TABLE 1

COMPOSITION/100 G OF VARIETIES OF TEOSINTE AND CORN
(Adjusted to 10% Moisture)

	Fat (g)	Nitrogen (g)	Methionine (g)	Lysine (g)	Tryptophane (g)	Niacin (mg)
Teosinte						
(Hulled grain)						
#223*	4.24	3.68	0.58	0.46	0.033	1.05
#35–51†	3.02	3.25	.45	.32	.051	0.78
#33–47‡	—	3.52	.40	.26	.054	1.02
#97–50§	2.26	3.48	.54	.35	.048	0.90
Corn						
(Whole grain)						
#7A–46‖	4.55	1.54	.16	.29	.048	1.58
#99A–115¶	5.06	1.32	0.14	0.35	0.052	2.18

* Collected near Progreso, Jutiapa, Guatemala (alt., 2925 ft), in Nov. 1950.

† Collected at Progreso, Jutiapa, Guatemala, in Jan. 1951.

‡ Collected at Progreso, Jutiapa, Guatemala, Sept. 1947, and grown in Antigua, Guatemala (alt., 4953 ft) in Dec. 1948.

§ Grown in Florida in 1949 and purchased from Reuter Seed Company, New Orleans, La.

‖ Commercial seed of Tiquisate Golden Yellow, a golden-yellow flint corn grown in Antigua, Guatemala, in Oct. 1949 and selected because it is above the average of 23 Guatemalan corns analyzed by INCAP in protein, methionine, and tryptophane.

¶ A commercial hybrid corn obtained from the May Seed Company, Shenandoah, Iowa, in Sept. 1949.

methionine content of teosinte, more than twice that of corn. Methionine is now recognized to be the limiting amino acid in the predominately vegetable diets of most underdeveloped areas of the world (*9*). The peoples of these areas must obtain increased amounts of methionine in their diets, but for basic agricultural, economic, and cultural reasons, this problem cannot be solved entirely by an increase in the production of animal protein (*10*). Therefore, vegetable products, which have a high supplementation value in the mixed diets of these areas and which can be produced readily, are urgently needed. From the data presented teosinte should be further studied as a potential source of vegetable protein of relatively high methionine content.

The amounts of tryptophane and lysine/100 g in teosinte do not appear to differ significantly from those in corn. On the basis of suggested minimum daily requirements (*11*) for these amino acids, the quantity of lysine is probably sufficient even with the increased proportion of methionine in teosinte. Tryptophane, however, must certainly be a limiting amino acid in teosinte protein. This makes the lower niacin content of teosinte listed in Table 1 significant, since an excess of tryptophane is not likely to be available for conversion to niacin. According to the data presented in Table 1, the fat content of teosinte may prove to average somewhat lower than that of corn. Three of the samples listed in Table 1 were also analyzed for their crude fiber content, but no consistent differences were observed between hulled teosinte and whole corn.

Teosinte corn hybrids can be readily obtained, but five such crosses (F_1) analyzed as part of the present study did not differ significantly from corn in their chemical composition although the plants and ears were intermediate in structure and appearance. However, their progeny (F_2) should show marked variation in nutrient composition (*12*). The yield of some plants grown from wild seed in Antigua reached 500 g, although the range of variation was great. This would indicate that the yield per acre of selected seed on good ground is potentially high.

Ground teosinte can be mixed with wheat or corn flours or used alone to make biscuits, tortillas, and other products. In view of the widespread efforts to improve the world supply of protein for human consumption, the relatively high proportions of total protein and methionine in teosinte are potentially important. The direct use of teosinte for food in mixed vegetable diets, as well as the possible improvement of the protein content of corn by hybridization with teosinte and subsequent selection for both yield and nutritive value, should be seriously investigated.

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A Simple Test of the Normality of Twenty-Four Distributions of Electrical Skin Conductance[1]

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The electrical resistance of the skin is widely used as a measure of emotion, energy mobilization, or level of activation. The "natural" unit for measuring resistance is the ohm, so this unit was used until Darrow (*1*) pointed out that changes in skin conductance were directly related to sweating, the process which seems basic to the electrical phenomenon. Since then, several different units have been proposed (*2–6*), as measures

[1] The data reported in this paper were collected as part of an investigation supported by Thomas J. Lipton, Inc.

both of basic skin conductance and of the rapid changes in conductance known as the psychogalvanic reflex (PGR) or galvanic skin response (GSR). There is one major requirement that an acceptable unit must meet: it must yield the normal distribution of measures that conventional statistical techniques demand. There is some precedence for assuming that a unit which meets this requirement will also meet another, that of an equal-unit scale.

