by means of a linear equation involving weight, stature, and age proposed by Harris and Benedict (1919) and the method previously mentioned of using the height and weight formula of DuBois and DuBois for calculating surface area in conjunction with a specific constant for each age. As the authors had previously made clear, inaccuracy of the formula contributes only a small part of the discrepancy between observed and predicted values. Consequently exceedingly large numbers of observations are required to determine that these small parts are significant; hence, the difficulty of distinguishing the relative merits of the two formulae by utilizing accuracy of prediction as a criterion. Berkson and Boothby (1936) found no significant difference between the precision of the linear and "surface area" formulae either in the case of the Mayo Foundation data or the data of Harris and Benedict. Harris and Benedict's (1919) earlier conclusions in favor of a linear formula they believed to be due to an omission by these authors of the age variable. Berkson and Boothby favor the surface area formulation because of the consistency of its implications with observations and because of certain methodological advantages such as the simplicity with which it can be used in the study of the change of metabolism with age. Attempts at the formulation of an equation for measuring "effective surface area" or "active protoplasmic mass" or a formula for taking into account body build gave no improvement in prediction over the surface area formulae already in use.

One further suggestion for prediction standards has been brought into prominence lately. Benedict (1923) published prediction standards based on weight which were not very successful. Talbot and others (1935) proposed new standards for girls, based on weight, which they believe lead to more accurate clinical diagnosis. These standards they find particularly valuable for individuals of abnormal development, especially those with abnormal height weight ratios. Talbot (1936) reported that the standard is statistically as accurate as other standards for normal girls and is more accurate for young girls and for pathological conditions.

IV. EXPERIMENTAL

The experimental methods used in the present study are essentially those outlined in the preliminary report (Young, 1937). In brief, the original subjects were volunteer normal freshman women drawn from the freshman hygiene classes. Since these classes are required of all women students, all freshmen are represented rather than a restricted group. The subjects formed, in most cases, a portion of the group used for anthropometric and blood studies conducted by other workers. Because of the early rising hour required for the test, subjects could not be selected at random as was the case in the other phases of the project. Many more students volunteered than could be handled in the laboratory. The ones taken for study represented a chance selection from those volunteers whose physical record was negative for disease.

Four observations were made per year on each subject. Two observations were taken on each of two successive days. On a limited number, observations were repeated in the various seasons of the year.

Subjects reported to the laboratory at 6:15 A.M. in a post absorptive state after their customary amount of sleep. Their presence involved a total activity of rising, dressing, a ten minute walk to the hospital, the ascent of one flight of stairs and undressing. A one hour rest period in a quiet, comfortable room as free from external stimuli as possible preceded the testing period. Two eight to ten minute observations were made using a new Benedict-Roth portable machine with a minute or two of rest between periods. The usual temperature, pulse and respiration checks were made before and during the tests. After completion of the test, the subject was weighed and measured in a minimum of underclothes. The student was questioned as to the amount of sleep the night previous, the date of onset of last menstrual period, her food intake the previous day and any unusual activity. An effort was made to avoid all periods when a student was subjected to unusual stimulation, whether worry or anticipation of pleasure. It was possible to avoid mornings of examinations, before or after dances, football games and similar activities. Observations were not made at the time of final examinations or holidays.

It will be assumed that the basal metabolism does not involve the lowest metabolism of a given individual which is found only under conditions of sleep. Rather, basal metabolism has been defined as the energy exchange obtained under certain specified laboratory conditions which are outlined by DuBois (1936):

> In practically all laboratories the metabolism is measured in the morning twelve to fourteen hours after the last meal with the subject lying motionless. Under such conditions is obtained what is usually called the basal metabolism or "Grundumsatz" of Magnus-Levy. Strictly speaking this is not the lowest or basal metabolism since

> figures are lower during prolonged undernutrition and during profound sleep. For this reason Krogh used the term "standard metabolism" which though perfectly rational has not yet come into general usage. Benedict employs the expression "post absorptive" to denote the fact that the tests are made after the absorption of food has ceased. Plummer and Boothby have adapted the phrase "basal metabolic rate". This seems to have caught hold in this country as it expresses the idea of chemical processes taking place within the body at a certain standard velocity. The only objection to this term is that it adds a word which is not strictly necessary and we hesitate to make two words grow where one grew before. (pp. 145-146)

In view of this definition all tests were accepted, unless at the time of the test and before calculation some error was noticeable in the technic,or the patient was either restless or asleep. The basal metabolism of the individual was taken as the average of all observations made, regardless of the check as to clinical percentage. For more of the details of methods and calibration of the apparatus, the reader is referred to the earlier report.

Since the preliminary report the Benedict-Roth apparatus has been checked for accuracy by means of the Jones Alcohol Respirator (Jones, 1929). The error due to mechanical inaccuracy of the instrument was found to be considerably less than one percent.

In view of the results of the present study there are certain aspects of the experimental situation which should be emphasized. Given sound apparatus and satisfactory technics the nature of the subjects and the degree of cooperation obtained are probably the most important factors in the successful study of basal metabolism. In these, this study has been extremely fortunate.

In all, 169 different subjects from 17 to 29 years of age were studied; 149 of these were between 17 and 23 years inclusive. Thus our data are more numerous and therefore, more conclusive, for the latter age range. The older subjects primarily, represent normal, healthy graduate students who became interested in the project and volunteered their services.

The original intention was to continue the observations on a given student throughout her four years of college residence. This intention was fulfilled within the limitations of the student's college career. However, it reckoned without the high college mortality. Of the original group it was possible to observe 55 individuals more than one year; 55 reported two years; 39 three years, and to date, 10 for the entire four year college period. This group subsequently will be referred to as the "repeat" group. The remaining 114 individuals who were observed for one year only will be known as the "non-repeats". At the outset the two groups constituted one undifferentiated unit. An attempt was made on succeeding years to contact all those who remained in school. In a few instances the subject has continued in residence but the experimenter was unable on repeated occasions to reach her. In certain other cases illness or some similar disturbing influence had entered the picture at a date subsequent to the first observation. The individual was then no longer a suitable subject. Of all the women contacted, only one ever refused to return for succeeding observations. The "non-repeats" then represent primarily students who have dropped from school after a year for one of several reasons, inadequate finances, marriage, scholastic failure plus, a few individuals who have continued in school but who were inaccessible.

The repeat group, in turn, had mortalities within itself on succeeding years, due primarily to marriage. Since part of the freshmen were not started until the second year of study, their fourth observations will not be made until next year. It should be borne in mind that in the beginning the repeats and non-repeats were one supposedly homogeneous, undifferentiated group which later differentiated itself into the two classifications it has been expedient to make.

It is believed that the experimental situation, in some aspects at least, approaches the ideal. This belief is the resultant of a number of factors, not the least of which is the representativeness of the sample of college women as a whole. It is the belief of the laboratory that all scholastic, social, physical and emotional types of individuals are represented. Subjects have been drawn from all curricula open to women; thus the study does not restrict itself to one group of students such as physical education majors. All the academic years are included. Both sorority and non-sorority girls are represented; students of ample financial means and those working their way through college in whole or in part; students scholastically poor and average as well as representatives of the highest academic honors. Likewise the group has among its number students ranging from those with no participation in campus activities to the most active women on the campus. The popularity and romantic interests of the students may be measured by the mortality from the original group due to engagements and marriages.

It is amazing to find as varied a sample in a volunteer group. A series of case studies has been included in the appendix with the thought of describing the group as well as aiding in interpretation of certain interesting variability factors.

In addition to the representativeness of the group, this study has been unusually privileged in the quality of cooperation it has received. This cooperation has been very important since it made possible not only the continuation of the study over more than one year, but the study itself. Secondly, with generous, whole hearted cooperation, greater reliability can be placed on the honesty of information given by students. Thirdly, voluntary cooperation leads to a greater degree of relaxation in the subject. For the latter reason the kind of cooperation obtained is extremely important in the study of basal metabolism, perhaps more than in many other physical measurements. The excellent attitude of our subjects was probably a result of the fact that participation was entirely voluntary. No pressure was ever brought to bear in getting a subject to return for successive tests and only one subject ever refused to return.

Every effort was made to put the participants at ease in the experimental situation. Since the experimenter was a student herself and well known to the subjects through other contacts, the relationship between the experimenter on the one hand and the subject on the other was such as to give the maximum relaxation. The experimental situation was probably much less strained than that often existing as almost all of the subjects slept during the preliminary hour of rest. During the actual experimental periods, particular care was taken to avoid all outside irritations such as light shining in the subjects' eyes. The frequent student comment after completion of the test of feeling "so relaxed, I'd just like to stay right here all the rest of the day," would be another expression of the ease of the testing environment.

Early in this paper the primary objective of the study was stated as the measurement of basal metabolism of college women under their usual living conditions. Important as are the representativeness of the group and the fundamental premise of relaxation, the experimental situation, if it were not such as to achieve this primary objective would still be far from ideal. The emphasis of this study has been focused on the achievement of this objective. More precise information on certain variability factors could have been obtained by the proper statistical design. This precision has been sacrificed deliberately in order to establish a practical situation.

With the objective in mind, no restrictions have been made in the students' routine other than to prohibit food intake after seven o'clock the night previous to testing in order to insure post absorptive conditions. Likewise the student was tested after his customary number of hour of sleep, rather than after any arbitrarily set sleep interval. Though the rising hour for the test was somewhat earlier than usual, students compensated by going to bed earlier. The six to seven hours of sleep often reported is, to the experimenter's mind, a characteristic part of the college living situation which appears to go hand in hand with certain fatigue pictures observed. In a fair picture of the basal metabolism of college students, possible inadequate sleep habits should not be covered up but made an integral part of the experimental situation. Also it is the author's belief that a better night of rest and consequently a better condition for the testing period results when the subject has had his customary amount of sleep than when he has attempted to fit himself into a definite sleep pattern.

We feel from the frank voluntary reporting of irregularities there is every reason to believe that the records obtained in this study are honest and accurate.

The statistical methods and vocabulary used in this study have been taken from Snedecor (1938) or from the verbal recommendations of the staff of the Iowa State Statistical Laboratory.

V. RESULTS AND DISCUSSION OF RESULTS

The entire series of data upon which subsequent analyses are based is presented in the appendix, Table 20. The special designations appearing under the subject numbers indicate the repeat individuals; all subjects not so designated comprise the non-repeat group. The Roman numeral refers to the total number of years which the individual has been studied; the Arabic number, the year of study which that particular set of figures represents. For instance, III 2nd yr., means the figures so designated are the observations of the second year on a subject who was studied a total of three years. For most individuals the results of four observations are given in the order in which they were obtained: first and second observations of the first day in order, followed by the two second day figures. In a very few instances, only one day of observation was available.

A. Factors Which Contribute to Variability of Basal Metabolism in College Women

1. Effect of age.

If the entire body of data is to be analyzed for the part played by certain factors in the variability of basal metabolism, it becomes important to know whether age differences within this limited range

Table 1

Number of Individuals Observed and Mean Basal Metabolism by Age Groups. First Year Only of Observation on Each Subject

Age Group Years	Number of Individuals	Mean Basal Metabolism Calories per square meter per hour
17	16	35.93
18	29	35.04
19	40	35.10
20	30	35.43
21	13	35.31
22	10	33.44
23	11	35.07
24	8	34.58
25	7	33.70
26	4	35.62
27	6	35.33
28	3	33.57

have a significant effect upon basal metabolism. If significant differences are not present, all data might be combined. Otherwise subsequent analyses must be made for each age group.

To study the effect of age, a group mean was computed for each age on the basis of the first year of observation for each subject, whether repeat or non-repeat. The number of individuals and means are presented in Table 1. It will be noted that the means for basal metabolism are inconstant with respect to age. Thus it is justifiable to combine all ages for the analyses of the variability factors to be considered in the following sections. The age group means will be considered further in section B under a standard proposed for college women.

Early in the preliminary examination of data it became apparent that even in the first year of observation the repeat and non-repeat groups differed as to both mean and variability of metabolism. A comparison of the mean metabolism of the repeat group, 35.46, with that of the non-repeat group, 34.99, gives a mean difference of 0.47 calories per square meter per hour. This mean difference is statistically significant. The two groups also appear to differ quite markedly in the variability of metabolism as well as the level of metabolism. Table 10 shows this distinguishing characteristic. These data are comparable since the figures for repeats are based on the first year of observation. The variance of the repeat group is less than the non-repeat group in every factor except one. Variation within the day is slightly less for the repeat group but the greater difference lies in the variance between days on the same individual where the repeats have only half the variance of the non-repeat group. The repeat individuals are much more stable from day to day. This probably will account for the fact that the repeat group as a whole shows a greater variance between the first and second day. It is a more stable group. The differences between first and second days are the result of training, and they pile up in the same direction to give a bigger mean square than where individuals are unstable enough so that instability covers up part of the training effect.

It will be observed, too, that there are greater individual differences in the non-repeat group than in the repeat group. It should be recalled that at the outset the entire series was one homogeneous group, and that the non-repeat group is composed primarily of individuals who have dropped from college plus a few who have remained in college but could not be contacted. It might be reasoned that the individuals who were able to survive successive years in college are more stable, but it is instructive to find evidence of this stability reflected in the basal metabolism. As a consequence of these observations, the data are treated as two separate series, repeat and non-repeat, in all subsequent analyses.

2. Effect of amount of sleep.

Certain workers have set eight to ten hours of sleep the night previous to testing as a requirement for the measurement of basal metabolism. It is obvious to anyone acquainted with the living habits of college women that most of them do not sleep regularly even eight hours a night. Since the objective of this study is to obtain a real picture of the metabolism of college women under their actual living conditions, this sleep deficiency must be a part of the pattern being measured. It was felt that if the women were asked to report the number of hours they slept, an accurate record of actual rest would be obtained. This procedure does not in any way violate DuBois' accepted definition of basal metabolism (DuBois, 1930a and 1936).

If observations are made under normal conditions, varied amounts of sleep will be incorporated in the records. It then becomes imperative to see whether or not the metabolism on successive days in the same subject is affected by the amount of sleep the night previous. To the knowledge of this laboratory such an analysis has never been made. However, it is possible to isolate this effect from our data.

Subjects 18 to 22 years of age have been considered together for this purpose, divided into the repeat and non-repeat groups and tabulated as to the amount of sleep obtained on the nights preceding successive test days. This tabulation made apparent

Table 2

Distribution of Individuals with
Different Hours Sleep on Successive Nights

Range of Hours of Sleep	5-6	5-7	6-7	6-8	7-8	7-9	8-9	Others
Non-repeats, No.	3	5	13	5	10	0	0	3
Repeats, No.	10	6	26	6	28	5	2	3

Table 3

Distribution of Individuals with
Same Number of Hours of Sleep on
Successive Nights

Hours of Sleep	5	6	7	8
Non-repeats, No.	0	7	13	5
Repeats, No.	2	19	47	6

Table 4

Distribution of Number of Daily Basal
Metabolism Tests on Basis of Amount of Sleep
Obtained by the Subject the Night Previous to Testing

Hours of Sleep	5	6	7	8	9	Average Hours of Sleep
Non-repeats, No.	8	35	54	25	0	6.79
Repeats, No.	22	80	159	50	7	6.81

Table 5

Analysis of Variance of Basal Metabolism on Successive Days Preceded by (a) Different and (b) the Same Number of Hours of Sleep

Non-Repeats

Source of Variance	(a) Different Amounts of Sleep				(b) Same Amount of Sleep	
	6 and 7 Hours		7 and 8 Hours		7 Hours Both Nights	
	D.F.	M.S.	D.F.	M.S.	D.F.	M.S.
Total	25		19		29	
Between Days	1	0.0540	1	0.365	1	0.0440
Between Individuals	12	16.93**	9	12.12*	14	15.75**
Error	12	2.780	9	2.692	14	2.707

Repeats

Source of Variance	(a) Different Amounts of Sleep				(b) Same Amount of Sleep			
	6 and 7 Hours		7 and 8 Hours		6 Hours		7 Hours	
	D.F.	M.S.	D.F.	M.S.	D.F.	M.S.	D.F.	M.S.
Total	51		55		41		85	
Between Days	1	0.6200	1	0.0500	1	1.820	1	0.0300
Between Individuals	25	9.100**	27	9.746**	20	8.855**	42	9.349**
Error	25	1.562	27	0.8197	20	1.133	42	2.056

two general sub-groups: those sleeping different amounts on successive nights and those sleeping the same number of hours. Components of these groups were then subjected to analysis of variance to test for significant differences.

The sleep records are of interest as records. Of 62 non-repeat individuals, 37 or 59.7 percent slept different number of hours on successive days; 25 or 40.3 percent had the same amount of sleep. Of 161 pairs of successive daily observations on 51 repeat individuals, 87 or 54.0 percent showed a different number of hours of sleep; 74 or 46.0 percent the same amount on successive days.

Tables 2, 3 and 4 give the detailed distribution of recorded hours of sleep. Only six percent more than the basal metabolism records for repeats were based on the same hours of sleep on successive days than in the case of the non-repeats. It is of interest to note the average sleeping time for repeats and non-repeats (6.81 and 6.79 hours respectively) are almost identical.

The non-repeat individuals who did not have the same amount of sleep on nights previous to testing fell principally into two groups, one with six hours sleep one night before testing and seven hours sleep the other night, the other group with seven hours sleep one night and eight the next. The analyses of variance on the basal metabolism of these individuals are presented in Table 5.

The mean difference between metabolism records of 13 individuals with six and seven hours of sleep respectively on consecutive nights was negligible, 0.09 calories per square meter per hour; between seven and eight hours sleep for ten individuals, 0.27 calories per square meter per hour. These differences were less than normally might be expected with chance variation. A tabulation of basal metabolism with sleep revealed a slight tendency for basal metabolic rate to decrease with decreased amounts of sleep the night preceding testing. This might be explained by fatigue which results in a greater than normal relaxation when the individual is given a chance to rest as in the testing situation.

In non-repeat individuals the mean difference between the basal metabolism observations on successive days following seven hours sleep in each case is 0.08 calories per square meter per hour which is also non-significant. Error variances are practically equal (Table 5 for different and the same amounts of sleep on successive days). The mean difference in basal metabolism on non-repeat individuals on two successive days is practically identical whether preceded by the same or different numbers of hours of sleep. It would seem, then, to make little difference whether an individual has the same or different amounts of sleep preceding successive days of observation; more specifically, six, seven or eight hours as here tested.

The same analysis was made for observations on repeat individuals (Table 5). For 26 individuals with six and seven hours of sleep respectively on successive nights; the mean difference between basal metabolism observations was 0.218 calories per square meter per hour, for 28 individuals sleeping seven and eight hours respectively, the mean basal metabolic rates were 35.065 and 35.125 respectively, a mean difference of 0.06 calories per square meter per hour. Both of these mean differences are much less than normally would be expected in chance variation. The error variance for seven and eight hours is only half that in the six and seven hour group. This might suggest that more variance in metabolism may be a consequence of reduction in number of hours of sleep.

For the repeats with the same amount of sleep on successive nights there were two sleep periods which included enough data to be analyzed. For 21 individuals with six hours sleep the nights preceding successive days of observation, the mean difference was 0.415 calories per square meter per hour; for 43 individuals in the seven hour sleep class, 0.03 calories per square meter per hour. These differences were insignificant.

Thus for both the repeat and non-repeat group there seems to be no evidence for the amount of sleep the night preceding the test affecting the level of metabolism in the individual.

Consequently the control of sleep on the night previous to testing would seem to be unnecessary. Rather it would seem advisable to allow a person on whom basal metabolic observations are to be made to follow his customary sleep pattern on the night preceding testing. Such a procedure would eliminate one of the most disliked portions of the basal metabolism technic. Most individuals are more relaxed following their usual night's rest than when attempting to prolong the sleep period, which probably instead of resulting in more rest, and therefore greater relaxation, results in a longer period of restlessness and wakefulness between completion of the usual sleeping period and that prescribed. A more satisfactory procedure would be for the subject to retire in time for his usual night of sleep and sleep soundly, until time to proceed to the testing laboratory.

3. Effect of phase of menstrual cycle.

Considerable uncertainty exists as to the effect of the menstrual cycle on basal metabolism, but in general the consensus is that there is a premenstrual rise and a decrease during menstruation and immediately following. An intermenstrual rise may occur. In any case, these variations are of relatively small magnitude. No one has considered whether they may be real or accidental.

