TABLE 1

NIACIN CONTENT OF SUGARY, WAXY, AND DENT F_2 SEGREGATES OF CROSS BETWEEN SUGARY AND WAXY LINES OF CORN

F_2 endosperm type	Niacin content, μg/g	
	Mean of endosperm type	Range within endosperm type
Sugary	33.8	26.5–42.0
Waxy	26.0	19.5–32.5
Dent	21.4	16.0–26.8
Differences between mean niacin values necessary for significance:	5% level—1.5 μg/g	
	1% level—2.0 μg/g	

the niacin content of all three endosperm types to about the same degree, as indicated by the correlations between them (Table 2).

TABLE 2

CORRELATIONS BETWEEN NIACIN CONTENT OF DIFFERENT ENDOSPERM TYPES BORNE ON SAME F_1 EARS

Comparison	Value of correlation coefficient
Sugary : waxy	+ 0.758*
Sugary : dent	+ 0.793*
Waxy : dent	+ 0.821*

* Exceeds value required for significance at 1% level.

With present information, the apparent relationship between endosperm type and niacin content cannot be satisfactorily explained. Genetic linkage has been suggested. The results reported here are not fully in accord with this idea. Sugary endosperm came into the cross with high niacin content, and the extracted sugary segregates were high in niacin. However, waxy endosperm came into the cross with low niacin content, yet the extracted waxy segregates were higher in niacin than the waxy parent and also higher than the dent segregates. Also, the data of Cameron and Teas (*3*) clearly indicated that the high niacin content of sugary kernels was not the result of linkage, since sugary kernels produced by the action of either of the independent genes su_1 and du were equally high in niacin. Therefore, it appears that a more likely explanation than linkage is that there is a direct influence of endosperm type on the niacin content of the corn kernel.

Richey and Dawson (*6*) have suggested that this influence may be related in some way to the effects of endosperm type on kernel size. Unpublished data of the present authors indicate, however, that there is no close relationship between kernel size and niacin content, at least in genetically similar material. As suggested by Cameron and Teas (*3*), it appears more probable that vitamin-carbohydrate interrelations in the developing corn kernel are involved, though little is known of the specific nature of these interrelations.

References

1. BARTON-WRIGHT, E. C. *Biochem. J.*, 1944, **38**, 314.
2. BURKHOLDER, P. R. *et al.* *Yale J. biol. Med.*, 1944, **16**, 659.
3. CAMERON, J. W. and TEAS, H. J. *Proc. nat. Acad. Sci.*, 1948, **34**, 390.
4. GORFINKEL, L. *J. agric. Sci.*, 1948, **38**, 339.
5. MATHER, K. and BARTON-WRIGHT, E. C. *Nature*, Lond., 1946, **157**, 109.
6. RICHEY, F. D. and DAWSON, R. F. *Plant Physiol.*, 1948, **23**, 238.
7. SNELL, E. E. and WRIGHT, L. D. *J. biol. Chem.*, 1941, **139**, 675.

Relation of Strength of Sediments to Water Content and Grain Size

Parker D. Trask and Jack W. Rolston

State of California, Department of Public Works, Division of San Francisco Bay Toll Crossings, San Francisco

Strength of sediments is of fundamental interest to geologists and foundation engineers. Water content is a basic factor affecting strength and has been used for many years as a guide to the relative strength of sediments. Water content, however, as many people have pointed out, is not an exact index, because other factors also influence strength. Among these other factors, grain size, because of its pronounced effect upon the general characteristics of sediments, should exert a significant influence.

Extensive data on the sediments of San Francisco Bay have given the authors an opportunity to investigate the relationship of strength to grain size and water content. More than 400 samples of silt and clay were available for study. Sands—that is, sediments having a median diameter, D_{50}, greater than 64 μ—were excluded. Samples were distributed fairly evenly between two Quaternary formations separated by an erosional disconformity.

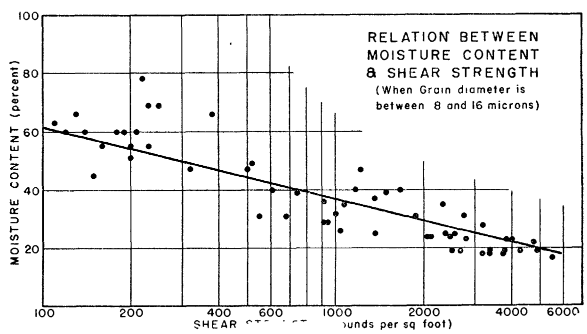

FIG. 1.

Sediments of the upper formation immediately beneath the bay bottom have been consolidated under normal load, but deposits in the underlying formation have been preconsolidated. Unconfined compression, water content, and grain-size distribution values were determined on all samples; and Atterberg limits, direct quick shear, and consolidation values were determined on a large proportion of the samples. The shear strength, s, as determined by direct shear tests, was found to approximate closely one-half the unconfined compression, $qu/2$.