Recently we were faced with the necessity of deciding which unit to use before we could analyze a large mass of resistance readings. The experiment that seemed to have the most direct bearing on our problem was that of Lacey (*5*). Lacey concluded that conductance (in mhos or micromhos) furnished the best unit in which to specify general level of skin resistance. But his study had certain limitations for our purposes. In the first place, he took five resistances on each subject and averaged them before further statistical treatment; if one is to make a conversion to conductance units, he certainly should make the conversion on raw data, *before* averaging. Second, Lacey made his readings at only one level, that of relaxation with eyes closed. In our study, we were following resistance changes during a session of repeated cycles of tests and tasks, lasting 2½ hr, and repeated on four successive days. It was clearly advisable to examine the data for normality at high, low, and intermediate levels of "tension."

Data were available on 20 women, ranging in age from 23 to 65. Readings were taken at 1-min intervals during tests of simple reaction time, choice reaction time (right hand to blue light, left hand to amber light), attention (Test 11 in [*7*]), and a 12-min period of long division. The resistance was measured by a Fordham d-c amplifier (*8*) using silver-silver chloride electrodes taped just in front of the heels. For an electrode paste we used a mixture of Bentonite, glycerin, and Ringer's solution.[2] The resistances varied widely from time to time. There was a consistent and rapid decrease in conductance during each task or test, with a rapid return to a high level at the start of each new test (*9*). Comparing successive cycles in the same session, there was a fairly consistent increase during the first cycle (½ hr), perhaps corresponding to "warming up," and then a fairly steady pattern thereafter.

In checking for normality of distribution of skin conductance, it was obviously desirable to take each sample at a specific stage in the session, as (*a*) second measurement, Attention Test, Cycle 1, Day 3; or (*b*) next-to-last measurement, Complex Reaction Time, Cycle 1, Day 2, etc. To test very many of these distributions by conventional statistical treatment would be extremely time-consuming. Fortunately, we were able to devise a simple graphic test that was quick and more satisfactory in many ways.

The basic plan was to plot sets of data as summated distribution curves against an ordinate so spaced that it converts the normal ogive to a straight line. After a few trials, it was clear that "Probit" paper was cumbersome. Since we always had 20 cases, it was easier to mark off the midpoints of the appropriate percentile intervals (2½, 7½, 12½ . . . 97½) on a transparent rule, and use this as a movable ordinate on ordinary graph paper. The method is illustrated in Fig. 1. The conductances were tallied on a base line of appropriate range, thus automatically ranking them. The movable ordinate was then used as a ruler to raise the first point to 2½ percentile, the second one to 7½ percentile, etc. By inspection, it was possible to see how well the distribution approximated a straight line—i.e., approached normality.

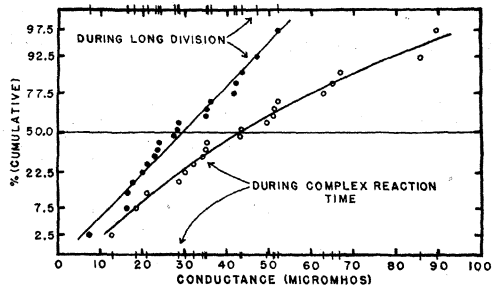

FIG. 1. Cumulative percentage distributions of 20 subjects' electrical skin conductance during one period of long division (illustrating a close approximation to normality) and during one period of complex reaction time tests (illustrating positive skewness). Conductance scores are tallied on upper and lower abscissae.

Many of the distributions appeared to be essentially normal (*cf.* curve for long division in Fig. 1). Three of the 24 distributions showed definite kurtosis, which cannot be corrected by a simple transformation. About one half of the distributions gave evidence of positive skewness (*cf.* curve for complex reaction time in Fig. 1). A logarithmic transformation of conductance overcorrects such skewness, but the square root of conductance does a better job (*cf.* Fig. 2). When 24 samples were compared, about 10 of them were fitted equally well by both conductance and square root of conductance. Of the remainder, square root of conductance was judged preferable by a ratio of

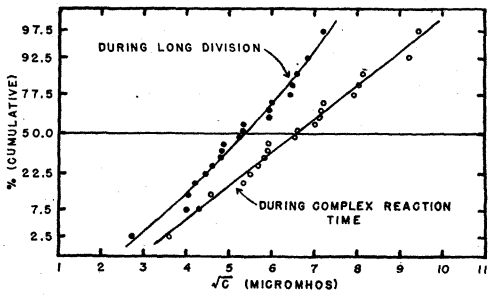

FIG. 2. Square root transformation of skin conductance measures which appear in Fig. 1, showing correction of positive skewness of conductance during complex reaction time tests and introduction of negative skewness in the curve for long division.