We are interested in determining if there are definite trends in our data which could be attributed to the phase of the men-

Table 6

Distribution and Means for Basal Metabolism at Various Phases of Menstrual Cycle: Repeat, Non-repeat, and Combined Data

Periods	I	II	III	IV	V	VI
Days after Onset Menstruation	1-5	6-10	11-15	16-20	21-25	26-30
Repeats						
Frequency	14	38	44	32	24	15
Mean*	34.47	34.20	34.51	34.90	35.03	35.46
Non-Repeats						
Frequency	4	21	22	21	10	11
Mean*	34.34	33.97	35.90	34.97	34.16	36.48
Repeats + Non-Repeats						
Frequency	18	59	66	53	34	26
Mean*	34.44	34.12	34.97	34.93	34.77	35.89

*Expressed as calories per square meter per hour.

strual cycle. Since for over one-half the period of collection of data, the immediate premenstrual and postmenstrual phases were avoided, our data in these ranges are relatively sparse. However, more recently a small group of data have been collected covering these periods. Though the data were not obtained to study menstrual effects specifically, provision was made for recording the time of onset of the individual's last menstrual period.

For this study, all data have been grouped except that the repeat and non-repeat series have been separated as in previous analyses. It was decided to assume a thirty day cycle (Stark, 1933; Wakeham, 1923) made up of six consecutive five day periods, beginning the cycle with the first day of menstruation. The mean for each subject was tabulated under the appropriate phase of the menstrual cycle: first the repeats alone, then the non-repeats and finally the two groups combined. The means and frequencies for this tabulation are presented in Table 6. The results closely parallel those reported in the literature. For the repeats, the basal metabolism in the first period, actual menstruation, was low, falling still lower in the second immediately postmenstrual period, then beginning a steady rise until metabolism reached its highest level in the premenstrual period. The pattern for the non-repeats varies slightly; in that there is an intermenstrual high at 11 to 15 days (Period III) with

Table 7

Frequency and Means for Paired
Comparisons of Basal Metabolism
Level with Phase of Menstrual Cycle

Pair Identification	Frequency	Periods I	II	III	IV	V	VI
a	9	35.03	34.53				
b	24		34.46	34.43			
c	19			34.05	34.95		
d	13				34.52	34.61	
e	6					34.53	35.53
f	6	33.08					34.39
g	14		34.90		35.04		

metabolism falling off subsequently to rise to the highest point in the immediately premenstrual period. The combined figures for the basal metabolism of the repeat and non-repeats show the characteristics of the latter group.

In the above method of tabulation, it has not been possible to take out individual differences. We have attempted to do this by tabulating menstruation and basal metabolism information for individuals who have been observed at two or more phases of the cycle. Then paired comparisons were made of the phases, two successive phases at a time, using the same individuals in each phase of the pair. Thus, in a given pair, the individual differences are eliminated and a true comparison of the phases results. Though these comparisons are limited, they probably are the fairest real indication of the trend of basal metabolism with the menstrual cycle.

Though the means vary greatly with the individuals included (Table 7), by careful examination of the pairs it becomes apparent that there is a fall in basal metabolism with the onset of menstruation (see f, Table 7), that metabolism falls still further in the second and third periods (a and b), that beginning with Period IV, there is a rise (c,d,g), which continues to a maximum in the immediate premenstrual period (e).

In addition to these analyses, for comparative purposes we have desired to study the magnitude of variation in terms of percentage deviation from a given standard (Boothby, Sandiford

Table 8

Frequency and Mean Percentage Deviation
for Basal Metabolism at Various Phases
of Menstrual Cycle: Repeats and Non-Repeat

	I	II	III	IV	V	VI
Non-Repeat						
Number	9	48	71	53	33	24
Mean	-6.35*	-7.79	-6.64	-5.21	-6.13	-2.75
Repeat						
Number	12	58	72	54	48	22
Mean	-4.35	-6.65	-6.48	-4.82	-4.55	-3.10

* Percent deviation from Boothby-Sandiford Prediction standards

Table 9

Analysis of Variance of Basal Metabolism at Three Phases of the Menstrual Cycle: Based on Subjects Reported by Wakeham

Source of Variation	Degrees of Freedom	Mean Square
Total	53	
Individuals	17	1569.**
Phases	2	765.5**
Error	34	86.47

Standard was used). Data for all ages were included; repeats and non-repeat were again treated separately. Table 8 presents the frequency and mean percentage deviations for each period. The trend here is the same as indicated in the previous tabulations. The magnitude of the variation of metabolism with the menstrual cycle is about that reported in the literature.

Wakeham (1923) published his notable piece of work without statistical analysis. At the time of publication, the method of analysis of variance was not yet in general use among American biologists. With this statistical tool, we have been interested in analyzing Wakeham's data for significant differences in basal metabolism at various phases of the menstrual cycle. For Wakeham's 24 subjects neither the same number of observations were taken for each subject throughout her menstrual cycle, nor were the observations systematically spaced throughout the menstrual period. Therefore, for the purpose of our analysis, some intervals had to be chosen for which Wakeham had data for most of his subjects. Since the actual menstrual, the intermenstrual, and the immediate premenstrual periods are the times at which metabolism changes are most apt to be apparent, these three phases of the cycle were chosen for comparison. For 18 of his 24 subjects, Wakeham presented series of observations which may be classified into the three catagories. These data are in terms of oxygen consumption per minute. The analysis of variance is presented in Table 9. An examination of the means for the three periods shows a marked rise in oxygen consumption in the premenstrual phase, 211.6 cubic centimeters oxygen per minute, a sharp fall during menstruation, 201.1, and an intermenstrual phase which is slightly lower, 199.7. There is a highly significant difference between these oxygen consumptions and therefore, basal metabolism in the three phases. By means of breaking the mean square between phase into individual comparisons, it may be shown that the difference between menstrual and intermenstrual phase is not significant, whereas there is a highly significant difference between menstrual and premenstrual phases and between intermenstrual and premenstrual phases. The most clear cut tendency in all the data appears to be a distinct premenstrual rise. The analysis of these data is the first demonstration that the small deviations noted in basal metabolism with phases of the menstrual cycle are statistically significant. Examination of the individual data shows that the influence is not present in the metabolism of all women but that in the women in whom it is present the effect is pronounced enough to produce highly significant differences in metabolism.

Our own data are not suitable for more detailed analysis. However, all approaches to the data confirm the trends reported in the literature.

4. Interindividual and intraindividual variability.

Earlier, we have defined in detail Berkson and Boothby's (1938) use of the terms total interindividual, interindividual and intraindividual variabilities; the standard deviations accorded each as well as their method of obtaining these standard deviations. It will be remembered that Berkson and Boothby (1936) showed that individual differences are the largest contributing factors to variability. It will be remembered also that the total interindividual variability figure was based on single observations of basal metabolism on 828 female subjects. These subjects were either Mayo Clinic employees, professional or non-professional, or patients at the clinic. The intraindividual figures, however, were based on only ten individuals, upon whom repeated observations were made. Because of the amount of cooperation required this group was made up, in all probability, of readily available employees of the clinic; or, in other words, a quite different sample from the large clinical one used in the first case. The interindividual variability was obtained by difference according to the formula $\sigma_t^2 = \sigma_i^2 + \sigma_I^2$.

We have been intrigued by the Mayo Foundation figures, both from the standpoint of the method of obtaining them and because they represent a tool for comparison of the variability found in the college group. It has been suggested repeatedly (Wishart; Rogers, 1939) that the metabolism of college women may be more variable than that of a similar non-college group. If, then, we

Table 10

Analysis of Variance of Basal Metabolism
17 to 23 Years Using All Data: Non-repeats;
Repeats--First Year of Observations

Source of Variance	Repeat		Non-Repeat	
	D.F.	Mean Square	D.F.	Mean Square
Total	191		375	
Individuals	47	18.02	93	24.75
Days on Individual	48	2.797	94	4.611
Observations on same day	96	1.171	188	1.353

Table 11

Iowa State and Mayo Foundation Interindividual and Intraindividual Variability of Basal Metabolism*

Variability		Iowa State College		Mayo Foundation
		Non-repeats	Repeats	
Total interindividual	s_t	2.83	2.41	2.42
Interindividual	s_I	2.24	1.95	1.81
Intraindividual	s_i	1.73	1.41	1.61
Interdaily intraindividual (day to day)		1.28	.90	
Intradaily		1.16	1.08	.96

*As expressed by standard deviation in calories per square meter per hour.

can compare standard deviations derived from our data with those given by the Mayo Foundation we may have a direct measure of this possibility.

Our data offer the advantage of obtaining all of the variability measures, both interindividual and intraindividual, from the same subjects rather than the three distinct unequal groups used by Berkson and Boothby.

To obtain our figures the repeat and non-repeat groups were handled separately. 94 non-repeat and 48 repeat individuals 17 to 23 years of age were observed twice daily on each of two successive days. These data were submitted to the analysis of variance (Table 10). The appropriate standard deviations were obtained by separating the mean squares into their constituent parts (Snedecor) and making due allowance for the number of records in each case. To be comparable with the Mayo Foundation figures the Iowa State standard deviations have been reduced to the basis of one record per day (Table 11).

When one considers the great difference in sample from which the data were obtained,the agreement between the Iowa State and Mayo Foundation figures is almost unbelievably good. Another striking feature is the difference between our own repeat and non-repeat groups. In every variability, both intraindividual and interindividual, the non-repeat individuals are more variable than the repeat individuals. The variabilities of the repeat individuals and the Mayo group are almost identical. Curiously, our repeat individuals even in their first year of observation show less intraindividual variability than the Mayo group.

The Iowa State non-repeat group presents slight but consistently higher variabilities than the Mayo Foundation group. The college women's standard deviations are higher in each case and most especially so for the interindividual variability. Though the differences in size of the standard deviations for the two groups are not large enough to warrant any positive assertions one might tentatively assume that the non-repeat group is made up of less stable individuals who are reflecting the varied influences which we know to be associated with college life. The repeat group is a more stable one, and consequently is less influenced by the heterogeneous influences of college life and shows a variability similar to that of a non-college group.

5. Effect of state of nutrition as measured by hemoglobin level.

A number of physiological measurements other than basal metabolism have been made on the group of subjects studied here. These were made by other workers of the project. Of all the measurements made the hemoglobin level seemed to give the best objective indication of the nutritive state of the student. Certain subjective opinions may give a better picture but these are not well enough defined to use for comparative purposes, nor are they available for all subjects. The hemoglobin level appeared to be the best measuring stick of nutrition we have to use in attempting to answer the question of whether or not a low grade chronic undernutrition is the explanation of the lowered basal metabolic rate observed in college women.

For this comparison the non-repeat and repeat groups were analyzed separately. A correlation was run between the hemoglobin level (expressed as gramsof hemoglobin per one hundred cubic centimeters of blood) and the basal metabolic rate(expressed as calories per square meter per hour). For 63 non-repeat individuals for whom both measurements were available, a non-significant correlation coefficient 0.113 was obtained. Apparently the hemoglobin level bore little relationship to the level of basal metabolism. If the hemoglobin level were low and this was used as an indication of undernutrition, it did not follow that the basal metabolism would also be low.

Since the metabolism of our repeat individuals has been found to be less variable, one would expect fewer extraneous influences to be entering here. Then if there were any relation between the level of hemoglobin and that of basal metabolism it should be apparent in the repeat group even if it did not show in the non-repeat correlation. For 36 repeat individuals the correlation coefficient between hemoglobin level and basal metabolism was only

0.234. In addition, for repeat individuals, successive yearly hemoglobin records were plotted against the corresponding basal metabolism observations. No trends whatsoever could be observed even within the given individual.

Thus, using hemoglobin level as an index of nutritive condition, the nutritive state within ranges which exclude the seriously abnormal would seem to be unrelated to the level of basal metabolism. From this evidence there is no justification for explaining the lowered basal metabolism reported in college women on the basis of a chronic low-grade undernutrition. The alternative conclusion that the prediction standards are too high seems the more logical and simple. It would seem wise to accept the simpler explanation until conclusive evidence may be presented for proof of the undernutrition theory.

6. Method of selection of data.

As has been mentioned previously one of the primary problems arising in the interpretation of basal metabolism is the result of selection of data. The Boothby and Benedict schools have been discussed and the confusion resulting from the use of these conflicting methods has been shown in the figures of previous investigators. Such confusion makes comparison of results of two or more investigators well nigh impossible. Unfortunately most experimenters, instead of recording and preserving all their data, preserve only that part which they consider accurate and pertinent. If they are of the belief that discards all data as invalid which does not check within certain self-set limits, the important data necessary for any real evaluation of variability are lost.

This laboratory has preserved all data excepting those observations thrown out before calculation due to obvious error in technic or non-basal condition. Such data are ideal for a careful scrutiny of the effects on the resultant metabolism figure of various selection methods.

There are two questions to be answered. What effect do the various methods have on the mean metabolism figure? And, are we changing the character of the sample by selection?

For the purpose of this study, four common methods of selection of data have been applied. The first method uses all data regardless of check in clinical percentage, on the assumption that six minute observation periods are representative of the 24 hour metabolism and if two samples are found which do not "check" within some given percentage and one is discarded, the sampling is not random and the principle on which the test is built is being violated.

The second method of selection consists of an average of all observations on individuals for whom both the within day records and the records from day to day check within five percent. This

Table 12

Mean Metabolism and Standard Deviations
Based on Different Methods of Selection of Data

a. Non-Repeat

	Calories per Square Meter per Hour			
	All Observations I.S.C.	All Check Within 5% Benedict	Lowest on Each Day Check in 5% DuBois	First Day Only Mayo
Mean	34.99	35.00	34.65	35.20
Standard Deviation	2.82	2.55	2.59	2.78
Number Individual	94	53	53	94
5% Fiducial Limits	34.61 to 35.36			
1% Fiducial Limits	34.70 to 35.27			

b. Repeat

	Calories per Square Meter per Hour			
	All Observations I.S.C.	All Check Within 5% Benedict	Lowest on Each Day Check in 5% DuBois	First Day Only Mayo
Mean	35.46	35.37	34.97	35.80
Standard Deviation	2.39	2.23	2.30	2.45
Number Individual	48	35	35	48
5% Fiducial Limits	35.12 to 35.79			
1% Fiducial Limits	35.01 to 35.91			

is essentially the method of selection advocated by Benedict[1] and represents the physiological point of view. Thirdly, the metabolism of a given individual is taken as the average of the lowest value on each of two days which check within five percent. This method has been suggested by DuBois(1930a). The Fourth and last method considered is that used by the Mayo Foundation in erection of their clinical standards and (Boothby, Berkson and Dunn, 1936) is based on an average of observations of the first day only without regard to check.

For this portion of the study data on individuals 17 through 23 years of age were used. Again, the repeat and non-repeat groups were analyzed separately. First year observations only on the repeat group were included. The means and standard deviations were derived for each grouping of the data defined above (Table 12). The mean metabolism derived by the first method was taken as the mean representative of the population. The one percent and five percent fiducial limits of the means of the population from which this sample could be drawn were calculated. Means obtained by the other methods of selection were examined to see if they fell within this range.

Table 12 presents the means and standard deviations so obtained. The differences in means are not great. The mean using all the data is practically identical with that using only the data which

1. Personal communication to Miss Hughina McKay of North Central States Cooperative Project, "The Nutritional Status of College Women."

checks within five percent. In both the repeats and non-repeats, the highest mean is obtained by the clinical method (Mayo), the lowest from the average of the lowest observations only. This would be anticipated. It is evident that the influence of the selection of data by these four methods is not great under conditions in which a series of observations is made on each individual.

In the non-repeat group, 34.99 calories per square meter per hour represents the mean of the sample. The one percent fiducial limits of the means of the population from which this sample could be drawn are 34.61 to 35.36 calories per square meter per hour, the five percent fiducial limits are 34.70 to 35.27 calories per square meter per hour. The mean of the lowest observations of each day, 34.65 calories per square meter per hour, is below the lower limit of the latter range. The mean of the first day observations (Mayo) is just below the upper five percent fiducial limit. Therefore, in the selection of data by the third method the population has been changed so that the selection of data has given a sample from a population probably different from the original as there are less than five chances in one hundred that the mean of the lowest observations could be drawn from the same population as the mean using all data.

For the repeat group, 35.46 calories per square meter per hour represents the mean of the entire sample. The one percent fiducial limits of the means of the population from which this sample could be drawn are 35.01 to 35.91 calories per square meter per hour; the five percent fiducial limits, 35.12 to 35.79 calories per square meter per hour . The mean of the lowest observation, 34.97 calories per square meter per hour is below the lower one percent fiducial limit. Apparently, then, there is even stronger evidence in the repeat group than in the non-repeat that the use of only the lowest observation on each day has changed the population. Also the mean of the first day's observation, 35.80 calories per square meter per hour is just beyond the upper five percent fiducial limit. In the repeat group there is some evidence of a change in population by the fourth method of selection of data.

In both the repeat and non-repeat groups, it will be noticed that the mean using only those observations which check within five percent is very little different from that using all observations. It falls well within the fiducial limits based on the mean of all observations. Statistically, the method using all observations is preferable since it represents a random sampling of basal metabolism. In insisting on a five percent check, one is violating the principle upon which the test is built, yet the mean metabolism is not changed significantly.

Insistance upon a five percentage check reduces the available information since 56 percent of the non-repeats and 73 percent of the repeats check within five percent. Since many investigators merely discard figures which do not agree within a specified percentage, it is difficult to find a comparison for these figures. However, Stark (1932) found only 64 percent of her subjects checked within five percent for repeated tests on the same individuals. In insisting on an arbitrary percentage check, not only is one destroying the randomness of the sample of data, but also he is losing part of the variability which is characteristic of the basal metabolism.

Judged by these data, the method of selection of data does have considerable influence. The methods of averaging the lowest observations on each day, and of taking only one day's observations seem to make a difference in the population studied. Ideally, the choice of method of selection of data should be found in the interpretation of the definition of basal metabolism (DuBois, 1936) which suggests the use of all observations, considered reliable before the results of the test were calculated. This method of selection of data is the method of choice of this laboratory.

From these analyses it becomes apparent that for satisfactory comparison of basal metabolism results, the method of selection of data must be uniform.

In addition to comparison of means using the four methods of selection of data, analyses of variance were made for the pertinent variability factors. The variance of certain factors as derived by the various methods of selection of data was compared. Again repeat and non-repeat individuals were treated separately. For

Table 13

Analysis of Variance of Basal Metabolism:
All Data Checking Within Five Percent

Source of Variation	Non-repeats		Repeats	
	D.F.	Mean Square	D.F.	Mean Square
Total	211		139	
Individuals	52	24.05**	34	17.53**
Days on Individual	52	1.410**	35	1.304**
First and Second Days	1	0.00		
Observations of Same Day	106	0.4325	70	.6737

Table 14

Analysis of Variance of Basal Metabolism:
Lowest Observation on Each Day Checking Within Five Percent

Source of Variation	Non-repeats		Repeats	
	D.F.	Mean Square	D.F.	Mean Square
Total	105		69	
Individuals	52	12.68**	34	8.703**
Days on Individual	53	0.8146	35	0.7966

Table 15

Analysis of Variance of Basal Metabolism:
Observations of First Day Only (Mayo)

Source of Variation	Non-repeats		Repeats	
	D.F.	Mean Square	D.F.	Mean Square
Total	187		95	
Individuals	93	14.00**	47	10.86**
Observations on Same Day	94	1.565	48	1.229

the repeat groups, the analyses cover the first year of observation only. Table 10 in section 4 gives variability factors using all data. As might be expected, there was far greater variation between individual than within observations of the same day on the same individuals. The difference between individuals was highly significant. Likewise the difference between observations on the same individual on different days (or from day to day) was highly significant. The variation between individuals is far greater than the variation within a given individual.

Table 13 presents the analysis based on only those data which checked within five percent. Because this method does, by its nature, eliminate a great portion of the variability, the variance for all factors within the individual: i.e., the intraindividual variance expressed in the variance of days on individual and the variance of observations on the same day are reduced by one-half. But the interesting point is that individuals are not differentiated more clearly; in fact, are slightly less well differentiated. By such a selection of data, we gain nothing on individual differences, and we lose much of our data. Apparently, the wide variability found in the basal metabolism of some individuals is a characteristic of those individuals, and its elimination means the loss of a fundamental characteristic.

We already have found that selection of only the lowest observations changes the population which we are sampling. In the case of the non-repeat group, use of the lowest observations checking within five percent, though it gives highly significant differences between individuals differentiates between individuals less well than have the other two previous methods. The same is true of the repeat group (Table 14).

The results of the analysis using only one day of observation also differentiates less well between individuals. The higher within day variance (Table 15) is accounted for by the fact that this represents the first day of testing.

7. Effect of training in the testing routine.

There has been much debate in the literature about the effect of training in the test situation on the basal metabolism observed for the individual. The actual measurement of a training effect has not been made. One or two investigators have, on the assumption of such an effect, discarded all first metabolism observations made on a subject. In connection with the analyses for the method of selection of data calculated from the first two days of observation in each individual, we have seized the opportunity of testing directly for the training effect. For this purpose a comparison has been made between the first and second day of observation which shows a highly significant difference (Table 10). In an analysis to be presented in a later section, involving three successive years of observations of the same individuals (Table 17) we have evidence that it is only between the first and second day of observation that this highly significant difference appears.