Samples were segregated into six groups according to grain size, Group 1 having a range in median diameter between 1 and 2 μ, Group 2, between 2 and 4 μ, and so on, in geometric intervals to Group 6, which ranged between 32 and 64 μ. The strengths of all samples were then plotted against water content for each grain-size group. A definite relationship was found within each group, as illustrated by Fig. 1, which shows the data for Group 4, in which D_{50} ranged between 8 μ and 16 μ. The slopes of the curves for all six grain-size groups varied in a very regular manner. The over-all relationship between strength, water content, and grain size is expressed by the following equation:

$$s = \mathrm{Log}_{10}^{-1}\left(\frac{7.5 - 3w - 4\mathrm{Log}_{10}D_{0}}{1.8 - \mathrm{Log}_{10}D_{50}}\right)$$

where s is the shear strength in lb/sq ft, as determined from measurements of unconfined compression, $qu/2$, w is the water content expressed as the ratio of the weight of water to the weight of solid constituents, and D_{50} is the median diameter in microns.

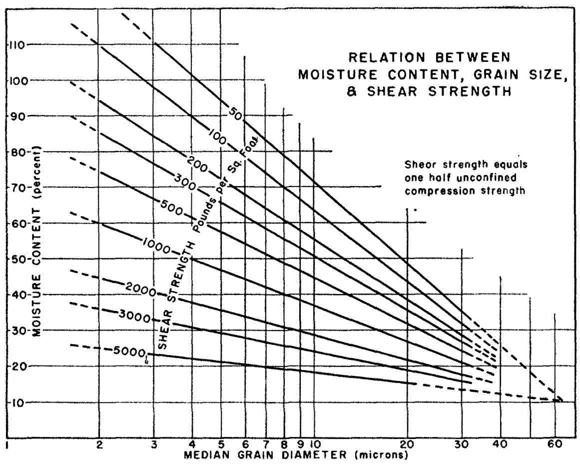

FIG. 2.

The equation is expressed graphically by the family of curves shown in Fig. 2. The reliability of the equation was substantiated by comparing, for 100 random samples, the strength as computed from the equation with the strength as measured in the laboratory. The average observed strength was found to be within 5% of the computed strength. The deviations between observed and computed strength are distributed according to a symmetrical bell-shaped probability curve. The relationship does not hold well for grain size in excess of 32 μ.

Strength naturally is influenced by factors other than water content and grain size. Among these other factors the mineral content, particularly the type of clay minerals, conceivably could be significant. However, in a restricted area such as San Francisco Bay, the newly deposited sediments could be presumed to be relatively similar in mineral and clay composition. This inference is supported by the fact that when the Atterberg limits are plotted on the plasticity chart (*1*), the points lie in a straight and narrow band parallel to and slightly above the "A" line. Apparently, clay and other minerals would have relatively little effect upon the over-all relationships between strength, water content, and grain size in the samples studied.

Factors affecting strength to some extent are mutually interrelated. Water content of sediments varies inversely with grain size (*2*). Also, the plasticity index of the samples from San Francisco Bay varies inversely with grain size. The equation for the relationship is:

$$I_w = 23(2 - \mathrm{Log}_{10}D_{50})$$

where I_w is the plasticity index and D_{50} is the median diameter expressed in microns. Consequently, it follows that in the sediments studied, the three principal variables affecting strength—water content, grain size, and mineral composition—are not completely independent variables.

Further study, particularly of sediments in other areas, is needed in order to appraise the significance of the relationship between strength, water content, and grain size, as observed in sediments of San Francisco Bay. The data obtained thus far, however, indicate that the comparison of unconfined compression with both water content and grain size may give a better understanding of the strength of sediments than comparison with water content alone.

References

1. CASAGRANDE, A. *Proc. Amer. Soc. civil Eng.*, June 1947, 783.
2. TRASK, PARKER D. *Bull. Amer. Assoc. petrol. Geol.*, 1931, **15**, 271.

Interchangeable Pencil-Type Micromanipulator[1]

Georg v. Békésy

Psycho-Acoustic Laboratory, Harvard University

The author is engaged in performing operations on the cochlear partition of the inner ear, a working area of less than 1 sq mm. Because the area is so small and speed is so essential in operations on living tissue, most available micromanipulators have proved unsuitable for this work, even though they are quite adequate for anatomical dissection. They are too large and clumsy, require too many complicated adjustments, and do not permit quick interchange of surgical instruments.

An ideal solution would be to have several small, pencil-like micromanipulators, one for each of the necessary surgical instruments. The movements of a handle would be transmitted to the tip, but greatly reduced in magnitude. The carrier for the manipulators should be simple enough to permit quick and easy interchange of manipulators. Thus the instruments could be brought to the

[1] This research was carried out at the Psycho-Acoustic Laboratory, Harvard University, under contract with the U. S. Navy, Office of Naval Research (Contract N5ori-76, Project NR147-201, Report No. PNR-75).