The results of these experiments demonstrate that inner medullary slices can accumulate potassium against concentration gradients and that this accumulation is dependent upon anaerobic rather than aerobic energy metabolism.

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22 June 1961

Effects of Context on the Subjective Equation of Auditory and Visual Intensities

Abstract. Thirty-six subjects were instructed to equate the loudness of a pure tone with the brightness of an illuminated field. Eighteen of the subjects had been given brief preliminary experience with tones of low intensity; the remaining 18, with tones of high intensity. A significant and substantial effect upon equation was demonstrated.

Several recent studies have suggested that "sensory magnitude" is a self-evident dimension, susceptible of direct introspective evaluation even by inexperienced subjects (*1*). Such subjects are capable of consistent judgments of "sensory magnitude"; furthermore, they seem to be able to match the intensity of a sensation in one modality with that of a sensation in another in a manner consistent with their first-order judgments.

Without disputing the basic data, Warren (*2*) has vigorously questioned the presumption that they represent a sensory dimension, rather than an essentially perceptual continuum. Garner (*3*), also, has emphasized that judgments of this sort can be "reliable" without being "valid" and has demonstrated that the context in which direct judgments of sensory intensity are made can have a radical influence upon their magnitudes. We have investigated, analogously, the effects of context upon the cross-modality equation of "sensory intensities."

Thirty-six female undergraduates were divided at random into two groups ("low" and "high") of 18 members each, and each subject was tested individually in a soundproof, lightproof room. A subject of either group was seated alone in the experimental room, the experimenter maintaining contact with her by means of a Teletalk communication system. After a dark-adaption period of 3 minutes, the subject began a series of visual judgments. At a distance of 18 inches from her eyes, she was presented with an illuminated disk, 1.5 inches in diameter (visual angle, 4°48′), produced by passing the beam from a 200-watt slide projector through an Eastman No. 58 Wratten ("green") filter and then through a small port in the exterior wall of the experimental room; the beam was finally used to illuminate from the rear a translucent plastic screen, set in the interior wall of the room and masked down to form the circular patch described. The intensity of the projector's beam was controlled by use of a General Radio Variac, monitored by electronic voltmeter; filtering of the beam served to prevent perceptible changes of hue in the stimulus. On each trial, the subject was first presented with a stimulus of 15 db (reference level, 0.15 mlam) for 2 seconds, and then immediately with one of either 0, 5, 10, 15, 20, 25, or 30 db for a further 2 seconds; all the timing of stimuli was accomplished automatically by a Hunter timer. The subject was asked to estimate the sensory intensity of the second stimulus on a scale which took that of the first arbitrarily as 10. Each comparison-stimulus was presented five times, in a random order unique to each subject; thus, she was required to make 35 visual judgments.

In a similar fashion, the subject next undertook 35 auditory estimations. Tones of 1024 cycles whose purity had been verified by oscilloscope were administered monaurally, with a Western Electric 6B audiometer as a source. A subject in the low group judged stimuli of either 25, 30, 35, 40, 45, 50, or 55 db (reference level, normal threshold) with respect to a standard of 40 db; a subject in the high group judged stimuli of 55, 60, 65, 70, 75, 80, or 85 db against a standard of 70 db. Again, there were five estimates at each possible level, randomly ordered; again, each standard was arbitrarily labeled 10.

As a final task, the subject performed 15 cross-modality equations. A

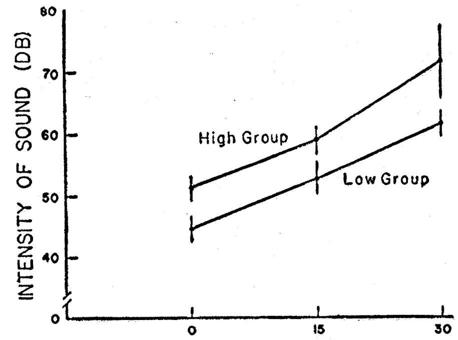

Fig. 1. Mean sound intensities required for equation with each of three light intensities, for each group of subjects ($N = 18$ per group). Vertical bars indicate $\pm\ \sigma$.

visual stimulus at the level of 0, 15, or 30 db was presented for 2 seconds, along with a tone of 55 db. At the subject's direction, this tone was altered in 5-db steps in additional simultaneous administrations until she was satisfied that a match in sensory intensities had been achieved. To obviate the possibility of mere "semantic matches" in this phase of the experiment, instructions emphasized that the numbers previously assigned to the stimuli were now of no significance and that they were to be ignored in making the cross-modality matches. Visual levels were ordered at random; there were five equations of sound with light at each of the three levels of brightness.

After each subject had made five judgments or five equations at each level of stimulation, the five values were averaged to provide a single score for the subject at that level. Figure 1

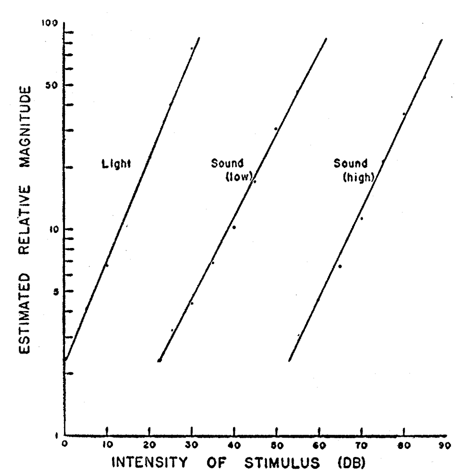

Fig. 2. Mean estimates of relative sensory magnitudes for light (function at left; $N = 36$, standard = 15 db), for sound at low level (middle function; $N = 18$, standard = 40 db), and for sound at high level (function at right; $N = 18$, standard = 70 db).

shows the means of these scores for each group, at each level of illumination, in the task of equating sound with light; vertical bars indicate $\pm 1\,\sigma$ at each point. To reach subjective equations with the same levels of illumination, the high group required systematically greater intensities of sound than the low group. When a single composite score (mean of the subject's three deviations from the respective over-all means at the three levels of illumination) is assigned to each subject, the mean of such scores is +3.74 db ($\sigma = 2.82$) for the high group and (necessarily) −3.74 db ($\sigma = 2.57$) for the low group; $t = 8.31$, and $p < .0_51$.