Apparently one duplicate test procedure acquaints the subject sufficiently well with the testing situation that subsequently the routine of testing itself has no effect on the metabolism. In the second and third years of testing, the difference between first and second days of observation is even less than chance variation.

This finding might be used as an argument for running practice tests for all individuals before recording data for physiological purposes so that the effect of training then would not be confused with other physiological factors. However, since in clinical work there is no provision for repeat testing the effect of the newness of the routine to the subject is a part of nearly all basal metabolic observations, and it should be included in any standard used for clinical comparison.

8. Effect of fatigue.

To those who have an opportunity to know college women well and observe them carefully over a period of time, there becomes apparent in many students a certain common picture.

The student starts the freshman year energetically, often somewhat bewildered by the newness of her environment and the many adjustments to be made, but physically alert, unstrained and able to cope gradually with these problems. The next year the students seem a more settled group with adjustments made, beginning to take college in their stride. As yet they have not begun to be particularly active in campus movements of a responsible or leadership character nor have they entered senior college and specialization in their chosen fields. One has the feeling that the sophomore student does not feel pushed, has adjusted to college living and her enthusiasm is marking time for a bit.

About the junior year these same individuals begin to take a more active interest in campus activities. Those already participating in them begin to assume positions and offices of responsibility requiring time, initiative and worry. The student enters the major field of interest scholastically and more time is demanded and given toward subject matter. Likewise by this year romantic interests are apt to develop to a greater degree.

The net result of all these factors is that there is more and more competition for the girl's time, so that time for rest and general unorganized leisure is cut to a minimum. Many students, too, have begun to exhaust their limited funds for college and are finding more outside work necessary.

Another contributing factor to fatigue is that dormitory regulations for upper-class women are more lax. After the freshman year students do not have to be in their rooms as early and the rule on "lights out" at a reasonable hour no longer holds. Consequently, with more demands on their time and no regulations requiring a definite amount of rest, the student tends to work later and later with less and less sleep. As a result a progressive fatigue builds up which may be expressed differently in different individuals or in the same individual at various stages. The fatigue may be such that when an opportunity to rest comes it brings a complete and utter relaxation beyond that ordinarily present, or it may be expressed as an inability to relax completely or rapidly. One observes in the individual a relaxed posture, a certain strained look and restlessness; these signs are difficult to define and obvious only to those who have known the individual over a period of time.

The senior year often only intensifies these symptoms with anxiety over future employment whether it be professional or as a homemaker. In certain individuals who have attained their goal, be it scholastically, socially, or romantically, we may observe somewhat less fatigue and strain. In some of the organized activities, much of the work may now be passed to oncoming juniors.

We have observed these things in the group of individuals we have been fortunate enough to follow rather closely over three and four year periods. It is extremely difficult to objectively measure the reaction we have pictured. Repeated physical checks taken yearly fail to show anything which can be put into numbers.

Since we were unable to attain any definitive measurement, the best possible substitute has been attempted. For this purpose we are introducing the case study to describe the physical status and character of the individuals studied. The case studies are presented in the appendix.

Our hypothesis is that in a group of students whose basal metabolisms have been observed over a three or four year period, those who have been unusually active either in campus activities or in outside work and who present the subjective picture just described will show a greater variability in basal metabolism as their activities increase. The year of greatest variability will coincide with that of greatest strain, whenever it appears in a given individual. One would expect the resultant fatigue to be present in either the junior or senior year or both.

On the basis of this hypothesis one would anticipate a rather high variability in basal metabolism in the freshman year due to two effects: the newness of the testing situation and the adjustment to the new college environment. In the sophomore year the student would be adjusted and under the least strain so that the variability should be the least then of any time. Then we would expect the variability to increase again in the junior or senior year, or both, if the individual is one who engages in campus activities. When the increase in variability will come will depend upon the individual and her activities. For individuals who follow a rather phlegmatic, uneventful course through college, one would expect little or no increase in the variability of their metabolism.

This laboratory has followed the basal metabolism of 37 women through three years of college life. In order to get an idea of the feasibility of our hypothesis we have examined this group. The group was divided into several sub groups: first, 14 individuals who on the basis of activity records and personal contact we know to represent the type of individuals previously described; secondly, four individuals who left school at the end of three years for marriage; thirdly, three who have dropped because of scholastic failure; fourth, nine who represent a relatively inactive non-participating group; and lastly, an assorted group of seven individuals on whom the years of observation were not consecutive or who entered as transfer students. The active and inactive groups are the ones in whom we are most interested. From these two groups the case studies of subjects 43 and 91 are presented here to illustrate the types of individuals to whom we have reference:

Subject No. 43

Residence: Delta Delta Delta House Major: Dietetics
Scholastic record:
   Entrance test: 89
   High School Q.P.A. 3.45
   College Q.P.A. 2.981
Medical: negative
Activity:
   Freshman:
      a. Music: band, band tour six days in March; orchestra
      b. W.A.A.: Outing Club, Saturday hikes
      c. Y.W.C.A.: Member
      d. Danforth Scholarship as outstanding freshman home economist in America
   Summer: Foods councilor at Y.W.C.A.; Playhouse in June and July; camp in August
   Sophomore:
      a. Music: band, band tour, orchestra; piano lessons fall and winter quarter
      b. A.W.S.: secretary; delegate to convention in Michigan for four days in April
      c. W.A.A.: elected to Naiads, honorary swimming organization
      d. Y.W.C.A.: poster committee
      e. Professional: proof reader for Homemaker staff; cherry pie committee for Veishea
      f. Sorority: pledge activities of Delta Delta Delta
   Summer: summer school in Milwaukee; camp for two weeks; work in office for six weeks
   Junior:
      a. Music: elected to Sigma Alpha Iota in January
      b. A.W.S.: junior class representative; chairman of tea for freshman candidates; chairman of book loan fund; committee on point system
      c. Y.W.C.A.: chairman weekly radio programs; Y.W.C.A. Cabinet; chairman and toastmistress Geneva banquet for Iowa Y.W.C.A. and Y.M.C.A.; invitations committee for Y.W.C.A. banquet; vice president
      d. Professional: elected to Phi Upsilon Omicron; president Phi Upsilon Omicron; chairman of Home Economics floats for Veishea parade
      e. Mortar board: president
      f. Religious Emphasis Week: radio chairman; dinner committee;
      g. Sorority: volleyball team; chairman of decorations for spring formal; Sor-Dor sing; corresponding secretary

Table 16

Analysis of Variance of Basal Metabolism
of 14 Active Individuals Through Three
Successive Years in College

Source of Variation	D.F.	First Year Mean Square	Second Year Mean Square	Third Year Mean Square
Total	55			
Individual	13	25.33**	18.04**	20.96**
Days on Same Individual	13	1.585	0.7538	3.845**
First vs. Second Day	1	1.040	0.00	1.60
Tests on Same Day	28	1.283	0.4354	0.4161
Mean Metabolism calories per square meter per hour		36.19	34.64	34.02

Table 17

Analysis of Variance of Basal Metabolism
of Nine Relatively Inactive Individuals
Through Three Successive Years in College

Source of Variation	D.F.	First Year Mean Square	Second Year Mean Square	Third Year Mean Square
Total	35			
Individual	8	27.62**	15.60	24.68**
Days on Same Individual	8	3.799	0.7856	0.3587
First vs. Second Day	1	15.36**	0.005	0.2100
Tests on Same Day	18	1.271	1.105	0.2400
Mean Metabolism calories per square meter per hour		35.11	34.29	33.32

Summer: flu for ten days; camp ten days in August
Senior:
a. Music: Sigma Alpha Iota
b. Y.W.C.A.: finance chairman and vice president
c. Professional: president Phi Upsilon Omicron; fruit cake committee; co-chairman of Ellen H. Richards Day
d. Mortar Board: president; co-chairman Mortar Board Recognition Dinner
e. Sorority: corresponding secretary

Subject No. 91

Residence: Dormitory
Major: Home Economics Education
Scholastic record:
Entrance test: C 5
High School Q.P.A. 3.55
College Q.P.A. 2.555
Medical: negative
Activity: No particular activities throughout college; engagement to hometown man announced winter quarter of senior year.

(Definitions of abbreviations are given preceding the section on case studies in the appendix.)

For a picture of the change in variability of basal metabolism of the active individuals, an analysis of variance was made on the data for each year (Table 16). The amount of variability in basal metabolism of the individual from day to day would be considered as an indication of the amount of relaxation attained in the individual in each year which in turn would measure the amount of fatigue present. We would then have a first objective measure of a purely subjective impression. Table 16 confirms the type of response we have suggested. The difference in the record from day to day on the same individual decreases in the sophomore year and then increases over five times within the junior year. This increased variability parallels the year of greatest activity to date in the subjects under study.

A similar treatment of the data on the nine non-participating students is presented in Table 17. The day to day variability in basal metabolism decreases in the sophomore year and still further in the junior year. This is in sharp contrast to the variability trend in the very active group. These inactive individuals merely reflect an increasing adjustment to the test; and furnish complemental evidence for the hypothesis presented. Though we do not present absolute proof for our hypothesis; it is one which investigators cannot afford to ignore and should receive further consideration with the accumulation of more data.

9. Number of observations necessary.

Certain practical implications concerning the number of observations necessary to establish the basal metabolism of a given individual can be drawn from the analysis of variance presented in Table 10. Since the variation within observations on the same day was so very small, only one observation per day would seem to be necessary. Since, however, the variance for days on the same individual was highly significant, observations on more than one day are necessary to establish the basal metabolic trend on an individual.

In a group of clinic individuals, one observation should be sufficient to distinguish those with a pathological trend. For these individuals, observations should be repeated not on the same day, but on successive days in order to verify this pathological tendency.

For more careful physiological work, repeated observations on different days are a necessity. Since no advantage is gained in taking more than one observation per day on an individual the best proposal, providing physical conditions of the laboratory are such as to make it feasible, would be to make a single observation each morning on as many individuals as time permitted. These individuals should all be checked on another day.

B. Tentative Standard for Basal Metabolism of College Women 17 to 28 Years of Age

It has been pointed out that none of the present prediction curves seem adequate for women of the college age range. For a long time the Harris and Benedict standards appeared to give the best prediction though even in the case of these the prediction averaged in most instances five to six percent too high for the observations on college women. More recently the Mayo Foundation Standards have been proposed which more closely approximate the observed basal metabolic rates. However, the Mayo Foundation prediction for the years 17 to 28 is based on a relatively small number of individuals. Also, at least part of the subjects are clincial patients in whom the factor of apprehension may play a part in elevating the basal metabolic level.

Since this laboratory has available considerably more data than did the Mayo Foundation in the age range from 17 through 22 years and since our subjects represent normal physiological material, a standard for basal metabolism has been suggested for college women 17 to 28 years of age.

The fundamental data for the standard consists of the average of four observations, two per day on each of two days, for each of 267 individuals. Of this number, 114 are non-repeat individuals and 153 represent yearly observations on 55 repeat individuals at different age levels. We previously have demonstrated that the repeat individuals are only one-half as variable as the non-repeat and it would seem that they should be given greater consideration in determining standards. Then in establishing a mean basal metabolism in calories per square meter per hour for each age group, the mean should be weighted to give it the stability of the repeat groups. The number of individuals and the mean metabolism of these individuals at each age were determined for the repeat and the non-repeat groups separately; to determine the combined mean metabolism for a given age, the repeats were weighted twice as much as the non-repeat individuals.

After the weighted means had been obtained for each age, a quadratic equation was used to fit a parabolic curve to the data. (See method of multiple regression, Snedecor, 1938.) The curve

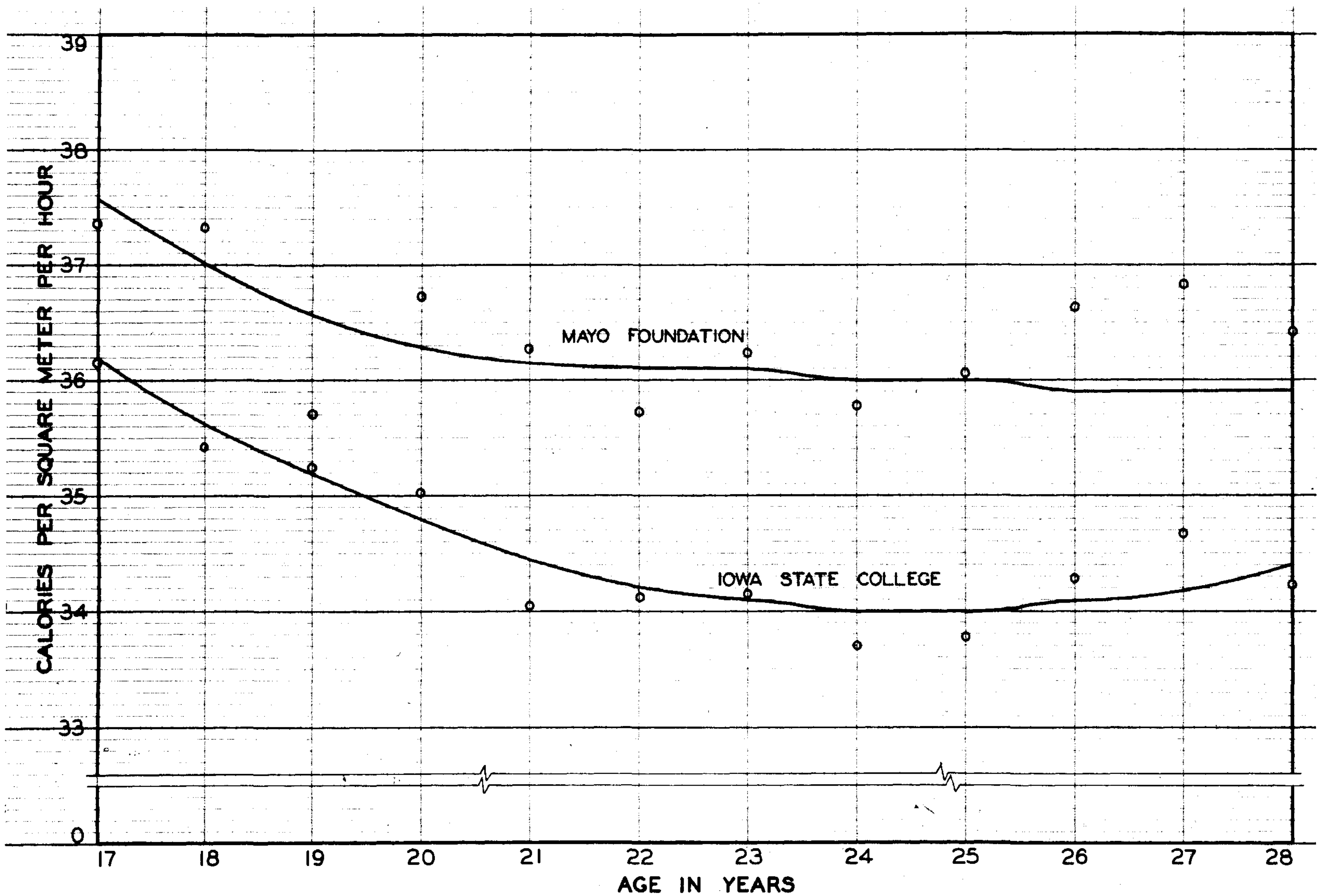

Figure 1 Prediction Curve for Basal Metabolism for Women 17-28 Years Inclusive

Table 18

Basal Metabolism, Mean Calories per Square Meter per Hour; Smoothed Values for Prediction.

Age	Calories per Square Meter per Hour	
	Mayo Foundation	Iowa State College
Years		
17	37.6	36.2
18	37.0	35.6
19	36.6	35.2
20	36.3	34.8
21	36.2	34.5
22	36.1	34.2
23	36.1	34.1
24	36.0	34.0
25	36.0	34.0
26	35.9	34.1
27	35.9	34.2
28	35.9	34.4
29	35.9	

Table 19

Observed Basal Metabolism, Calories per Square Meter per Hour, for Age in Years to Nearest Birthday

Age Years	Mayo Foundation		Iowa State College	
	Number	Mean	Number	Weighted Mean
17	4	37.35	16	36.17
18	9	37.33	31	35.42
19	30	35.70	47	35.23
20	18	36.73	51	35.02
21	23	36.27	46	34.04
22	29	35.72	26	34.12
23	23	36.23	16	34.16
24	19	35.78	11	33.70
25	15	36.08	7	33.78
26	15	36.63	7	34.30
27	13	36.83	5	34.69
28	15	36.41	4	34.22
29	12	35.29		

was weighted by the frequency at each age so that the means having the greatest number of cases involved have the greatest influence on the trend of the curve. Table 18 presents the smoothed values for prediction. Figure 1 presents the curve obtained and the scatter of the weighted means about the curve .

For comparative purposes the Mayo Foundation observed means and curve have been plotted in the same figure. One immediately notices the similarity of the curves whose principal difference is the consistently higher prediction given by the Mayo Clinic data. The curves are so similar that it would seem they varied only in some constant factor. It would be our suggestion that the constant factor involved is the apprehension found in clincial patients on even routine examination.

Our curve shows a somewhat sharper decline and the decline in basal metabolism with age continues over a longer period before reaching a temporary plateau. Iowa State weighted means deviate less from the smoothed curve than do those of the Mayo Foundation. In other words, the age means show less fluctuation from year to year. This is indicated by a comparison of the mean basal metabolism figures found in Table 19. Table 19 also gives the number of individuals at each age included in the determination of the two standards. It is apparent that for the 17 to 22 year range, the Iowa State data are considerably more extensive.

Another surprising feature is the rise in metabolism to be noted beginning at 25 and continuing through 29 years of age. We recognize that our own data are extremely limited at these ages. But, examination of the mean metabolisms obtained by the Mayo Foundation, (Figure 1, or Table 19) which are based on two to three times as much data in these years, shows exactly the same thing. After a plateau of a year or two the basal metabolism begins to rise at 25, reaches a peak about 27 and then gradually returns to normal at about 29 years. For a four year period there is an unexpected deviation from the trend of basal metabolism. To our knowledge, there is no known physiological explanation of this irregularity. One is tempted to wonder what influence matrimonial status may have at this point. For many women the period of late twenties is one of adjustment. If the individual is interested in marriage and by the age of 25 has not yet achieved that status, it becomes a matter of concern. By 30 it would be assumed the adjustment to the unmarried state has been made, and other stabilizing influences have entered the individual's life. This is merely a hypothesis. However, in considering a physiological measurement which is as subject to emotional influences as basal metabolism, surely such a consideration cannot be ignored. It would be interesting to compare the basal metabolism of a group of unmarried women of 25 to 30 years with that of a group of women married long enough to have made adjustments to marriage.

The Iowa State standards are presented as a better basis for comparison of the basal metabolism of subjects than is found in a prediction based on clinical material. For clinical purposes a standard which involved the elevating factor of apprehension would still be the one of choice. It should not, however, be confused with a physiological standard.

This standard is presented tentatively. At present the method of handling the data by weighting seems the best procedure for taking care of both the repeat and non-repeat data.

VI. SUMMARY AND CONCLUSIONS

At least four basal metabolism observations, two on each of two days, are reported on 169 different college women from 17 to 29 years of age—149 of whom were between 17 and 23 years inclusive. Of this original group, 55 individuals remained in college and were observed for more than one year; 55 for two years, 39 for three years and, to date, 10 for the entire four year college period. This group is known as the repeat group. The remaining 114 were observed one year only and are referred to as the non-repeats. Thus both a longitudinal and a cross-sectional study has been possible. This study is the most extensive college study so far reported.

The purpose of the study was to report the basal metabolism of the college woman measured under her usual living conditions. Variability is dealt with as a fundmental characteristic of basal metabolism. By statistical methods an attempt has been made to segregate some of the factors which may contribute to the variability of basal metabolism, for example, the effects of the amount of sleep the night previous to testing, the menstrual cycle, interindividual and intraindividual variability, the state of nutrition as measured by hemoglobin level, the method of selection of data, training in testing routine and fatigue. An endeavor has also been made to clarify to some extent the existing lack of parallelism between present standards and observed basal metabolism in college women. On the basis of this body of data a tentative standard for college women has been formulated.

The repeat and non-repeat groups were found to differ significantly in mean metabolism. The metabolism of the repeat group was less than half as variable as that of the non-repeat group. Consequently in all analyses the repeat and non-repeat data were treated as two separate series.

The average sleeping time the night previous to testing was 6.8 hours. Within the range studied, it made no difference in the basal metabolism observed on two successive days whether the tests were preceded by the same or different amounts of sleep.

The reported effects of the menstrual cycle on basal metabolism were confirmed. These consist essentially of a premenstrual rise in basal metabolism with a lowering during actual menstruation and in the immediately postmenstrual period. Statistical analysis by this laboratory of Wakeham's data (1923) showed a highly significant increase in basal metabolism in the premenstrual period.