[2] We question the widespread use of EKG or EEG electrode pastes designed to minimize skin resistance when one wishes to measure resistance.

3/1. This suggests that square root of conductance is the best measure to use where it is important to have the closest approximation to normality, especially over wide ranges of conductance. For most routine purposes, however, conductance would seem to be a perfectly adequate measure. It might be noted that a microammeter reads in units directly linear with mhos; such as ammeter, plus a suitable voltage divider is perfectly adequate for measuring conductance directly.

Our data furnished no evidence on the appropriate units for measuring rapid changes in skin conductance, but it may be noted that Lacey and Siegel (*6*) found conductance to be a satisfactory measure of GSR (or PGR). Hence, it would save much time and confusion if workers calibrated their instrument dials in micromhos instead of in ohms.

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A Simple and Practical Method for Measuring and Recording Blood Coagulation Time

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Since the work of Stewart (*1*) in 1899, many investigators have been interested in conductivity as a method of studying the physical properties of blood. Most of this work has been concerned with the relative proportions of blood ingredients (*1–5*). Numerous methods have been devised for these measurements as new instrumentation has developed (*1–8*). A few attempts have been made to correlate the electrical conductivity of blood with blood coagulation, with different conclusions resulting from these studies. In 1905 Frank (*9*) reported no appreciable change in conductivity during blood coagulation. However, Rosenthal and Tobias (*7*) in 1948 described a method more precise than that of Frank. By the use of a 1000 cps a-c voltage across a bridge they were able to measure resistance changes with blood clot formation. Later, in 1949, Henstell (*10*) reported that by the use of a similar method, with a 60 cps a-c voltage, resistance changes with clot formation could be measured. These methods, however, require a complex apparatus, and the results may be affected appreciably by the constituents of the blood. In fact, Hirsch and colleagues (*8*) used a similar apparatus to evaluate the hematocrit.

[1] Jack H. Hall assisted during these studies.

Fig. 1.

Lee and White (*11*) in 1913 devised a somewhat satisfactory mechanical technique for observing and measuring blood coagulation time. This method consisted of withdrawing venous blood, placing it in a small test tube, and rotating it every 30 sec until a clot was formed. This method is widely used today. In 1952 Macht and Hoffmaster (*12*) reported a mechanical method for modifying the Lee and White technique which demonstrated that blood coagulation did not occur as a discrete event. This finding is in agreement with the methods that used conductivity measurements, but progressive changes in coagulation would not be delineated by the original Lee and White method. It also has been shown by Sigman *et al.* (*13*) that motion of blood has an effect on electrical conductivity of the fluid. From this evidence one might conclude that any motion of the blood during a measurement of coagulation time should be uniform, if a maximum reliability of the measurements is to be achieved.

With all these factors in mind, we have developed a new method in this laboratory for the measurement of the coagulation time of blood. This is a modification of the method of Lee and White (*11*) and uses the conductivity of blood as a means of recording the onset and final clot formation. The method is exceedingly simple and practical for use clinically or in the research laboratory.

The apparatus used is composed of a 110-v a-c motor attached to a gear that oscillates back and forth through 90° in such a manner that an attached platform will swing 45° up and down from horizontal. A full oscillation occurs every 10 sec. On the platform attached to the shaft of the gear is placed a container for blood, and a mercury switch. This switch may be reversed so that it makes contact at either extreme of the vertical motion but is always open at the other extreme.

Three different modifications have been employed for blood containers: (1) a culture tube 75 mm × 10 mm; (2) an insulated container of two sealed chambers—an inner glass tube 55 mm × 12 mm and an intermediate chamber filled with glass wool (Fig. 1); and (3) a dual chamber similar to (2), but with a constant temperature fluid circulating through the intermediate chamber that surrounds the inner chamber (Fig. 2). In all cases the tube containing the blood is