Subsidiary results may be of some interest. Figure 2 summarizes the first-order estimations of relative magnitude for light (N=36), for sound at the lower level ($N = 18$), and for sound at the higher level ($N = 18$). The graphical points indicate mean scores (*4*), and the straight lines have been fitted by the method of orthogonal polynomials (*5*). The slope of the light line is .50; and the slopes of the low-level and high-level sound lines are, respectively, .40 and .43, considered in terms of acoustic energy. Results for individual subjects are not shown. Among all 36, however, mean slope of individual light function was .49; the range of individual slopes was from .24 to .78 ($\sigma = .11$). Among the 18 subjects in the low group, mean slope of sound function was .39 (range, .18 to .56; $\sigma = .11$), and among the 18 subjects in the high group, mean slope of sound function was .42 (range, .23 to .60; $\sigma = .10$). Again, all slopes were computed by the method of orthogonal polynomials.

It would appear that the cross-modality equation of "sensory magnitude" is a process strongly subject to contextual effects and thus presumably not an absolute judgment of sensory quality. We suspect that the slopes of our light and sound lines are somewhat larger than usually reported (*1*, *6*; although see *7*), too, because of the context (a narrow range of stimulus values) in which they were obtained. Finally, the great variability among slopes of individual light and sound functions is worthy of note; such variability is not suggestive of a simple sensory process (*8*).

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2 August 1961

Coesite Discoveries Establish Cryptovolcanics as Fossil Meteorite Craters

Abstract. Discovery of coesite in St. Peter sandstone from the central uplift of the Kentland structure, Newton County, Indiana, and in shatter cones of Lilley dolomite of Middle Silurian age from the central uplift of the Serpent Mound structure near Sinking Springs, Ohio, proves that shatter cones are evidence of meteorite impact.

The association of the high-pressure silica polymorph, coesite, with meteorite craters is now widely accepted, a little more than a year after this important discovery by E. C. T. Chao and associates (*1*). Coesite has been found by these workers at Canyon Diablo (Barringer) Crater, Arizona, the Rieskessel of Miocene age in Germany, Wabar Crater in Saudi Arabia, Bosumtwi (Ashanti) Crater in Ghana, and at the artificial Teapot Ess Crater at the Nevada Proving Ground. This work has recently been summarized by Dietz (*2*).

Shatter cones, first discovered at the Steinheim Basin early in this century, have been associated with many cryptovolcanic structures by Dietz (*3*). Shatter cones are associated with six of these structures in the United States. Chao discovered a small fragment of shattered sandstone in the fallout at Canyon Diablo Crater (*2*).

Coesite was concentrated from a Serpent Mound shatter cone that weighed over 2 lb by dissolving the carbonate in hydrochloric acid. The residue was treated by methods described by Chao and co-workers (*4*). Sufficient material was recovered for petrographic identification and photomicrography. Small individual grains in the acid residue have a mean refractive index of 1.591 and show the strain characteristic of natural coesite. In the specimens collected the coesite content appears to be only 10 parts per million. An x-ray rotation photograph was taken of a hand-picked grain which gave the reflections for the 3.1-A d spacing, the strongest reflection of coesite. The x-ray diffraction spots were of low intensity; therefore it was assumed that coesite is present as small inclusions in the large grain. The refractive index of the grain is 1.560, and the grain is amorphous, as the only pattern on the x-ray film other than that of coesite is a diffuse halo. Core drilling of this uplift might yield material of higher coesite content.

The low coesite content in the Serpent Mound material prompted a field trip to the McCray quarry in the Kentland structure, 3 miles east of Kentland, Indiana. Coesite was detected optically in St. Peter sandstone and in breccia. The finest fraction (−320 mesh) from St. Peter sandstone (about 98 percent silica) was found to contain most of the coesite. The residue after hydrofluoric acid treatment consisted predominantly of zircon with smaller amounts of tourmaline and coesite. Table 1 shows the seven d spacings of coesite with which zircon and tourmaline did not interfere. In addition there are four coesite lines coincident with zircon and two with tourmaline. Comparison with Boyd and Eng-

Table 1. Comparison of x-ray diffraction powder data (d spacing and intensity) between Kentland coesite (as found in this study) and synthetic coesite (as found by Boyd and England, *5*).

Synthetic coesite		Kentland coesite	
d(A)	Intensity	d(A)	Intensity*
6.19	3		
4.37	2		
3.436	52	3.438	M
3.099	100	3.089	VS
2.765	8	2.77	W
2.698	11		
2.337	3		
2.295	6	2.29	W
2.186	4	2.18	W
2.033	6		
1.849	5	1.84	VW
1.839	3		
1.794	4	1.79	W
1.787	4		
1.715	9		
1.698	10		
1.655	6		
1.584	5		
1.548	6		
1.409	2		
1.345	6		

* Intensity: M, moderate; VS, very strong; W, weak; VW, very weak.