Standard deviations for total interindividual, interindividual, intraindividual, intradaily intraindividual and day to day intravidual variabilities are presented for both the repeat and non-repeat groups;our data offer the advantage of obtaining all of the variability measures, both interindividual and intraindividual, from the same subjects, rather than three distinct, unequal groups used by the Mayo Foundation workers. They confirm the Mayo Foundation work. Standard deviations for the non-repeat group suggested a greater variability in the basal metabolism of college women than in the clinic individuals surveyed by the Mayo group.

Using hemoglobin as an index, the nutritive state, within ranges which exclude the seriously abnormal, was unrelated to the level of basal metabolism.

It was found that training in the testing routine had a highly significant effect on basal metabolism, but apparently one day of testing was sufficient to acquaint the subject with the routine of observations. For careful physiologic work it is suggested that one practice day of testing be run before recording data. For clinical work, since there is usually no provision for repeat testing, the effect of the newness of the test should be included in standards used for clinical purposes.

The method of selection of data proved to be a variability factor of some importance. For a satisfactory comparison of basal metabolism, the method of selection of data must be uniform. The method suggested by this laboratory as the procedure of choice, is the use of all data, unless at the time of the test and before calculation of results the test is discarded for reasons of error in technic or non-basal condition of the subject. Using this method as a standard of comparison the method of averaging the lowest observations on each of two days which check within five percent and the method of using only the first day of observation appear to change the population from which the sample is drawn.

The hypothesis was advanced that the fatigue picture observed in very active college women is reflected in an increased day to day variability in their basal metabolism. Evidence is presented for this hypothesis.

Because of the very small variance between tests made on the same day, only one observation per day would seem to be necessary. Since the variance between days on the same individual was highly significant, observations on more than one day are essential to establish the basal metabolism of the individual for physiological studies.

There seems little need to explain the lowered basal metabolism reported for college women on the basis of a chronic low grade undernutrition. The simplest interpretation offered so far is the dearth of data for this age group at the time standards were compiled, which resulted in prediction standards too high for physiological studies.

A tentative prediction curve for basal metabolism of women 17 through 28 years of age is proposed. The curve follows much the same shape as the Mayo Foundation curve for women of these ages, but at a definitely and almost constantly lower level. This lower level is in keeping with the basal metabolism observations reported on college women. It is suggested that the difference between the Mayo Foundation and the Iowa State standards may be due to the elevating effect of apprehension present in the clinical situation under which the Mayo Foundation standards were made, but absent in the Iowa State testing situation.

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Table 20

All Observations on Individual Women

Subject by Age Groups Key No.	Height Cm.	Weight Kg.	Surface Area Sq.M.	Oral Temperature	Calories per Sq.M. per Hour	Sleep Night Before Hours	Days After Onset of Last Menstruation	Pulse		Respiration
								Before Test	With Test	
					17 years					
1	162.0	51.8	1.51	98.4	34.42	7	8	80	70	18
					34.13				75	
	162.5	50.4	1.52	97.4	34.46	7	9	79	85	15
					36.83				77	
2	156.0	52.6	1.52	97.3	36.70	7	16	80		
					35.50					
	156.0	54.9	1.54	97.8	36.00	7	26	76	76	14
					36.87				76	
3	163.5	54.2	1.57	98.2	35.91	7	20	71	68	14
					36.48				69	
	163.5	54.1	1.57	97.8	35.75	7	21	69	73	18
					34.03				63	
4	166.5	57.7	1.63	98.0	34.94	6	14	74	72	
					35.49				70	
	166.5	57.1	1.62	97.8	35.75	6	15		70	16
					35.75				72	
5	164.0	46.4	1.48	97.8	34.47	9	*	64	64	14
					36.32				65	
	164.0	46.0	1.47	97.9	34.13	10	*	70	65	16
					34.13				70	

Table 20 (continued)

Subject by Age Groups Key No.	Height Cm.	Weight Kg.	Surface Area Sq.M.	Oral Temperature	Calories per Sq.M. per Hour	Sleep Night Before Hours	Days After Onset of Last Menstruation	Pulse		Respiration
								Before Test	With Test	
6	160.0	48.7	1.48	98.0	37.30 35.77	7	11	70	76 76	14
	160.0	48.7	1.48		38.49 37.58	6	12			
7	172.5	68.1	1.80	97.8	34.61 34.61	7	*	60	61 61	14
	172.5	68.5	1.80	97.6	32.83 33.33	7	*	61	59 59	12
8	171.5	55.8	1.64	97.2	40.74 39.91	7	14	92	86 89	13
	171.5	55.8	1.64	96.8	38.89 38.99	7	16	80	76 73	16
9	162.5	54.2	1.56	98.1	37.17 37.46	9	16	66	62 60	14
10	183.0	69.4	1.89	97.8	35.00 35.47	7	10	74	64 66	
	183.0	69.9	1.89	97.3	33.96 31.54	7	13	67	64 65	11
11	164.0	57.2	1.60	97.0	35.01 35.73	7	20	64	61 61	16
	163.5	57.7	1.61	97.2	38.25	8	21	66	62 62	16
12	169.0	56.5	1.63	97.7	37.88 38.81	5	12	65	66 64	16
	169.5	56.5	1.63	97.7	35.34 39.57	7	13	59	60 62	14

Table 20 (continued)

Subject by Age Groups Key No.	Height Cm.	Weight Kg.	Surface Area Sq.M.	Oral Temperature	Calories per Sq.M. per Hour	Sleep Night Before Hours	Days After Onset of Last Menstruation	Pulse		Respiration
								Before Test	With Test	
13	168.5	61.0	1.69	98.2	34.57	7	11	67	60	13
III 1st yr.					35.75				65	
	168.5	60.6	1.68	98.0	35.09	6	12	63	59	15
					34.55				64	
14	167.5	58.4	1.65	98.6	42.22	8	1	84	79	14
III 1st yr.					41.13				75	
	167.5	56.5	1.63	97.8	41.24	7	3	78	76	15
					40.11				73	
15	162.0	59.0	1.61	97.6	32.04	7	10		59	15
					34.59				58	
	162.0	59.9	1.62	97.8	31.98	7	11	59	50	15
					31.42				50	
16	162.0	60.3	1.63	97.3	33.40	7	16	65	64	14
					33.61				60	
	162.0	60.9	1.63	94.6	33.11	7	18	62	66	15
					34.15				59	
					18 Years					
17	169.0	47.3	1.58	97.8	34.99	7	1	66	67	16
					35.58				66	
	169.0	46.9	1.58		32.14	6	13	70	67	16
					33.84				66	
18	178.5	61.5	1.77	97.8	31.16	6	10	73	67	16
					30.13				69	
	178.5	60.8	1.76	97.2	27.49	5	11	75	66	15
					28.26				63	

Table 20 (continued)

Subject by Age Groups Key No.	Height Cm.	Weight Kg.	Surface Area Sq.M.	Oral Temperature	Calories per Sq.M. per Hour	Sleep Night Before Hours	Days After Onset of Last Menstruation	Pulse		Respiration
								Before Test	With Test	
19 III 1st yr.	158.5	46.7	1.45	97.8	40.04 40.04	7	24	61	62 64	20
	158.5	46.8	1.45	97.4	35.81 37.63	7	25	68	68 68	17
20	161.5	47.6	1.48	98.0	34.37 34.37	8	17	78		
	161.5	48.3	1.49	97.4	34.33 34.33	5	18	76		
14 III 2nd yr.	169.0	62.6	1.71	97.5	36.82 37.34	5	6	70	61 70	16
	169.0	63.0	1.71	97.6	38.30 37.78	6	7	79	72 72	19
21	165.5	57.3	1.62	97.6	37.67 32.61	8	32	64	66 68	16
	165.5	57.6	1.62	97.6	36.27 35.70	7	33	65	68 66	16
22 II 1st yr.	171.5	65.3	1.76	97.6	37.84 37.32	6	11		82 81	23
	171.5	65.5	1.76	98.0	37.33 37.33	8	20	79	78 78	14
23	173.5	64.5	1.76	98.2	38.05 38.22	8	25	70	70 67	12
	173.5	64.6	1.76	98.0	35.32 35.17	7	26	65	62 62	10
24	164.5	63.3	1.68	97.8	35.37 35.91	6	17	66		
	164.5	63.1	1.68	97.4	35.98 36.14	7	18	76		

Table 20 (continued)

Subject by Age Groups Key No.	Height Cm.	Weight Kg.	Surface Area Sq.M.	Oral Temperature	Calories per Sq.M. per Hour	Sleep Night Before Hours	Days After Onset of Last Menstruation	Pulse Before Test	Pulse With Test	Respiration
25	175.0	64.2	1.77	97.3	36.45 36.45	7	25	64	65 63	14
	175.0	64.3	1.77	97.8	38.41 38.25	5	26	68	67 68	16
26	172.0	61.0	1.71	97.6	35.75 30.82	8	9	70		
	172.0	61.2	1.71	98.0	32.82 31.53	7	10	80		
27 III 1st yr.	168.5	65.5	1.74	98.0	35.06 35.59	8	15	72		18
	168.5	66.0	1.74	97.6	34.22 35.27	8	22	70	68 68	20
28	157.5	61.5	1.61	97.2	38.91 39.26	8	14	60	57 55	16
	157.5	61.5	1.61	97.6	35.66 41.27	6	15	60	56 66	19
29 II 1st yr.	162.0	56.7	1.59	98.2	36.29 37.28	7		70	65 66	14
	162.0	57.8	1.60	97.8	36.35 37.47	7		72	72 85	13
30	157.5	56.7	1.56	97.4	37.58 38.41	7	Never	58	68 64	16
	157.5	56.8	1.56	97.2	33.17 31.60	7	Never	56	60 60	15
31 II 1st yr.	165.0	59.0	1.64	98.0	35.24 30.09	6	7	68	72 72	14
	165.0	57.8	1.63	98.0	30.51 31.64	7	11	63	67 60	13

Table 20 (continued)

Subject by Age Groups Key No.	Height Cm.	Weight Kg.	Surface Area Sq.M.	Oral Temperature	Calories per Sq.M. per Hour	Sleep Night Before Hours	Days After Onset of Last Menstruation	Pulse		Respiration
								Before Test	With Test	
32	162.5	66.2	1.70	97.6	31.81 32.35	6		56	60 58	13
33	175.5	57.2	1.69	97.8	34.94 30.47	8	12	64	66 68	17
	175.5	56.8	1.69	97.4	35.31 35.31	7	13	68	70 70	16
34	159.0	49.0	1.48	97.6	35.06 37.23	6	11		62 52	16
	159.0	49.2	1.48	97.4	31.25 30.94	6	12		56 56	14
35	160.0	55.8	1.56	98.0	28.31 30.37	7	15	66	62 60	17
	160.0	57.4	1.58	98.2	33.42 33.99	7	16	66	63 62	16
36	161.0	58.7	1.60	96.6	34.40 35.26	7	*	76	80 72	14
	161.0	58.7	1.60	98.0	32.40 33.52	7	*	65	69 66	15
37	171.0	63.7	1.74	97.6	37.85 38.11	7	11		72 77	13
	171.0	63.9	1.74	97.8	33.94 33.94	5	12	73	72 74	13
13 III 2nd yr.	169.5	59.9	1.68	98.0	35.17 33.28	7	19	61	58 62	12
	169.5	59.7	1.68	97.4	33.01 33.57	7	12	66	60 64	13

Table 20 (continued)

Subject by Age Groups Key No.	Height Cm.	Weight Kg.	Surface Area Sq.M.	Oral Temperature	Calories per Sq.M. per Hour	Sleep Night Before Hours	Days After Onset of Last Menstruation	Pulse Before Test	Pulse With Test	Respiration
38	163.0	56.0	1.59	98.3	36.58	6	14	70	68	
					36.02				62	
	163.0	56.2	1.59	98.2	34.18	6	18		64	22
					36.01				65	
39	171.0	64.8	1.75	97.8	34.98	7	30	60	62	14
II 1st yr.					33.69				64	
	171.0	64.9	1.75	97.8	32.04	7		61	60	14
					35.15				61	
40	164.0	51.7	1.55	98.0	36.68	6		60	56	
					36.08				56	
	164.0	51.7	1.55	98.0	32.17	7		60	56	15
					32.17				56	
41	167.0	65.2	1.72	97.4	36.19	8	*	76	74	18
IV 1st yr.					38.50				81	
	167.0	65.4	1.73	97.4	36.56	7	*	79	80	22
					37.62				79	
42	159.5	59.1	1.60	97.8	38.38	7		64	64	16
III 1st yr.					37.83				62	
	159.5	59.7	1.61	98.0	39.75	5		68	57	18
					38.93				58	
43	163.0	59.0	1.62	97.8	35.86	7	10		58	16
IV 1st yr.					35.58				76	
	163.0	58.3	1.61	98.0	36.02	7	11	74	78	18
					36.02				77	
44	157.0	47.6	1.44	97.0	36.98	5	21	75	65	19
					36.02				62	
	157.0	48.1	1.45	97.4	32.89	6	24	70	70	19
					35.42				75	

Table 20 (continued)

Subject by Age Groups Key No.	Height Cm.	Weight Kg.	Surface Area Sq.M.	Oral Temperature	Calories per Sq.M. per Hour	Sleep Night Before Hours	Days After Onset of Last Menstruation	Pulse		Respiration
								Before Test	With Test	
45	160.0	47.6	1.46	98.0	36.25 33.48	7	21	64	64 64	16
	160.0	47.4	1.46	98.3	34.83 34.52	6	22	66	64 66	18
					19 Years					
46 III 1st yr.	167.5	59.9	1.67	97.6	35.21 34.67	6	14	72	70 70	18
	167.5	60.2	1.67	97.4	34.63 35.17	6	15	70	68 70	15
47 IV 1st yr.	165.5	53.1	1.56	97.8	33.79 33.79	6	11	62	60 60	24
	165.5	52.8	1.56	97.4	30.88 33.12	7	12	60	60 64	22
48 III 1st yr.	162.0	66.7	1.70	97.8	44.16 39.66	7	15	69	69 68	19
	162.0	66.9	1.70	97.2	37.72 36.10	6	16	61	68 65	17
49 II 1st yr.	167.5	57.6	1.64	97.7	37.45 37.45	7	7	68	62 61	17
	167.5	57.0	1.63	97.8	35.81 35.53	7	8	68	66 64	17
50	155.0	49.7	1.46	98.0	38.79 38.16	7	20	76	80 68	15
	155.0	49.7	1.46	97.8	35.37 35.37	8	21	78	78 79	14

Table 20 (continued)

Subject by Age Groups Key No.	Height Cm.	Weight Kg.	Surface Area Sq.M.	Oral Temperature	Calories per Sq.M. per Hour	Sleep Night Before Hours	Days After Onset of Last Menstruation	Pulse Before Test	Pulse With Test	Respiration
51	165.0	57.1	1.61	98.2	36.25 30.37	8	25	68	64 66	16
	165.0	57.7	1.61	98.0	34.87 36.33	7	26	62	60 64	16
52	162.5	47.5	1.54	98.1	40.71 41.00	7	15	68	74 75	13
	162.5	47.4	1.54	98.0	38.61 38.03	8	16	70	74 71	12
19 III 2nd yr.	159.5	46.0	1.44	97.7	33.36 33.05	7	4	60	58 60	16
	159.5	45.9	1.44	97.7	33.03 33.65	7	5	59	56 59	18
13 III 3rd yr.	170.0	61.5	1.71	97.5	29.92 30.73	7		56	56 56	12
	170.0	61.9	1.71	97.6	32.53	7			57 60	13
14 III 3rd yr.	169.0	64.7	1.73	97.8	36.49 36.76	6	17	66	70 62	13
	169.0	64.9	1.73	98.0	38.88 39.15	6	18	78	76 76	16
53	165.5	53.1	1.57	98.1	35.03 35.82	7	16	62	64 68	
	165.5	53.5	1.58	98.6	37.08 33.43	5	17	70	72 70	
54 III 1st yr.	170.5	60.8	1.70	98.2	35.94 35.74	7	14	70	67 64	13
	170.5	61.0	1.70	98.0	34.34 34.19	7	15	68	68 64	12

Table 20 (continued)

Subject by Age Groups Key No.	Height Cm.	Weight Kg.	Surface Area Sq.M.	Oral Temperature	Calories per Sq.M. per Hour	Sleep Night Before Hours	Days After Onset of Last Menstruation	Pulse		Respiration
								Before Test	With Test	
55	159.5	58.1	1.59	97.6	35.72	7	5	74	76	13
IV 1st yr.					37.35				70	
	159.5	58.5	1.59	97.6	36.66	9	6	70	68	12
					33.28				68	
56	166.5	56.5	1.61	97.4	35.07	7	11	60	66	
					33.95				68	
	166.5	56.0	1.61	96.6	32.25	7	13	70	70	18
					33.64				70	
57	151.5	52.4	1.47	97.4	32.28	8	8	60	64	15
					34.10				60	
	151.5	52.8	1.47	98.0	34.47	7	9	56	64	15
					34.47				60	
58	153.5	55.6	1.51	98.0	33.91	5	35	78	80	17
IV 1st yr.					33.91				82	
	153.5	56.2	1.52	97.8	30.21	5	36	68	68	18
					31.33				72	
59	178.5	56.0	1.70	97.8	33.64	6	10	54	56	14
					34.45				59	
	178.5	54.7	1.69	97.4	33.25	8	12	56	57	16
					34.58				60	
60	166.5	55.6	1.60	98.0	35.07	5	21	59	62	14
III 1st yr.					35.20				61	
	166.5	56.3	1.61	97.6	32.50	7	22	60	60	14
					35.51				57	
61	167.0	59.6	1.65	98.0	36.03	7	19	76	70	13
IV 1st yr.					34.86				72	
	167.0	59.6	1.65	97.5	37.52	6	20	68	70	13
					38.36				68	

Table 20 (continued)

Subject by Age Groups Key No.	Height Cm.	Weight Kg.	Surface Area Sq.M.	Oral Temperature	Calories per Sq.M. per Hour	Sleep Night Before Hours	Days After Onset of Last Menstruation	Pulse Before Test	Pulse With Test	Respiration
27 III 2nd yr.	169.5	60.8	1.70	97.4	34.93 35.59	7	16	66	66 68	17
	169.5	60.8	1.70	98.0	35.80 34.74	7	17	72	72 78	18
22 II 2nd yr.	172.0	63.0	1.74	98.0	40.66 39.62	8	7	77	79 78	17
	172.0	63.0	1.74	98.0	37.09 36.31	8	9	76	79 74	20
62 II 1st yr.	167.5	73.0	1.82	97.0	33.24 34.48	8	24	68	80 80	16
	167.5	72.3	1.81	97.2	34.83 34.83	7	25	60	64 70	14
29 II 2nd yr.	161.5	57.6	1.59	97.8	36.43 35.86	8	14	57	61 59	12
	161.5	58.1	1.59	98.0	37.35 38.47	5	15	68	60 60	12
63	165.5	56.4	1.61	97.4	34.42 34.82	7	15	69	69 70	17
	165.5	56.8	1.62	97.4	35.90 35.62	7	16	64	65 65	17
64	182.0	73.1	1.92	97.6	31.52 30.16	7	10	60	62 64	20
	182.0	73.2	1.92	98.0	31.39 31.75	7	11	59	59 64	14
65	159.5	60.8	1.62	98.0	35.00 35.28	8	18	64	69 66	18
	159.5	60.5	1.62	97.2	35.53 34.67	6	20	63	66 64	16

Table 20 (continued)

Subject by Age Groups Key No.	Height Cm.	Weight Kg.	Surface Area Sq.M.	Oral Temperature	Calories per Sq.M. per Hour	Sleep Night Before Hours	Days After Onset of Last Menstruation	Pulse		Respiration
								Before Test	With Test	
66	180.0	61.0	1.77	97.8	29.99 33.80	6	7	62	60 60	17
	180.0	60.8	1.77	98.0	34.01 33.51	8	10	64	67 67	19
67	166.0	68.2	1.75	97.6	34.70 35.07	6	10	62	58 58	15
	166.0	68.0	1.74	97.6	34.11 35.16	6	11	62	57 59	18
68	170.0	54.3	1.62	98.3	38.50 41.84	7	27	74	69 69	13
	170.0	54.9	1.62	98.4	40.79 40.24	7	30	74	74 72	15
69	167.5	64.3	1.72	97.4	34.76 34.83	5	14	71	75 70	16
	167.5	64.3	1.72	97.5	35.48 36.40	7	16	76	74 75	16
70	168.5	55.6	1.62	98.2	41.43 34.88	6	19	72	72 80	15
	168.5	55.7	1.62	97.6	39.17 35.90	5	20	72	78 80	14
71 III 1st yr.	168.0	64.6	1.72	98.4	32.61 33.77	8	10	70	66 62	14
	168.0	64.3	1.72	98.0	33.22 32.69	7	11	67	67 67	12
72 III 1st yr.	170.0	53.3	1.60	98.2	33.38 33.38	7	4 months	74	78 69	16
	170.0	53.5	1.60	97.8	30.80 31.64	5	4 months	70	76 68	14

Table 20 (continued)

Subject by Age Groups Key No.	Height Cm.	Weight Kg.	Surface Area Sq.M.	Oral Temperature	Calories per Sq.M. per Hour	Sleep Night Before Hours	Days After Onset of Last Menstruation	Pulse		Respiration
								Before Test	With Test	
73	169.0	61.9	1.70	97.6	32.16 32.70	8	11	64	64 64	17
	169.0	61.9	1.70	98.0	32.55 33.43	8	12	76	70 74	16
74	170.5	65.3	1.75	97.8	32.26 30.52	7	11	61	63 62	14
	170.5	65.5	1.75	97.8	31.27 32.48	7	12	50	60 60	15
75 III 1st yr.	171.0	55.9	1.64	97.4	35.12 37.05	7	14	66	66 64	14
	171.0	55.5	1.64	97.4	33.93 35.74	7	15		66 72	14
76	157.0	57.8	1.57	98.0	39.24 38.37	7	14	89	84 83	17
	157.0	57.4	1.56	97.8	40.14 41.00	8	15	83	74 79	16
77	164.0	52.6	1.56	97.2	34.57 33.73	8	*		62	
	164.0	52.4	1.56	97.6	34.08 36.39	7	*		64	
78 IV 1st yr.	163.0	50.1	1.51	98.0	40.34 38.58	7	8	82	74 76	14
	163.0	50.0	1.51	98.0	38.74 40.59	6	9	70	69 70	18
79	169.5	56.7	1.64	97.0	37.40 37.40	6	9		68 65	15
	169.5	56.2	1.64	97.2	36.65 35.54		10	78	70 70	15

Table 20 (continued)

Subject by Age Groups Key No.	Height Cm.	Weight Kg.	Surface Area Sq.M.	Oral Temperature	Calories per Sq.M. per Hour	Sleep Night Before Hours	Days After Onset of Last Menstruation	Pulse		Respiration
								Before Test	With Test	
80	157.5	50.9	1.49	97.0	34.09 34.09	7	8	66	63 63	17
	157.5	51.0	1.49	97.4	34.13 32.91	7	9	72	65 62	14
81	164.0	54.7	1.57	98.0	33.49 33.36	7	8	64	74 70	13
	164.0	53.9	1.57	98.0	32.48 35.04	8	9	64	68 68	14
82	162.0	58.1	1.61	97.8	33.45 31.86	6	19	60	54 60	13
	162.0	57.4	1.60	97.4	30.48 29.19	6	22	51	54 52	15
42 III 2nd yr.	160.5	62.6	1.65	97.5	35.61 36.99	6	12	56	51 52	18
	160.5	62.9	1.65	97.6	35.38 34.83	7	13	53	53 52	14
83 II 1st yr.	161.0	54.7	1.56	97.8	34.19 34.19	6	4	58	58 58	19
	161.0	54.9	1.56	97.6	33.28 36.75	7	5	64	64 64	18
84	155.0	55.3	1.52	97.8	33.00 31.25	7	8		76 76	14
	155.0	55.9	1.53	97.4	37.36 33.80	8	9		68 68	16
85	152.5	48.1	1.42	98.2	34.33 34.62	9	26	70		
	152.5	48.1	1.42	98.0	37.50 36.56	7	27	64		

Table 20 (continued)

Subject by Age Groups Key No.	Height Cm.	Weight Kg.	Surface Area Sq.M.	Oral Temperature	Calories per Sq.M. per Hour	Sleep Night Before Hours	Days After Onset of Last Menstruation	Pulse		Respiration
								Before Test	With Test	
					20 Years					
86	164.5	51.7	1.56	97.8	30.25	6	16	80		
					29.70					
	164.5	51.7	1.56	97.6	30.91	6	17	80		
					31.20					
87	164.5	52.8	1.56	98.0	38.18	6	7	67	66	19
IV 1st yr.					36.47				66	
88	163.5	47.6	1.49	98.4	36.64	7	28	77	73	18
III 1st yr.					35.44				69	
	163.5	48.3	1.50	98.6	35.88	8	29	71	72	20
					35.72				70	
47	166.5	54.4	1.59	98.0	37.11	7	13	66	72	20
IV 2nd yr.					37.67				63	
	166.5	54.4	1.59	97.8	37.24	7	14	63	71	21
					36.67				71	
48	164.0	62.5	1.67	97.1	36.44		28	70	68	17
III 2nd yr.					37.76				67	
	164.0	63.0	1.67	97.0	34.68	7	29	67	63	17
					36.58				64	
49	166.5	56.1	1.61	97.9	37.35	7	15	70	66	17
II 2nd yr.					37.63				66	
	166.5	56.1	1.61	98.0	36.31	9	16	70	66	17
					36.73				66	

Table 20 (continued)

Subject by Age Groups Key No.	Height Cm.	Weight Kg.	Surface Area Sq.M.	Oral Temperature	Calories per Sq.M. per Hour	Sleep Night Before Hours	Days After Onset of Last Menstruation	Pulse		Respiration
								Before Test	With Test	
89	160.5	46.3	1.45	97.4	28.30 32.97	6	17	59	72 70	14
	160.5	46.6	1.46	97.2	27.50 29.02	7	18	52	51 53	16
90 IV 1st yr.	170.5	59.0	1.68	98.0	37.25 36.16	7	9	80	80 80	14
	170.5	59.0	1.68	97.8	38.45 35.75	8	10	80	80 80	13
91 IV 1st yr.	162.5	54.4	1.56	98.0	30.79 32.12	7	1	60	64 64	
	162.5	54.9	1.56	98.0	32.08 32.62	7	2	63	65 64	16
92	159.0	54.6	1.54	96.6	39.20 38.03	7	16	65	69 70	15
	159.0	54.3	1.54	97.0	35.89 37.36	7	17	56	60 63	13
93 III 1st yr.	163.0	52.4	1.55	97.8	38.95 41.30	5	23	78	78 77	21
94	171.0	62.7	1.72	98.0	38.89 39.94	6	7	80	76 80	18
	171.0	63.0	1.73	97.6	37.80 40.27	7	8	69	64 66	15
95 III 1st yr.	162.5	47.9	1.49	98.0	38.54 38.25	7	10	57	64 58	15
	162.5	48.2	1.49	98.0	34.95 36.79	7	11	64	66 60	15

Table 20 (continued)

Subject by Age Groups Key No.	Height Cm.	Weight Kg.	Surface Area Sq.M.	Oral Temperature	Calories per Sq.M. per Hour	Sleep Night Before Hours	Days After Onset of Last Menstruation	Pulse		Respiration
								Before Test	With Test	
96 II 1st yr.	161.5	55.2	1.57	97.6	35.20 33.33	6	8	74	74 74	14
	161.5	55.2	1.57	97.0	33.87 32.50	7	10	62	62 66	14
97 II 1st yr.	161.5	55.5	1.58	97.2	35.08 32.54	7	7	64	63 60	15
	161.5	55.9	1.58	97.2	33.79 35.08	7	8	62	60 60	18
98	161.0	56.5	1.58	97.8	34.49 36.44	6	12	64	70 68	13
	161.0	56.0	1.58	97.8	33.26 36.58	6	13	60	61 64	15
55 IV 2nd yr.	159.0	57.0	1.57	97.2	32.25 32.70	7	14	63	62 62	14
	159.0	57.0	1.57	97.4	33.42 33.53	7	15	61	63 66	14
99	164.5	53.9	1.52	98.0	39.06 38.11	6	13	64	74 70	12
	164.5	53.8	1.52	98.4	33.22 32.68	7	15	72	76 74	12
58 IV 2nd yr.	153.5	59.0	1.55	97.4	31.60 30.72	7	7	65	63 65	17
	153.5	59.0	1.55	97.4	32.26 33.13	7	8	65	63 64	17

Table 20 (continued)

Subject by Age Groups Key No.	Height Cm.	Weight Kg.	Surface Area Sq.M.	Oral Temperature	Calories per Sq.M. per Hour	Sleep Night Before Hours	Days After Onset of Last Menstruation	Pulse Before Test	Pulse With Test	Respiration
100	155.0	59.0	1.57	97.6	37.56	5	10	72	69	12
					37.56				71	
	155.0	59.2	1.57	97.4	39.44		14	73		14
					39.44				74	
101	169.0	62.2	1.71	98.0	36.60	7	22	76	76	17
III 1st yr.					37.67				76	
	169.0	63.7	1.72	97.6	35.64	7	23	71	72	16
					37.20				76	
87	165.0	62.3	1.68	97.8	36.47	7	24	73	69	18
IV 2nd yr.					37.54				70	
	165.0	62.6	1.68	97.8	35.85	7	25	75	77	19
					35.85				73	
46	168.0	61.2	1.69	97.8	35.44	7	23	68	62	15
III 2nd yr.					34.91					
	168.0	62.1	1.69	97.5	35.61	7	24	69	62	17
					35.34				60	
20	162.5	47.7	1.48	98.2	32.87	6	14	80	76	22
III 2nd yr.					32.87				78	
	162.5	47.7	1.48	97.6	32.73	6	15	77	75	16
					31.52				71	
54	170.5	65.9	1.76	98.0	36.98	6		69	72	
III 2nd yr.					37.50				66	
	170.5	65.9	1.76	98.0	34.97	5		69	64	14
					36.77				64	
61	166.5	58.2	1.65	97.2	33.41	8	15	67	64	14
IV 2nd yr.					35.05				65	
	166.5	58.2	1.65	97.2	33.23	7	16	68	65	16
					32.95				67	

Table 20 (continued)

Subject by Age Groups Key No.	Height Cm.	Weight Kg.	Surface Area Sq.M.	Oral Temperature	Calories per Sq.M. per Hour	Sleep Night Before Hours	Days After Onset of Last Menstruation	Pulse		Respiration
								Before Test	With Test	
27 III 3rd yr.	170.5	64.2	1.74	97.4	30.69 32.18	8	10	62	63 61	17
	170.5	64.4	1.74	97.4	32.04 32.04	7	11	63	64 66	15
62 II 2nd yr.	168.0	75.7	1.84	97.0	34.31 36.14	5		65	63 60	18
	168.0	76.0	1.84	97.0	36.27 34.05	7		69	60 69	
102 III 1st yr.	163.0	51.3	1.53	98.4	35.51 35.51	8	26	68	69 64	14
	163.0	50.1	1.52	98.0	36.17 35.67	7	11	71	74 74	13
103 II 1st yr.	160.5	65.3	1.68	97.6	33.21 33.63	7	11	53	50 52	11
	160.5	65.8	1.68	97.8	35.44 34.36	7		56	57	
104 II 1st yr.	163.5	56.9	1.60	98.2	33.88 34.46	8	18	72	68 68	14
	163.5	56.5	1.59	98.2	35.80 36.50	8	19	70	70 70	14
105 III 1st yr.	167.5	54.8	1.60	98.0	33.19 33.84	7	24	74	66 70	15
	167.5	54.9	1.60	98.4	33.82 33.19	8	1	76	78 71	20
106 II 1st yr.	173.0	72.4	1.85	98.0	34.98 34.49	6	17	80	81 74	17
	173.0	72.6	1.85	97.8	36.66 36.66	7	18	71	69 74	15

Table 20 (continued)

Subject by Age Groups Key No.	Height Cm.	Weight Kg.	Surface Area Sq.M.	Oral Temperature	Calories per Sq.M. per Hour	Sleep Night Before Hours	Days After Onset of Last Menstruation	Pulse		Respiration
								Before Test	With Test	
107	176.5	56.9	1.69	97.4	33.13 35.38	7	10	72	78 72	14
	176.5	57.3	1.70	97.2	31.33 33.98	5	11	72	70 72	15
71 III 2nd yr.	168.5	64.9	1.73	97.8	35.02 35.02	6	20	66	66 66	13
	168.5	65.9	1.74	97.6	33.80 33.80	5	21	66	59 63	14
108	154.5	47.6	1.43	97.6	35.52 37.22	7	10	82	75 73	13
	154.5	48.1	1.43	97.8	41.36 42.45	6	11	77	76 74	16
109 III 1st yr.	164.0	71.2	1.77	97.8	36.26 36.61	6	19	59	59 59	14
	164.0	71.2	1.77	97.7	37.34 36.92	6	21	60	60 61	15
110	163.0	68.1	1.72	97.8	35.38 35.90	8	14	68	64 64	18
	163.0	68.1	1.72	97.4	32.89 32.89	5	16	62	67 56	16
111	162.0	52.8	1.55	97.6	39.97 39.97	7	15	64	68 72	15
	162.0	52.3	1.55	97.8	39.16 40.11	7	16	68	71 72	
78 IV 2nd yr.	162.0	52.2	1.54	98.0	34.46 34.76	6	8	68	68 65	14
	162.0	52.5	1.54	98.0	34.95 36.00	6	9	64	64 63	

Table 20 (continued)

Subject by Age Groups Key No.	Height Cm.	Weight Kg.	Surface Area Sq.M.	Oral Temperature	Calories per Sq.M. per Hour	Sleep Night Before Hours	Days After Onset of Last Menstruation	Pulse		Respiration
								Before Test	With Test	
19	159.5	45.4	1.44	97.7	30.22	8	5		64	11
III 3rd yr.					30.22				60	
	159.5	45.8	1.44	97.3	30.22	7	6		56	16
					30.22				54	
75	171.0	54.5	1.63	97.6	33.42	6	28		71	15
III 2nd yr.					34.51				62	
42	160.5	63.7	1.65	97.6	33.33	7	8	58	53	16
III 3rd yr.					33.88				52	
	160.5	64.4	1.66	97.6	35.30	7	9	54	54	13
					35.86				54	
72	171.0	51.8	1.60	97.6	30.17	6	8	58	61	14
III 2nd yr.					33.53				62	
	171.0	52.2	1.60	97.6	31.71	6	9	58	58	18
					31.98				58	
112	155.0	50.6	1.47	97.6	35.36	7	19	70	74	14
					35.98				69	
	155.0	50.6	1.47	98.0	35.20	6	20	75	75	14
					36.24				74	
113	164.5	59.7	1.64	98.0	30.66	8	17	64	60	11
					31.37				60	
	164.5	60.0	1.64	98.0	31.77	5	23	64	62	12
					32.98				60	
39	171.0	68.9	1.80		31.45	5	14	64	54	15
II 2nd yr.					35.51				58	
	171.0	69.0	1.80		36.98	6	15	56	57	15
					34.17				58	

Table 20 (continued)

Subject by Age Groups Key No.	Height Cm.	Weight Kg.	Surface Area Sq.M.	Oral Temperature	Calories per Sq.M. per Hour	Sleep Night Before Hours	Days After Onset of Last Menstruation	Pulse		Respiration
								Before Test	With Test	
41	168.5	59.3	1.67	98.0	37.32	6	22	73	75	14
IV 2nd yr.					37.58				74	
	168.5	59.3	1.67	97.6	38.31	7	23	73	68	23
					38.86				70	
43	163.0	59.4	1.63	98.1	35.72	7	10	58	64	14
IV 2nd yr.					35.72				66	
	163.0	58.9	1.63	97.8	35.96	7	12	82	84	17
					36.08				84	
114	160.5	60.1	1.61	98.1	33.65	6	21	79	73	15
III 1st yr.					33.09				68	
	160.5	60.1	1.61	97.7	34.20	6	25	77	68	14
					33.09				70	
115	160.0	57.6	1.58	97.6	34.54	6	20	63	67	18
IV 1st yr.					34.54				74	
	160.0	58.1	1.59	98.0	34.83	8	23	64	66	16
					31.13				63	
					21 Years					
88	163.0	48.0	1.49	98.6	33.97	9	9	73	73	16
III 2nd yr.					34.27				72	
	163.0	48.0	1.49	98.6	36.12	8	10	70	70	19
					35.52				71	
47	166.5	52.8	1.58	98.0	35.58	7		62	66	19
IV 3rd yr.					34.71				63	
	166.5	52.6	1.58	98.0	36.21	8		66	70	20
					35.65				66	

Table 20 (continued)

Subject by Age Groups Key No.	Height Cm.	Weight Kg.	Surface Area Sq.M.	Oral Temperature	Calories per Sq.M. per Hour	Sleep Night Before Hours	Days After Onset of Last Menstruation	Pulse		Respiration
								Before Test	With Test	
116	157.5	49.5	1.48	98.0	33.66	7	15	62	65	15
II 1st yr.					32.73				65	
	157.5	49.4	1.48	98.0	32.07	7	16	64	68	15
					30.85				68	
90	170.0	59.2	1.67	97.0	31.99		9	77	87	13
IV 2nd yr.										
	170.0	58.5	1.67	97.2	33.48	6	10	81	78	
					34.94				80	
91	162.0	54.2	1.56	98.0	33.03	6	18	57	57	16
IV 2nd yr.					33.46				57	
93	164.0	51.6	1.55	98.0	33.50	6	14	76	74	17
III 2nd yr.					35.56				72	
	164.0	51.8	1.55	97.6	34.69	6	15	72	69	19
					34.69				67	
96	161.5	55.5	1.58	97.4	36.73	5	10	70	66	
II 2nd yr.					36.73				66	
	161.5	56.5	1.59	97.2	30.35	6	11	64	60	16
					34.72				63	
97	162.5	55.4	1.58	97.2	33.79	6	10	62	63	12
II 2nd yr.					32.64				60	
	162.5	56.5	1.59	97.4	33.65	6	11	66	63	15
					33.93				66	
95	163.0	47.6	1.49	97.6	32.88	5	16	55	57	13
III 2nd yr.					30.83				60	
20	164.0	47.4	1.49	97.4	32.32	8	10	75	69	14
III 3rd yr.					32.32				65	
	164.0	47.8	1.49	97.4	32.21	6	12	72	68	21
					32.81				70	

Table 20 (continued)

Subject by Age Groups Key No.	Height Cm.	Weight Kg.	Surface Area Sq.M.	Oral Temperature	Calories per Sq.M. per Hour	Sleep Night Before Hours	Days After Onset of Last Menstruation	Pulse		Respiration
								Before Test	With Test	
54 III 3rd yr.	171.0	66.9	1.77	97.8	37.86 36.56	6		64	68 62	13
	171.0	66.7	1.77	97.6	36.75 37.46	5		66	69 67	13
55 IV 3rd yr.	161.0	56.1	1.57	97.6	35.49 36.07	7	24	66	67 66	13
	161.0	55.0	1.56	97.9	37.90 36.84	8	26	63	66 63	
99 II 2nd yr.	164.5	49.7	1.53	97.6	33.63 33.05	6	10	68	69 69	13
	164.5	50.5	1.54	97.8	32.40 35.29	6	14	70	70 65	12
58 IV 3rd yr.	154.0	54.4	1.51	97.8	35.07 36.58	6	10	80	76 76	20
	154.0	54.4	1.51	97.6	34.66 34.07	6	16	81	82 80	20
101 III 2nd yr.	171.0	62.5	1.72	97.2	36.51 33.90	9	20	70	62 60	13
	171.0	62.8	1.72	97.8	36.49 38.29	6	21	65	65 64	19
60 III 2nd yr.	167.0	55.5	1.61	97.6	34.04 35.07	6	10	59	60 59	16
	167.0	55.8	1.61	97.6	33.38 33.67	5	11	62	60 60	15
61 IV 3rd yr.	167.5	60.0	1.67	97.4	35.29 35.29	7	23	72	66 65	14
	167.5	60.1	1.67	97.5	35.93 35.19	6	25	68	64 65	14

Table 20 (continued)

Subject by Age Groups Key No.	Height Cm.	Weight Kg.	Surface Area Sq.M.	Oral Temperature	Calories per Sq.M. per Hour	Sleep Night Before Hours	Days After Onset of Last Menstruation	Pulse Before Test	Pulse With Test	Respiration
102	163.5	52.2	1.55	97.6	35.27	8	13	71	69	14
III 2nd yr.					35.27				66	
	163.5	52.3	1.55	98.3	35.79	7	14	72	72	15
					36.66				72	
31	166.0	55.4	1.60	97.7	32.37	6	17	60	60	16
II 2nd yr.					32.65				59	
104	163.5	54.0	1.57	97.6	32.79	8	10	59	66	15
II 2nd yr.					33.24				69	
	163.5	54.3	1.57	97.4	31.81	6	14	69	65	15
					30.07				69	
105	169.0	52.2	1.59	97.4	31.65	7	10	63	57	16
III 2nd yr.					32.80				54	
	169.0	52.3	1.59	97.4	35.70	7	11	71	57	20
					33.09				62	
117	164.5	52.2	1.56	97.8	34.25	8	15	69	75	13
					35.11				72	
	164.5	53.0	1.56		34.00	7	16	74	76	15
					35.21				70	
118	170.0	58.5	1.67	97.4	42.00	7	*	81	91	15
					42.55				86	
	170.0	59.2	1.68	97.4	44.16	9	*	87	94	18
					44.84				103	
119	173.5	53.5	1.63	98.6	40.08	6	21	70	71	16
III 1st yr.					36.16				74	
	173.5	53.8	1.63	98.2	35.87	7	22	71	74	16
					36.28				66	

Table 20 (continued)

Subject by Age Groups Key No.	Height Cm.	Weight Kg.	Surface Area Sq.M.	Oral Temperature	Calories per Sq.M. per Hour	Sleep Night Before Hours	Days After Onset of Last Menstruation	Pulse		Respiration
								Before Test	With Test	
120	161.0	66.0	1.71	97.2	39.39	7	17	66	58	16
II 1st yr.					38.59				60	
	161.0	66.0	1.71	97.4	35.35	7	18	63	56	16
					34.82				56	
121	159.0	72.5	1.74	97.8	32.37	7	10	60	66	18
					32.37				66	
	159.0	72.7	1.74	97.6	35.39	7	11	62	58	16
					36.47				62	
122	156.5	53.8	1.52	97.4	38.42	7	*	59	63	15
					39.04				59	
	156.5	53.5	1.52	97.6	34.24	6	*	64	68	14
					34.84				64	
123	155.5	43.0	1.37	97.6	29.59	7	13	60	60	13
					30.57				60	
	155.5	43.1	1.37	98.0	31.59	6	15	59	59	15
					29.92				60	
124	174.0	65.1	1.77	98.0	34.15	7	17	68	68	19
III 1st yr.					36.25				70	
	174.0	64.4	1.77	98.6	34.22	6	18	67	65	17
					34.22				69	
125	167.5	50.0	1.54	97.8	36.84	7	18	76	74	15
					35.63				74	
	167.5	49.8	1.54	98.0	35.35	7	19	76	75	18
					35.65				76	
103	161.5	61.7	1.64	97.4	31.39	6		51	54	20
II 2nd yr.					31.94				54	
	161.5	62.2	1.65	97.4	31.67	6		54	56	15
					32.22				57	

Table 20 (continued)

Subject by Age Groups Key No.	Height Cm.	Weight Kg.	Surface Area Sq.M.	Oral Temperature	Calories per Sq.M. per Hour	Sleep Night Before Hours	Days After Onset of Last Menstruation	Pulse		Respiration
								Before Test	With Test	
109 III 2nd yr.	164.5	65.8	1.71	97.6	35.53 35.79	6	11	64	63 60	16
	164.5	65.8	1.71	97.0	36.36 37.45	7	12	60	63 60	13
78 IV 3rd yr.	164.0	51.6	1.55	98.0	32.29 32.29	7	11	71	67 66	13
	164.0	51.7	1.55	98.0	33.87 32.40	6	12	68	63 60	16
126	162.0	55.0	1.57	98.0	35.03 35.31	8	13	69	71 70	19
	162.0	55.0	1.57	98.2	34.58	8	14	66	66 72	20
127	170.0	51.8	1.59	97.8	41.41 38.00	8	5	76	70 70	17
	170.0	51.9	1.59	97.6	33.08 33.08	6	6	68	68 65	17
43 IV 3rd yr.	164.0	57.2	1.61	97.6	32.53 33.50	5	30	63	59 58	18
	164.0	57.5	1.61	97.4	30.12 31.83	5	31	54		14
114 III 2nd yr.	160.5	59.3	1.61	97.7	36.50 39.33	7	15	70	65 74	17
	160.5	59.3	1.61	97.2	36.60 39.20	7	16	76	66 69	15
115 IV 2nd yr.	160.0	57.6	1.59	98.6	34.32 32.16	6	14	64	64 61	15
	160.0	57.9	1.59	98.0	34.72 34.82	7	17	61	58 60	12

Table 20 (continued)

Subject by Age Groups Key No.	Height Cm.	Weight Kg.	Surface Area Sq.M.	Oral Temperature	Calories per Sq.M. per Hour	Sleep Night Before Hours	Days After Onset of Last Menstruation	Pulse		Respiration
								Before Test	With Test	
46 III 3rd yr.	168.5	60.3	1.68	97.4	32.24 32.77	5	16	66	60 64	16
	168.5	60.5	1.68	97.6	33.60 32.53	6	17	65	60 59	18
101 III 3rd yr.	171.5	64.1	1.75	98.0	36.32 35.00	7	34	69	70 67	17
	171.5	64.4	1.75	97.8	35.29 35.80	6	36	76	66 66	14
128	163.0	62.1	1.66	97.4	31.87 31.87	8	30	63	61 62	18
	163.0	62.6	1.66	97.5	33.29 32.73	8	32	60	59 55	14
71 III 3rd yr.	169.5	64.4	1.73	98.0	33.52 32.99	6	19	64	64 63	14
	169.5	65.5	1.75	97.8	31.17 33.24	8	21	68	68 65	12
41 IV 3rd yr.	168.0	65.2	1.73	98.0	36.42 34.39	6	20	78	78 78	14
	168.0	65.0	1.73	98.0	34.60 35.25	6	21	77	81 80	13
48 III 3rd yr.	163.5	62.2	1.66	97.2	36.57 35.52	7	21	68	66 66	16
	163.5	62.3	1.66	97.0	35.40 34.57	6	22	60	62 64	14
60 III 3rd yr.	167.5	54.9	1.61	98.2	34.93 36.08	7	26		54 55	12
	167.5	54.6	1.61	98.2	32.78 32.78	6	27		60 62	19

Table 20 (continued)

Subject by Age Groups Key No.	Height Cm.	Weight Kg.	Surface Area Sq.M.	Oral Temperature	Calories per Sq.M. per Hour	Sleep Night Before Hours	Days After Onset of Last Menstruation	Pulse		Respiration
								Before Test	With Test	
72 III 3rd yr.	171.5	55.0	1.64	97.4	30.21 30.21	6	4		69 66	14
	171.5	54.5	1.63	97.6	29.37 28.81	6	6	63	62 62	13
75 III 3rd yr.	171.5	55.1	1.64	98.0	36.19 35.35	6	29	65	62 64	14
	171.5	55.2	1.64	97.8	34.87 34.87	6	30	65	66 65	16
					22 Years					
87 IV 3rd yr.	165.5	58.3	1.63	97.6	36.32 36.44	8	13	71	70 68	16
	165.5	58.4	1.63	97.6	35.41 35.98	8	15	71	71 69	17
129	166.0	57.8	1.63	97.4	30.92 33.41	7	16	64	61 62	12
	166.0	57.9	1.63	97.4	31.05 32.96	7	17	57	59 57	15
116 II 2nd yr.	158.0	48.6	1.47	97.2	29.93 31.67	6	10	58	60 55	14
	158.0	48.7	1.47	97.0	31.94 32.58	4	11	65	60 60	14
90 III 3rd yr.	170.5	59.0	1.68	98.3	38.65 37.55	7	21	78	73 73	
	170.5	59.0	1.68	98.0	36.80 37.60	7	22	74	74 75	14

Table 20 (continued)

Subject by Age Groups Key No.	Height Cm.	Weight Kg.	Surface Area Sq.M.	Oral Temperature	Calories per Sq.M. per Hour	Sleep Night Before Hours	Days After Onset of Last Menstruation	Pulse		Respiration
								Before Test	With Test	
91 III 3rd yr.	162.5	54.0	1.56	97.4	32.08 32.60	5	24	61	57 59	14
	162.5	54.3	1.56	97.4	32.68 32.68	6	25	59	59 58	18
95 III 3rd yr.	164.0	47.9	1.50	97.8	37.49 37.19	8	15	62	63 63	13
	164.0	48.1	1.50	98.0	35.09 35.68	7	17	66	60 64	12
130	162.0	54.0	1.55	98.0	33.22 33.22	7	15	76	76 70	
	162.0	54.2	1.55	97.6	35.21 34.05	7	16	67	66	
102 III 3rd yr.	164.5	51.8	1.55	98.0	35.26 36.13	6		64	61 61	13
	164.5	51.8	1.55	97.7	35.81 36.95	6		70	65 63	14
131	159.0	64.9	1.66	98.0	31.95 34.97	8	23	58		
	159.0	65.1	1.66	97.6	33.53 33.16	7	24	56		
132 III 1st yr.	164.5	64.0	1.69	97.6	33.18 31.07	7	16	63	64 63	13
	164.5	64.3	1.69		32.61 32.34	6	17	67	65 66	17
133	172.0	63.3	1.73	97.8	33.18 36.86	7	10	64	64 68	13
	172.0	63.3	1.73	97.4	30.87 32.78	7	11	62	66 68	14

Table 20 (continued)

Subject by Age Groups Key No.	Height Cm.	Weight Kg.	Surface Area Sq.M.	Oral Temperature	Calories per Sq.M. per Hour	Sleep Night Before Hours	Days After Onset of Last Menstruation	Pulse		Respiration
								Before Test	With Test	
106	174.0	69.0	1.82	97.8	33.55	10	19		70	16
II 2nd yr.					33.55				72	
	174.0	69.3	1.82	97.8	33.18	8	20	68	70	17
					34.19				70	
119	175.0	54.4	1.65	98.4	35.85	8		68	71	16
III 2nd yr.					34.75				66	
	175.0	55.2	1.66	98.4	35.36	7		65	68	15
					34.54				66	
120	162.0	65.8	1.69	97.2	36.89	7	18	58	58	14
II 2nd yr.					35.56				56	
	162.0	65.8	1.69	97.0	36.66	7	19	59	56	16
					33.42				52	
47	166.0	54.2	1.59	98.2	39.10	7	26	79	76	16
IV 4th yr.					39.95				72	
	166.0	54.5	1.59	98.3	36.83	7	27	76	68	16
					36.27				68	
90	170.0	60.4	1.69	97.7	37.03	8	7	76	72	14
IV 4th yr.					38.37				70	
93	164.5	50.8	1.54	98.3	31.60	7	9	78	71	18
III 3rd yr.					34.21				74	
	164.5	51.6	1.55	98.0	35.10	7	10	75	71	19
					35.70				78	
55	160.5	54.8	1.55	97.2	34.13	7	8	69	67	14
IV 4th yr.					33.53				67	
	160.5	55.3	1.56	97.6	34.14	7	10	68	68	14
					33.28				64	

Table 20 (continued)

Subject by Age Groups Key No.	Height Cm.	Weight Kg.	Surface Area Sq.M.	Oral Temperature	Calories per Sq.M. per Hour	Sleep Night Before Hours	Days After Onset of Last Menstruation	Pulse		Respiration
								Before Test	With Test	
58 IV 4th yr.	154.5	54.4	1.51	98.2	40.28 41.21	7	16	84	80 82	20
	154.5	54.4	1.51	97.9	37.22 37.22	7	17	76	68 88	19
109 III 3rd yr.	164.5	65.8	1.71	97.8	37.16 36.38	7	10	60	60 58	14
	164.5	65.8	1.71	97.6	35.28 34.48	5	11	56	57 58	15
134	173.0	63.9	1.75	97.4	33.72 33.72	8	14	67	69 66	18
	173.0	64.3	1.75	97.6	32.94 33.46	8	15	67	62 65	16
78 IV 4th yr.	164.0	51.6	1.55	98.4	32.51 32.22	7	16	70	68 64	16
	164.0	51.5	1.55	98.1	32.55 31.97	8	17	72	76 76	16
114 III 3rd yr.	160.5	59.3	1.61	98.0	32.53 31.97	7	10	67	68 67	14
	160.5	59.3	1.61	97.6	32.46 31.62	6	11	70	67 64	15
87 IV 4th yr.	166.0	58.6	1.64	97.8	34.80 35.36	7		68	64 69	14
	166.0	57.9	1.63	97.8	36.57 35.85	6		67	72 70	14
43 IV 4th yr.	164.5	58.5	1.63	97.6	32.76 32.76	7	8	55	60 60	15
	164.5	58.1	1.63	98.0	36.48 35.38	7	9	67	62 65	13

Table 20 (continued)

Subject by Age Groups Key No.	Height Cm.	Weight Kg.	Surface Area Sq.M.	Oral Temperature	Calories per Sq.M. per Hour	Sleep Night Before Hours	Days After Onset of Last Menstruation	Pulse		Respiration
								Before Test	With Test	
135	170.5	51.5	1.59	97.6	33.02	8	23	81	82	16
					33.02				82	
	170.5	51.9	1.59	97.4	30.74	7	24	67	72	15
					31.17				69	
105	169.0	54.0	1.61	97.6	34.63	8	10	65	64	18
III 3rd yr.					34.05				64	
	169.0	53.9	1.61	97.6	33.86	7	11	65	64	14
					34.43				61	
88	164.5	49.6	1.52	98.3	36.18	8	18	70	72	18
III 3rd yr.					34.98				70	
	164.5	49.1	1.52	98.3	34.05	8	20	72	72	20
					34.95				72	
61	167.5	58.9	1.65		36.20	9	31	68	68	
IV 4th yr.					38.69				69	
	167.5	59.3	1.65		38.73	7	32	67	66	13
					37.07				67	
124	174.5	65.1	1.78	97.4	32.79	6	20	62	65	14
III 2nd yr.					33.82				61	
	174.5	65.0	1.78	97.9	34.37	6	21	68	63	15
					34.37				68	
136	162.5	57.5	1.60	97.7	36.93	6	20	60	62	12
					36.36				62	
	162.5	56.7	1.59	97.8	36.03	6	21	61	60	11
					36.03				56	
137	164.5	47.4	1.49	98.4	33.49	8	15	62	62	18
					33.49				61	

Table 20 (continued)

Subject by Age Groups Key No.	Height Cm.	Weight Kg.	Surface Area Sq.M.	Oral Temperature	Calories per Sq.M. per Hour	Sleep Night Before Hours	Days After Onset of Last Menstruation	Pulse		Respiration
								Before Test	With Test	
138	162.5	51.3	1.53	98.0	35.32	9	16	71	72	16
					33.52				72	
	162.5	51.3	1.53	98.0	33.41	8	17	64	72	14
					34.31				70	
115	161.5	56.0	1.57	97.4	35.98	5	10	77	68	12
IV 3rd yr.					35.69				68	
	161.5	56.0	1.57	97.2	36.13	7	12		64	15
					35.55				61	
					23 Years					
139	164.5	59.0	1.63	97.5	34.65	6	17	61	61	14
					34.37				57	
	164.5	59.5	1.64	97.0	33.17	7	18	65	58	14
					34.95				59	
140	163.5	54.2	1.57	97.7	35.75	6	11	74	72	14
					36.47				69	
	163.5	53.5	1.56	97.7	35.39	6	21	72	68	20
					35.97				68	
141	167.5	65.7	1.73	98.4	38.24	6	26	63	63	16
					37.73				61	
	167.5	65.7	1.73	98.0	33.89	6	27	72	62	19
					34.40				55	
142	167.0	51.0	1.56	98.2	36.83	7		76	79	14
III 1st yr.					37.83				72	
	167.0	52.0	1.57	97.8	36.36	5		73	73	16
					35.79				73	

Table 20 (continued)

Subject by Age Groups Key No.	Height Cm.	Weight Kg.	Surface Area Sq.M.	Oral Temperature	Calories per Sq.M. per Hour	Sleep Night Before Hours	Days After Onset of Last Menstruation	Pulse		Respiration
								Before Test	With Test	
143	164.0	62.2	1.66	97.6	33.79 34.06	6	20	63	60 60	15
	164.0	62.8	1.67	97.6	32.59 33.67	9	1	65	64 65	15
144	169.5	57.8	1.66	97.6	33.42 32.87	8	5	64	57 54	17
	169.5	57.9	1.66	98.0	32.93 33.48	7	7	65	60 60	17
132 III 2nd yr.	166.0	64.1	1.71	97.6	28.52 29.31	7	10	65	62 63	17
	166.0	64.6	1.71	97.4	29.97 28.09	7	13	60	56 54	18
145	165.5	65.8	1.72	98.0	38.27 38.27	6	18	65	67 68	15
	165.5	66.3	1.73	98.0	38.17 37.65	5	20	67	75 78	15
91 IV 4th yr.	162.5	53.1	1.55	98.2	32.70 33.28	6	25	62	60 63	15
	162.5	53.2	1.55	98.2	32.52 33.10	7	27	58	60 58	14
119 III 3rd yr.	175.0	54.2	1.65	98.0	34.12 32.95	8	12	66	74 74	14
	175.0	54.2	1.65	98.3	35.14 34.87	7	14		74 70	16
146	172.0	59.4	1.70	98.3	35.96 35.96	8	26	84	78 78	15
	172.0	59.2	1.70	98.3	36.61 36.61	10	27	77	78 78	14

Table 20 (continued)

Subject by Age Groups Key No.	Height Cm.	Weight Kg.	Surface Area Sq.M.	Oral Temperature	Calories per Sq.M. per Hour	Sleep Night Before Hours	Days After Onset of Last Menstruation	Pulse		Respiration
								Before Test	With Test	
147	168.0	54.5	1.61	97.6	34.76 35.33	6	22	72	66 70	16
	168.0	54.8	1.61	97.2	34.19 34.48	6	24	65	64 67	14
115 IV 4th yr.	161.0	56.6	1.58	97.8	35.32 34.18	7	4		67 64	
	161.0	56.3	1.58	97.6	36.69 35.25	8	5		59 56	14
124 III 3rd yr.	175.0	65.8	1.79	97.7	33.73 33.23	7	12	63	64 64	18
	175.0	65.3	1.79	97.4	32.25 32.75	7	13	66	66 64	16
148	164.5	55.4	1.59	97.8	31.34 32.88		9	70	72 72	19
149	166.0	51.7	1.56	97.6	36.08 36.67	6	23		66 71	15
	166.0	52.8	1.57	97.6	33.51 33.51	7	24	72	72 71	13
					24 Years					
150	159.0	50.9	1.51	98.0	34.49 33.60	6	9	74	72 70	16
	159.0	51.5	1.51	98.0	32.90 33.78	8	11	70	67 70	15

Table 20 (continued)

Subject by Age Groups Key No.	Height Cm.	Weight Kg.	Surface Area Sq.M.	Oral Temperature	Calories per Sq.M. per Hour	Sleep Night Before Hours	Days After Onset of Last Menstruation	Pulse		Respiration
								Before Test	With Test	
151	161.0	47.2	1.46	98.3	35.86 35.56	9	25	76	74 71	14
	161.0	47.2	1.46	97.6	33.92 35.35	7	28	65	64 65	
152 II 1st yr.	160.0	51.9	1.52	97.6	33.47 31.30	7	30	60	70 65	17
	160.0	51.5	1.51	97.6	32.64 33.66	7	31	65	68 64	19
142 III 2nd yr.	168.5	50.9	1.57	97.6	33.78 34.24	7	8	73	71 69	17
	168.5	51.1	1.57	98.0	33.18 33.75	7	9	69	66 64	14
153	160.0	53.0	1.53	97.4	35.39 34.42		*	62	62 61	13
	160.0	52.7	1.53	97.5	37.59 36.24	6	*	63	63 62	13
132 III 3rd yr.	165.5	65.8	1.72	97.6	29.33 29.59	7	19	61	60 59	13
	165.5	65.8	1.72	96.6	27.42 28.74	6	21	56	60 60	14
154	163.0	62.7	1.67	97.6	36.43 36.43	7	26	55	57 60	14
	163.0	63.1	1.67	98.0	34.36 34.36	7	28	57	60 58	17
155	172.0	64.4	1.75	98.2	33.39 32.11	8	13	64	66 60	15
	172.0	64.7	1.75	97.6	30.89 32.18	7	14	60	60 60	14

Table 20 (continued)

Subject by Age Groups Key No.	Height Cm.	Weight Kg.	Surface Area Sq.M.	Oral Temperature	Calories per Sq.M. per Hour	Sleep Night Before Hours	Days After Onset of Last Menstruation	Pulse		Respiration
								Before Test	With Test	
142	168.5	54.3	1.61	98.2	35.91	7	24	73	70	14
III 3rd yr.					35.32				68	
	168.5	54.4	1.61	98.6	34.72	8	25	72	68	16
					36.16				60	
156	169.5	72.6	1.82	97.4	36.92	7	18	63	65	16
					36.68				67	
	169.5	72.6	1.82	97.6	35.70	7	19	65	65	15
					35.70				62	
157	167.5	57.5	1.63	98.4	34.91	8		63	66	18
					34.91				59	
	167.5	57.3	1.63	98.6	35.92	7		63	64	18
					35.64				56	
					25 Years					
158	168.5	54.3	1.61	97.2	35.98	7	10	67	67	11
					33.97				68	
	168.5	53.4	1.60	97.6	33.06	7	9	60	64	14
					33.06				65	
159	151.0	51.7	1.45	97.9	33.04	6	8	71	74	16
					33.35				72	
	151.0	51.0	1.44	97.6	32.05	7	9		71	14
					32.68				69	
160	159.0	56.2	1.56	98.4	36.07	7	14	70	72	15
III 1st yr.					36.07				72	
	159.0	57.4	1.58	97.6	31.41	6	17	63	61	12
					33.94				62	

Table 20 (continued)

Subject by Age Groups Key No.	Height Cm.	Weight Kg.	Surface Area Sq.M.	Oral Temperature	Calories per Sq.M. per Hour	Sleep Night Before Hours	Days After Onset of Last Menstruation	Pulse		Respiration
								Before Test	With Test	
161	158.0	49.6	1.48	98.0	32.70 34.19	5	9	75	72 70	16
	158.0	48.8	1.47	97.6	32.02 33.74	6	12	78	78 76	17
162	170.0	56.5	1.64	98.1	36.46 36.66	8	25	68	67 66	14
	170.0	56.5	1.64	98.2	34.55 35.11	8	26	62	64 62	12
163	167.0	53.2	1.58	97.6	30.93 31.50	9	9	64	56 55	17
	167.0	53.6	1.59	97.4	30.99 31.28	6	10	62	55 60	17
164	164.0	59.0	1.62	98.2	35.75 34.64	8	21	73	71 71	13
	164.0	59.4	1.63	98.4	34.23 34.23	8	22	76	76 74	15
					26 Years					
160 III 2nd yr.	159.0	56.7	1.57	97.6	33.93 35.09	7	11	64	60 64	13
	159.0	56.7	1.57	97.4	33.56 33.56	5	12	60	61 61	16
152 II 2nd yr.	159.5	52.3	1.52	98.1	32.14 33.34	6	32	72	64 66	14

Table 20 (continued)

Subject by Age Groups Key No.	Height Cm.	Weight Kg.	Surface Area Sq.M.	Oral Temperature	Calories per Sq.M. per Hour	Sleep Night Before Hours	Days After Onset of Last Menstruation	Pulse		Respiration
								Before Test	With Test	
165	169.0	53.3	1.60	97.6	33.19 33.19	7	11	65	66 61	19
	169.0	53.3	1.60	97.6	34.97 34.13	7	12	60	65 61	15
166	167.5	61.4	1.68	98.4	37.61 38.14	7	26	70	66 67	17
	167.5	61.7	1.68	98.4	36.54 37.24	7	25	68	63 61	14
167	154.5	55.3	1.53	97.2	34.24 34.76	7	15	60	62 58	17
	154.5	55.8	1.54	97.6	33.64 34.23	7	16	58	58 58	15
168	161.0	61.0	1.62	98.0	 36.83	9	31	59	65 65	16
	161.0	60.7	1.62	98.0	37.97 36.27	8	1	65	63 62	15
					27 Years					
160 III 3rd yr.	159.5	55.8	1.56	98.2	33.07 31.91	8	26	67	64 66	13
	159.5	56.7	1.56	97.4	33.17 35.83	6	10	62	64 60	13
169	170.0	68.2	1.77	97.4	38.87 38.87	6	15	74	67 72	16
	170.0	68.2	1.77	97.4	36.91 37.42	5	16	74	70 70	16

Table 20 (continued)

Subject by Age Groups Key No.	Height Cm.	Weight Kg.	Surface Area Sq.M.	Oral Temperature	Calories per Sq.M. per Hour	Sleep Night Before Hours	Days After Onset of Last Menstruation	Pulse		Respiration
								Before Test	With Test	
170	158.5	53.4	1.53	97.6	30.69	8	15	60	68	17
					31.58				66	
	158.5	53.4	1.53		32.94	8	16	63	65	
					33.81				63	
171	167.5	48.7	1.53	98.0	31.41	6	21	70	67	18
					31.99				67	
	167.5	48.8	1.53	98.1	34.35	7	23	72	67	16
					35.09				69	
172	172.0	77.6	1.90	98.0	39.95	6	17	65	67	15
III 1st yr.					37.13				66	
173	162.5	65.8	1.70	98.0	33.46	7	21	62	59	14
					32.40				58	
	162.5	65.8	1.70	97.9	33.73	6	22	63	59	16
					32.93				58	
174	169.5	62.2	1.70	98.2	35.78	8	24	64	60	16
					38.16				67	
	169.5	62.6	1.71	98.2	36.78	6	25	64	62	17
					36.52				62	
					28 Years					
175	164.5	51.0	1.54	97.5	31.18	8	10	68	72	14
					31.77				70	
	164.5	51.2	1.54	97.2	30.67	7	11	70	68	12
					32.10				70	

Table 20 (continued)

Subject by Age Groups Key No.	Height Cm.	Weight Kg.	Surface Area Sq.M.	Oral Temperature	Calories per Sq.M. per Hour	Sleep Night Before Hours	Days After Onset of Last Menstruation	Pulse		Respiration
								Before Test	With Test	
176	182.5	68.7	1.88	98.0	34.48 34.73	9	9	62	62 60	14
	182.5	68.3	1.88	98.2	34.65 34.65	8	10	59	60 62	15
177	164.5	57.7	1.62	98.0	35.47 35.47	6	27	61	66 62	14
	164.5	57.9	1.62	97.8	32.81 34.88	8	28	55	59 57	15
172 III 2nd yr.	174.0	79.0	1.93	97.7	35.36 36.76	9	17	67	60 60	15
	174.0	79.0	1.93	98.0	35.17 33.53	8	18	66	62 60	15
					29 Years					
172 III 3rd yr.	174.0	76.8	1.90	98.2	36.47 36.23	7	28	63	60 62	13
	174.0	76.2	1.90	97.8	37.75 37.28	7	29	64	63 63	13
178	176.0	62.8	1.76	97.7	33.38 34.39	8	8	88	88 87	15
	176.0	62.3	1.76	97.6	33.38 33.72	8	10	84	82 82	15
179	170.5	68.0	1.78	98.1	35.29 35.79	8	25	68	72 69	14
	170.5	68.0	1.78	98.2	34.10 34.36	7	26	66	66 66	14

B. Case Studies

To portray the type of individuals who compose the repeat and non-repeat groups, the following brief case studies are introduced. For the repeat group individuals have been taken only from the three and four year series. Since many of these students are still in residence, it has been possible to obtain somewhat more detailed information concerning them. This information has been particularly important in considering the effect of fatigue on variability of basal metabolism. Only a portion of the non-repeat group has been included. The information about these individuals is limited, necessarily, to what appears in the college files, plus in certain instances our personal knowledge of the subsequent course of the student.

The student's college ability rating is based on certain entrance examinations and her high school quality point average. Both of these records have been included in the case studies. The grade for the entrance examination is indicated by a letter and a number, as C 7, which represents the position of the student with respect to her entering class. The letters refer to the distribution of scores of the entering examination in the normal curve, i.e., A equals five percent of the upper end of the curve; B, the next 20 percent; C, the middle 50 percent; D the following 20 percent; and E, the lowest five percent.

The numerals range from one to ten and represent percentiles. Each percentile covers exactly one-tenth of the total number of the entering class. Thus for a student rating C7 in an entering class of 2,000, the C indicates that she falls in the middle 50 percent of the normal curve, the 7 that her position was between 1200 and 1400 in the class in which the top position was 2000.

Both high school and collegiate scholastic records are expressed in terms of quality point averages in which four would represent a perfect A record; three a B; two a C; and one a D. The collegiate average will be reported only as of the last available figure in point of time.

The pre-college medical record has been considered negative if it involved only uncomplicated childhood diseases, an appendectomy or a tonsillectomy. Illness during the college period has been indicated except for uncomplicated upper respiratory infections.

In addition to the scholastic and medical records, notation has been made of the subject's major curriculum and place of residence; the extra curricular activities and outside work in which the student may have engagedhave been presented for each college year. No effort has been made to include either all of the repeat or the non-repeat individuals but sufficient cases are presented to indicate the type of individuals who comprise each group.

For ease and conciseness of tabulation certain abbreviations have been used. These abbreviations plus certain campus organizations are defined briefly for the benefit of those unacquainted with Iowa State College organization nomenclature:

A.W.S. Associated Women Students, the women's governing organization.

Bomb. The school annual.

College Q.P.A. College quality point average.

Campus Varieties. Competitive group skits put on quarterly by dormitories or organized groups.

Daily Student: The official daily student publication.

Green Gander: The student humor magazine.

Homemaker: The monthly publication of Home Economics students.

H.S.Q.P.A.: High School quality point average.

Independents: Campus political party of non-sorority and non-fraternity men and women.

Kappa Phi: Methodist social sorority.

Newman Club: Catholic student organization.

Omicron Nu: Home Economics scholastic honorary.

Pep Club: An organized girl's cheering section for games and pep rallies.

Phi Upsilon Omicron: Home Economics social, professional honorary.

Representatives: Campus political party of fraternity and sorority men and women.

Sor-Dor Sing: Annual campus singing competition between dormitories and sororities for prize cup.

Veishea: An annual all college open house lasting three days and climaxing with a parade and pageant.

W.A.A.: Women's Athletic Association.

Workshop: Student theatrical group.

Subject No. 13

Residence: Dormitory   Major: Textiles and Clothing
Transferred to Home
Economics Education

Scholastic record:
    Entrance test: C 7
    H.S.Q.P.A.: 3.68
    College Q.P.A.: 3.051
        Highest 3% freshman-sophomore class.
Medical: negative except flu February, 1939, for four days.
Activities:
    Freshman:
        a. Workshop-costuming Winter and Spring Quarter.
    Sophomore:
        a. Workshop-Fall-costuming.
            Winter-lead in one act play.
            Spring-make-up.
            Made an associate member.
        b. W.A.A.-President of Beginner Archery Club.
            Council member, Fall, Winter and Spring.
        c. Y.W.C.A.-Winter-member Religion group.
            Spring-candy sale committee.
        d. Veishea-Home Economics Open House committee.
        e. Daily Student-Reporter Spring Quarter.
        f. Dormitory-Winter Quarter-wrote skit, placing
            second in Varieties.
    Junior:
        a. Workshop-Fall Quarter-business manager.
            Winter-co-chairman of business.
            Winter-made active member.
        b. W.A.A.-Fall and Winter-publicity chairman.
            Fall, Winter and Spring-Bowling Club.
            Spring-official delegate to A.F.C.W.
                Convention in Illinois.
        c. Y.W.C.A.-Spring-cabinet member in charge of an
            Interest group.
        d. Veisha-sales committee.
        e. Daily Student-Reporter-Fall,Winter,Spring.
        f. Dormitory-chairman of Homecoming decoration.
        g. Committee for General Education Convocation,
            Winter Quarter.
        h. Debate team-Fall Quarter.

Subject No. 14

Residence: Pi Beta Phi   Major: Foods and Nutrition

Scholastic record:

Entrance test: B 10

H.S.Q.P.A.: 2.86

College Q.P.A.: 2.41

Medical: negative; very immature as freshman.

Activities:

Freshman:

Member of Bomb staff; Health Council; W.A.A. and Coffee Forums.

Sophomore: (out of school Fall Quarter)

a. Publications-reporter, Daily Student; advertising and editorial staff of Homemaker and Green Gander. Vice president of Journalism Club.
b. Veishea-publicity committee; chairman of publicity for "Stars Over Veishea"; Foods and Nutrition Open House; Technical Journalism Open House.
c. Professional-junior representative to Home Economics Council.
d. W.A.A.-Tennis and Outing Clubs.
e. Sorority activities-Campus Varieties; Veishea Vodvil.

Junior:

a. Publications-Student, Homemaker, Green Gander, Bomb editorial staffs. Vice president Technical Journalism Club.
b. Professional-Home Economics Council.
c. Pep Club-president and Executive Council.
d. Coffee Forum-active participant.
e. Sorority-author and director of skit for Campus Varieties.

Subject No. 19

Residence: Alpha Delta Pi   Major: Industrial Science (geology) and Economics

Scholastic record:

Entrance test: B 9

H.S.Q.P.A.: 3.07

College Q.P.A.: 1.966 not promoted to Senior College, fourth year in residence

Medical: negative; appendicitis, 12-17

Activities: No special participation.

Subject No. 20

Residence: Chi Omega Major: Textiles and Clothing

Scholastic record:
- Entrance test: A 10
- H.S.Q.P.A.: 3.74
- College Q.P.A.: 2.84

Medical: pneumonia 6 yr.; influenza 8 yr.; operation on ethnoid sinus, 6 yr.; mastoid 7 yr.; college, negative.

Activities:
- Freshman:
  - Band and orchestra.
- Sophomore:
  - Band and orchestra.
  - Work in local store on Saturdays.
- Junior:
  - Work in store on average of 10-18 hours a week.
- Senior:
  - Band and pep club.

Subject No. 27

Residence: Dormitory Major: Home Economics Education

Scholastic record:
- Entrance test: C 7
- H.S.Q.P.A.: 2.96
- College Q.P.A.: 2.62

Medical: negative.

Activity: Left school to marry at end of junior year.

Subject No. 41

Residence: Cooperative Dormitory Major: Home Economics Education

Scholastic record:
- Entrance test: C 6
- H.S.Q.P.A.: 3.62
- College Q.P.A.: 2.423

Medical: negative. February,1939,acute upper respiratory infection and left cervical adenitis.

Activities:
- Freshman:
  - a. Work-NYA, 30 hours a month; Cooperative Dormitory seven hours a week.
  - b. Y.M.C.A.-Member Devotion Committee.
  - c. Church-Choir;Sunday School class officier; Social Committee of church.
  - d. Dormitory-Proctor; Sor-Dor sing; Veishea Open House Committee; Veishea Vodvil.

Sophomore:
 a. Work-by the house; cooperative dormitory seven hours a week.
 b. Professional-Homemaker Congress Committee; Cherry pie production for Veishea.
 c. Church-choir; chairman of foods committee for all parties and meetings; member of Wesley Players and Kappa Phi.
 d. Dormitory-Variety skit; Veishea float; committee for Dormitory Tea.

Junior:
 a. Work-as above.
 b. Professional-two committees of Home Economics Education Club.
 c. Church-choir, president of Wesley Players; member Kappa Phi.
 d. Dormitory-chairman of Devotions; proctor; Sor-Dor Sing; Variety Skit.
 e. Glee Club-Women's Chorus.

Subject No.42

Residence: Dormitory Major: Science (botany)

Scholastic record:
 Entrance test: C 7
 H.S.Q.P.A.: 2.74
 College Q.P.A.: 1.729 not promoted to Senior College

Medical: pneumonia, 4 yr.; strept. throat, sophomore year; several bronchial colds, junior year.

Activities:

Freshman:
 a. Professional-Science Women's Club.
 b. Church-committees; orchestra, choir.
 c. Varsity Band.

Sophomore:
 a. Professional-Science Women's Club; Botany Club.
 b. Church-Deaconess,Choir.
 c. Daily Student-reporter.
 d. Order of Eastern Star.
 e. Sorority-Zeta Tau Alpha pledge.

Junior:
 a. Professional-Science Women's Club; Botany Club; float committee chairman for Veishea.
 b. Church-Deaconness, choir.
 c. W.A.A.-Bowling Club; Bit and Spur; Cheering Squad.
 d. Daily Student-staff
 e. Order of Eastern Star

Subject No. 43

Residence: Delta Delta Delta   Major: Dietetics
Scholastic record:
    Entrance test: B 9
    H.S.Q.P.A.: 3.45
    College Q.P.A.: 2.981 Transfer from Milwaukee State Teacher's College; four years in residence here.
Medical: negative
Activities:
    Freshman:
    a. Music-Band, 2 rehearsals a week; band tour in March, 6 days; orchestra.
    b. Outing Club-Saturday hikes.
    c. Y.W.C.A.-member.
    d. Danforth Scholarship as outstanding freshman Home Economist in America.
    e. Summer-Foods Counselor; Y.W.C.A. Playhouse June-July; Camp, August.

    Sophomore:
    a. Music-band, 2 or 3 rehearsals per week; orchestra, 2 or 3 rehearsals per week; band tour, 6 days in March; piano lessons, Fall and Winter Quarter.
    b. Associated Women Students-secretary; delegate to A.W.S. Convention in Michigan, four days in April.
    c. W.A.A.-elected to Naiads, honorary swimming organization.
    d. Y.W.C.A.-poster committee
    e. Professional-proofreader for Homemaker Staff; cherry pie committee for Veishea.
    f. Sorority-pledge activities Tri Delts.
    g. Summer-Summer school in Milwaukee; camp for two weeks; work in office, one and one-half months.

    Junior:
    a. Y.W.C.A.-chairman weekly radio programs; Y.W.C.A. cabinet; chairman and toastmistress Geneva Banquet for Iowa Y.W.C.A. and Y.M.C.A., Palisades Park, Iowa, May; invitations committee, Y.W. Banquet, May; vice president, February--June.
    b. A.W.S.-junior class representative, Sept. to June; chairman of tea for freshman candidates, February; chairman of Book Loan Fund, September, May; committee on Point System, March.
    c. Professional-elected to Phi Upsilon Omicron, November; president Phi Upsilon Omicron, May; chairman of Home Economics Float for Veishea parade.
    d. Mortar Board-president in May.

e. Music-elected to Sigma Alpha Iota, January.
f. Religious Emphasis Week-Radio chairman; dinner committee.
g. Sorority-Volleyball team, May; Chairman of decorations, Spring formal, May; Sor-Dor Sing; corresponding secretary, March to June.
h. Summer-flu, one and one-half weeks; camp, 10 days in August.

Senior:
a. Y.W.C.A.-finance chairman and vice president.
b. Professional-president Phi Upsilon Omicron; fruit cake committee; Phi Upsilon Omicron co-chairman Ellen H. Richards Day, December.
c. Mortar board-president; co-chairman of Mortar Board Recognition dinner.
d. Music-Sigma Alpha Iota.
e. Sorority-corresponding secretary.
f. Home Management residence first six weeks Fall Quarter.

Subject No. 46

Residence: Town girl. Major: Science (mathematics, minor, zoology and vocational education)

Scholastic record:
Entrance test: C 8
H.S.Q.P.A.: 3.50
College Q.P.A.: 2.475

Medical: scarlet fever; chronic nephritis; March, 1939, influenza one week.

Activities:
Worked half time in a bank throughout school.

Subject No. 47

Residence: Dormitory Major: Dietetics and Home Economics Education

Scholastic record:
Entrance test: D 3
H.S.Q.P.A.: 2.96
College Q.P.A.: 2.188

Medical: diphtheria 4 yr.; negative except fatigue.

Activities:
a. Work-at least three hours daily throughout entire four years for board. Freshman year, half time NYA. Summers-strenuous work entire summers as waitress.
b. Margaret Hall fire-sophomore year; lost entire possessions.
c. Beginning junior year attended Home Economics Clubs, League of Women Voters, Health Council; Y.W.C.A. interest group.

Subject No. 48

Residence: Dormitory Major: Home Economics Education

Scholastic record:
- Entrance test: C 6
- H.S.Q.P.A.: 1.92
- College Q.P.A.: 2.140

Medical: scarlet fever, 4 yr.; negative
Activities: No special activities.

Subject No. 54

Residence: Dormitory Major: Experimental Cookery
Scholastic record:
- Entrance test: C 4
- H.S.Q.P.A.: Fair
- College Q.P.A.: 1.544 not promoted to Senior College

Medical: negative
Activities: Dropped from school after junior year, probably due to scholastic failure.

Subject No. 55

Residence: Cooperative Dormitory Major: Household Equipment
Scholastic record:
- Entrance test: C 7
- H.S.Q.P.A.: 3.42
- College Q.P.A.: 2.899 Upper 3% freshman and sophomore class.

Medical: Scarlet fever, 7 hr.; small amount albumin.
Activities:

Freshman:
- a. Professional-Home Economics Club Council.
- b. W.A.A.-Archery Club, Outing Club, Hockey Club.
- c. Church-Methodist Sunday School.

Sophomore:
- a. Professional-Home Economics Club.
- b. Y.W.C.A.-member.
- c. W.A.A.-intramurals; Archery, Outing and Hockey Clubs.
- d. A.W.S.-Independent Council; Campus Sister.
- e. Campus 4 H Club.
- f. Church-Methodist Sunday School.

Junior:
- a. Professional- Household Equipment Club Council secretary; Home Economics Club Council; Phi Upsilon Omicron; Omicron Nu.
- b. W.A.A.-intramurals; Archery, Outing and Hockey Clubs; intramural board; Women's "I" fraternity.

c. A.W.S.-Independent Council; Campus Sister; Freshman Days Leader.
d. Dormitory- Veishea.
e. Alternate for 1939 Danforth Fellowship.
f. Y.W.C.A.
g. Campus 4 H Club.
h. Church-Methodist Sunday School.

Senior:
a. Professional-Home Economics Club Council; Household Equipment Club Council, president; Phi Upsilon Omicron; Omicron Nu.
b. W.A.A.-Intramurals; Women's "I" Fraternity.
c. Dormitory-council; Joint Social Council.
d. Veishea-Campus 4H Club; Y.W.C.A.
e. Methodist Sunday School.

Subject No. 58

Residence: Alpha Delta Pi Major: Dietetics
Scholastic record:
Entrance test: C 5
H.S.Q.P.A.: 3.08
College Q.P.A.: 1.925
Medical: Diabetes mellitus since 12 yrs.
Activities:

Freshman:
a. Health Council-member.
b. Veishea-member.
c. Y.W.C.A.-member.
d. Newman Club-member.
e. Coffee Forum-attended.

Sophomore:
a. Health Council.
b. Campus Sister.
c. Y.W.C.A.-Religious committee.
d. Newman Club.

Junior:
a. Campus Sister
b. Veishea-sub-chairman of Home Economics Open House tours.
c. Y.W.C.A.-charge of booth for bazaar.
d. Newman Club.
e. Home Economics Club-membership committee.
f. Sorority-secretary.

Senior:
a. Campus Sister; Freshman Days student leader.
b. Newman Club.
c. Sorority, alumna chairman.

Subject No. 60

Residence: Delta Delta Delta   Major: Applied Art
Scholastic record:
    Entrance test: C 5
    H.S.Q.P.A.: 2.86
    College Q.P.A.: 2.365
Medical: negative except sinus.
Activities:
    Freshman:
        a. Y.W.C.A.
        b. Publications-Iowa Homemaker, Daily Student reporter.
        c. Home Economics Club.
        d. Health Council.
        e. Sorority-pledge duties.
    Sophomore:
        a. Y.W.C.A.-chairman of faculty finance drive, October to March.
        b. Publications-Iowa Homemaker committee, Fall and Winter; circulation manager, Winter and Spring, Bomb, feature editor, October.
        c. Sorority-Pan Hellenic Council; Sor-Dor Sing, treasurer.
        d. W.A.A.-Archery Club,archery tournament.
        e. Religious Emphasis Week committee.
        f. Summer-counselor in camp ten weeks; Art Institute, Chicago, three weeks.
    Junior:
        a. Y.W.C.A.-Cabinet; Crafts interest group, Fall and Winter; president, Spring Quarter.
        b. Publications-Iowa Homemaker.
        c. Sorority-Sor-Dor Sing, February; Pan Hellenic Dance Committee, January; corresponding secretary for sorority, February.
        d. Veishea Central committee, program chairman.
        e. Junior Prom committee, December.
        f. A.W.S., January.
        g. W.A.A.-Bowling Club, Fall and Winter; Archery tournament, first place, October.

Subject No. 61

Residence: Dormitory   Major: Experimental Cookery
Scholastic record:
    Entrance test: A 10
    H.S.Q.P.A.: 3.79
    College Q.P.A.: 3.596 Upper 3% of class throughout school.
Medical: negative.
Activities:
  Freshman:
    a. W.A.A.-intramural baseball, volleyball.
    b. Church-secretary, League of Evangelical Students.
  Sophomore:
    a. W.A.A.-intramurals, baseball, volleyball, basketball.
  Junior:
    a. W.A.A.-intramurals, volleyball, baseball.
    b. Church-secretary, League of Evangelical Students; Interchurch Council.
    c. Y.W.C.A.-Membership drive.
    d. Dormitory-Freshman sponsor.
    e. Health Council-representative from dormitory.
    f. Veishea-chairman of Foods and Nutrition Open House.
    g. Professional-elected to Phi Upsilon Omicron, December; Omicron Nu, March.
    h. Mortar Board, May.
    i. Danforth Fellowship, summer.
    j. NYA work, six hours per week.
  Senior:
    a. W.A.A.-intramurals, volleyball.
    b. Y.W.C.A.-finance drive in charge of dormitories.
    c. Professional-program chairman, Foods and Nutrition Club; chairman Phi Upsilon fruit cake project; vice president Omicron Nu; chairman, Omicron Nu Honors Tea.
    d. Mortar Board treasurer.
    e. Election to Phi Kappa Phi.

Subject No. 71

Residence: Cooperative Dormitory   Major: Household Equipment
Scholastic record:
    Entrance test: A 10
    H.S.Q.P.A.: 3.59
    College Q.P.A. 3.187 Highest 3% sophomore, junior class; entered as a transfer student.
Medical: negative.
Activities: Omicron Nu; no other special activities.

Subject No. 72

Residence: Dormitory Major: Dietetics
Scholastic record:
  Entrance tests: D 3
  H.S.Q.P.A.: 2.36
  College Q.P.A.: 2.024 transfer from Univerisityof Dubuque.
Medical: negative.
Activities: no reported activities.

Subject No. 75

Residence: Phi Beta Pi Major: Home Economics Education
Scholastic record:
  Entrance test: C 7
  H.S.Q.P.A.: 3.60
  College Q.P.A. 2.836
Medical: negative; influenza, February, 1939.
Activities: active on campus. Left at end Fall Quarter, junior year for marriage.

Subject No. 78

Residence: Dormitory Major: Institutional Management
Scholastic record:
  Entrance test: D
  H.S.Q.P.A.: 2.28
  College Q.P.A.: 1.947 not in senior college after four years.
Medical: migraine; negative in college.
Activities:
  a. Workshop-same activity for four years.
  b. W.A.A.-miscellaneous sports.

Subject No. 87

Residence: Town and Dormitory Major: Home Economics Education
Scholastic record:
  Entrance test: C 7
  H.S.Q.P.A.: 3.25
  College Q.P.A. 1.960
Medical: influena; frequent colds; acute rhinopharyngitis with cervical adenitis.

Activities:

Freshman:

a. Work-Fall and Winter board and room job, 35 hours a week hard work; Spring, full time NYA, 50 hours a month.
b. Church-choir; Epworth League; Philian Society, student calls, etc.
c. Margaret Hall fire; lost all possessions; moved five times within the year.

Sophomore:

a. Work-Fall Quarter Cooperative Dormitory; Winter and Spring, all expense position with full responsibility of four year child; worked throughout all vacations; half-time NYA all year.

Junior:

a. Work-Fall, by hour at Union, poorly fed; Winter, by hour plus one good meal a day for private family.
b. Dormitory: social secretary.
c. Glee Club.

Subject No. 88

Residence: Cooperative Dormitory   Major: Applied Art

Scholastic record:

Entrance test: B 9
H.S.Q.P.A.: 3.65
College Q.P.A.: 2.479 Transfer from Junior College.

Medical: negative; interval appendicitis, 1/5/38.

Activities:

Sophomore:

a. Work-Cooperative Dormitory; miscellaneous typing for people.

Junior:

a. Work-Cooperative Dormitory.
b. Workshop-poster committee.
c. Dormitory-chairman of Veishea float committee.

Senior:

a. Work-Cooperative Dormitory.

Subject No. 91

Residence: Dormitory   Major: Home Economics Education

Scholastic record:

Entrance test: C 5
H.S.Q.P.A.: 3.55
College Q.P.A.: 2.555

Medical: frequent colds.

Activities: None throughout four years; engagement announced Winter Quarter of senior year.

Subject No. 93

Residence: Chi Omega Major: Home Economics Education

Scholastic record:
 Entrance test: C 7
 H.S.Q.P.A.: 2.89
 College Q.P.A.: 2.265 Transfer from a Junior College.

Medical: negative.

Activities: Graduated before information obtained; active in sorority circles; scholastic worry.

Subject No. 95

Residence: Dormitory Major: Mathematics, later Home Economics
 Entrance test: B 10
 H.S.Q.P.A.: 3.38
 College Q.P.A.: 2.366

Medical: frequent cold; 11/26/37, severe nervous tension.

Activities: Left college during junior year for marriage.

Subject No. 101

Residence: Cooperative Dormitory Major: Child Development

Scholastic record:
 Entrance test: C 4
 H.S.Q.P.A.: 1.60
 College Q.P.A.: 1.503

Medical: inflammatory rheumatism at 11; slight murmur; negative in college.

Activity: Dropped indefinitely by scholarship committee after Fall Quarter of junior year.

Subject No. 102

Residence: Dormitory Major: Dietetics

Scholastic record:
 Entrance test: C 6
 H.S.Q.P.A.: 3.59
 College Q.P.A.: 2.77

Medical: negative; metabolism experiment student in nutrition department three years.

Activities: No organized activities. Graduated and in dietetic interneship.

Subject No. 105

Residence: Cooperative Dormitory   Major: Institutional Management

Scholastic record:
Entrance test: D 2
H.S.Q.P.A.: 1.53
College Q.P.A.: 1.955

Medical: Palpable thyroid; negative in college.

Activity: All years-Kappa Phi; work in Cooperative Dormitories. Summers strenuous work caring for sick or both sessions summer school.

Subject No. 109

Residence: Dormitory   Major: Dietetics

Scholastic record:
Entrance test: A 10
H.S.Q.P.A.: 3.82
College Q.P.A. 3.147 Transfer from Waldorf College.

Medical: negative.

Activities: Fairly inactive; elected Omicron Nu, senior year; Margaret Hall fire, sophomore year; B.S., Fall, 1939; dietetic internship.

Subject No. 114

Residence: Dormitory   Major: Dietetics

Scholastic record:
Entrance test: C 3
H.S.Q.P.Q.: 2.50
College Q.P.A.: 2.021

Medical: pleurisy at 2 yr., negative.

Activities: Inactive; member Y.W.C.A. throughout college; member Health Council; Senior year some practical experience in dinner preparation.

Subject No. 115

Residence: Cooperative Dormitory   Major: Institutional Management

Scholastic record:
Entrance test: C 4
H.S.Q.P.A.: 3.43
College Q.P.A.: 1.953

Medical: negative.

Activities: No particular activities; member 4 H Club throughout college; member Kappa Phi throughout four years; Health Council,
Junior:
a. Campus Sister.
b. Work-Cooperative Dormitory.
Senior:
a. Campus Sister.
b. Kappa Phi-social chairman.
c. Dormitory-cooperative work; charge of formal tea.

Subject No. 119

Residence: Dormitory   Major: Home Economics Education

Scholastic record:
Entrance test: B 9
H.S.Q.P.A.: 2.65
College Q.P.A.: 2.317
Medical: negative.
Activities:
Freshman:
a. Professional-Home Economics Club.
b. Music-Glee Club; Mixed Chorus.
c. W.A.A.-intramural baseball.
Sophomore:
a. Professional- Home Economics Club.
b. Music-Glee Club; Mixed Chorus.
c. W.A.A.-Intramural manager for dormitory.
Junior:
a. Professional-Home Economics Club.
b. Music- Glee Club; Mixed Chorus.
c. W.A.A.-Intramural manager.
d. Dormitory-freshman sponsor; desk work.
Senior:
a. As in junior year plus Home Management House residence and student teaching.

Subject No. 124

Residence   Major: Foods and Nutrition and Experimental Cookery

Scholastic record:
Entrance test: B 9
H.S.Q.P.A.: 3.27
College Q.P.A.: 2.525 Transfer from University of Louisville.

Medical: scarlet fever, nine yr.; influenza, six yr.; January, 1940, influenza, four years.

Activities:

Freshman:

a. W.A.A.-Basketball Club; intramural baseball; basketball; tennis; volleyball; badminton.

b. Work-party service at Union.

Sophomore:

a. W.A.A.-treasurer; in charge of intramural sports for dormitories; tennis.

b. Dance Club-"Stars Over Veishea"; dance program.

c. Work-party service at Union; office work 15-20 hours a week.

Junior:

a. W.A.A.-president, Women's "I" Fraternity; intramural sports.

b. Dance Club-"Stars Over Veishea" dance program.

c. Work-15-20 hours a week in an office.

d. Dormitory-vicepresident; scholarship committee.

e. Professional-publicity manager, Food and Nutrition Club; ticket manager Foods and Nutrition picnic and dinner.

f. A.W.S.-council; tea dance ticket manager.

g. Professional tour trips-Iowa City, Chicago, Omaha, etc.

Subject No. 132

Residence: Dormitory　　　Major: Foods and Nutrition Dietetics

Scholastic record:

Entrance test: D 2

H.S.Q.P.A.: 2.18

College Q.P.A.: 2.011

Medical: influenza at five years; some thyroid medication following last observation.

Activities:

Freshman-no activity.

Sophomore:

a. Work-Winter and Spring Quarters; 12 weeks work at Union.

b. Music-Glee Club; church choir; sextet.

Junior:

a. Work-Fall Quarter room and board job, at least 30 hours a week; Winter catering at Union 18 hours a week.

b. Music-Glee club; church choir; sextet.

Subject No. 142

Residence: Cooperative Dormitory   Major: Home Economics Education

Scholastic record:
  Entrance test C 7
  H.S.Q.P.A.: 3.36
  College Q.P.A.: 2.69

Medical: scarlet fever, 12 years; frequent colds;1/29/40, acute pharyngitis with cervical adenitis.

Activities:

Freshman:

a. Work-Cooperative Dormitory chairman of committee six weeks; NYA two quarters; odd jobs.
b. Y.W.C.A.-on membership committee.
c. W.A.A.-member.
d. Home Economics Club-member.
e. Church-program committee for Presbyterian Fellowship.

Sophomore:

a. Work-Cooperative Dormitory chairman of committee 12 weeks; NYA work two quarters; housework three hours a week for one quarter; care for children one afternoon a week and one evening every two weeks for two quarters.
b. Y.W.C.A.-membership and nursery school (service) committees; participant in three programs.
c. Home Economics Club.
d. Church-Deaconess of Presbyterian Church, and officier of Fellowship.

Junior:

a. Work-NYA three quarters; Cooperative Dormitory.
b. Home Economics Club-member of Workshop committee.
c. Church-deaconess officier and officier of fellowship.
d. Council of Campus 4 H Club.

Subject No. 160

Residence: Cooperative Dormitory   Major: Home Economics Education

Scholastic record:
  Entrance test: C. 5
  H.S.Q.P.A.: 2.98
  College Q.P.A.: 2.276

Medical: slightly palpable thyroid; pneumonia nine year; diptheria six year/. influenza, 15 yr.; mantoux +++; negative in college.

Activities: Left college after Winter Quarter, junior year, reason unknown.

Non-Repeats

For the non-repeat individuals very little personal information is available. However, wherever the individual's subsequent course is known it has been given.

Subject No. 21

Residence: Gamma Phi Beta Major: Home Economics
Scholastic record:
Entrance test: C 3
H.S.Q.P.A.: 2.52
College Q.P.A.: 1.903
Subsequent course: left school; working at home.

Subject No. 22

Residence: Dormitory Major: Applied Art
Scholastic record:
Entrance test: C 7
H.S.Q.P.A.: 4.00
College Q.P.A.: 2.794
Subsequent course: unknown.

Subject No. 24

Residence: Dormitory Major: Home Economics
Scholastic record:
Entrance test: B 8
H.S.Q.P.A.: 2.77
College Q.P.A.: 1.81
Subsequent course: unknown, left school after one week in second quarter because dissatisfied.

Subject No. 26

Residence: Kappa Delta Major: Home Economics
Scholastic record:
Entrance test: C 5
H.S.Q.P.A.: 3.50
College Q.P.A.: 2.00
Subsequent course: transcript sent to Iowa State Teacher's College after one year.

Subject No. 31

Residence: Kappa Delta Major: Child Development

Scholastic record:

Entrance test: B 8

H.S.Q.P.Q.: 2.88

College Q.P.A.: 2.47

Subsequent course: left after two years for marriage to former high school teacher.

Subject No. 32

Residence: Sigma Kappa Major: Home Economics

Scholastic record:

Entrance test: C 6

H.S.Q.P.A.: 2.85

College Q.P.A.: 1.80

Subsequent course: after one quarter transcript sent to Florida, D.C. College for Women.

Subject No. 35

Residence: Dormitory Major: Industrial Science Mathematics

Scholastic record:

Entrance test: C 8

H.S.Q.P.A.: 3.48

College Q.P.A.: 1.64

Subsequent course: after one year transcript sent to Iowa State University.

Subject No. 36

Residence: Phi Beta Pi Major: Institution Management

Scholastic record:

Entrance test: C 7

H.S.Q.P.A.: 3.35

College Q.P.A.: 2.15

Subsequent course: still in residence, unable to contact.

Subject No. 37

Residence: Dormitory Major: Institution Management

Scholastic record:

Entrance test: C 4

H.S.Q.P.A.: 2.52

College Q.P.A.: 1.812

Subsequent course: dropped out school; returned Winter, 1940.

Subject No. 51

Residence: Dormitory Major: Home Economics
Scholastic record:
Entrance test: E 1
H.S.Q.P.A: 1.78
College Q.P.A.: 1.22
Subsequent course: dropped after one year; opened dance studio in Ames.

Subject No. 53.

Residence: Dormitory Major: Home Economics
Scholastic record:
Entrance test: B 9
H.S.Q.P.A: 3.35
College Q.P.A.: 3.22
Subsequent course: dropped after one year to take a Civil Service Appointment; returned to school two years later (Fall, 1939).

Subject No. 56

Residence: Dormitory Major: Dietetics
Scholastic record:
Entrance test: C 7
H.S.Q.P.Q.: 3.26
College Q.P.A.: 2.24
Subsequent course: left during fifth quarter to assume a position; nature of position unknown; maybe a student nurse.

Subject No. 57

Residence: Dormitory Major: Dietetics
Scholastic record:
Entrance test: C 7
H.S.Q.P.A.: 3.51
College Q.P.A. 1.884
Subsequent course: married after two years; employed in office on campus.

Subject No. 63

Residence: Dormitory Major: Child Development
Scholastic record:
Entrance test: C 4
H.S.Q.P.A.: 3.22
College Q.P.A.: 1.754
Subsequent course: left after four quarters; transcript sent to St. Mary's School of Nursing and Kahlor School of Nursing.

Subject No. 73

Residence: Dormitory   Major: General Science
Scholastic record:
    Entrance test: C 7
    H.S.Q.P.A.: 3.32
    College Q.P.A.: 2.26
Subsequent course: left after one year; wanted Liberal Arts; transcript sent to University of Iowa.

Subject No. 74

Residence: Dormitory   Major: Home Economics
Scholastic record:
    Entrance test: B 9
    H.S.Q.P.A.: 3.74
    College Q.P.A: 2.98
Subsequent course: entered Iowa Methodist Hospital School of Nursing after one year.

Subject No. 76

Residence: Dormitory   Major: Home Economics
Scholastic record:
    Entrance test: D 3
    H.S.Q.P.A.: 2.03
    College Q.P.A.: 0.98
Subsequent course: scholastic failure in one year; reported transferred to Grinnell College.

Subject No. 79

Residence: Dormitory   Major: Industrial Science (bacteriology)
Scholastic record:
    Entrance test:
    H.S.Q.P.A.:
    College Q.P.A. 1.741
Subsequent course: married an I.S.C. graduate after one year.

Subject No. 81

Residence: Dormitory   Major: Home Economics
    Entrance test: B 8
    H.S.Q.P.A.: 2.81
    College Q.P.A.: 1.63
Subsequent course: left after one year to marry hometown boy; two years later has son.

Subject No. 82

Residence: Dormitory Major: Industrial Science
Scholastic record:
Entrance test: C 7
H.S.Q.PA.: 2.32
College Q.P.A.: 2.59
Subsequent course: after two years transcript sent to University of Minnesota School of Nursing.

Subject No. 84

Residence: Dormitory Major: Home Economics
Scholastic record:
Entrance test: C 8
H.S.Q.P.A.: 2.65
College Q.P.A.: 1.79
Subsequent course: unknown

Subject No. 85

Residence: Dormitory Major: Foods and Nutrition
Scholastic record:
Entrance test: C 6
H.S.Q.P.A: 3.00
College Q.P.A.: 2.47
Subsequent course: after five quarters transcript sent to University of Wisconsin.

Subject No. 86

Residence: Dormitory Major: Home Economics
Scholastic record:
Entrance test D 1
H.S.Q.P.A.: 2.98
College Q.P.A.: 1.76
Subsequent course: left after one year for marriage to former Iowa State graduate student.

Subject No. 111

Residence: Dormitory Major: Dietetics
Scholastic record:
Entrance test: C 8
H.S.Q.P.A.: 2.97
College Q.P.A.: 2.41
Subsequent course: unknown.

Subject No. 121

Residence: Dormitory Major: Home Economics
Scholastic record:
Entrance test: C 5
H.S.Q.P.A.: 2.57
College Q.P.A.: 2.34

Subsequent course: according to subject, came for one year to meet a suitable man; left intending to marry.

Subject No. 133

Residence: Gamma Phi Beta Major: Dietetics
Scholastic record:
Entrance test: B 8
H.S.Q.P.A.: 3.96
College Q.P.A.: 3.413
Subsequent course: unknown.

Subject No. 138

Residence: Dormitory Major: Home Economics
Scholastic record:
Entrance test: D 1
H.S.Q.P.A.: 3.74
College Q.P.A.: 1.830
Subsequent course: after one year took stenographic position on campus; later transferred to similar position at University of Illinois.