was a complex interaction between block, words, and sequence group ($P < 0.5$), which can be illustrated though not easily interpreted.

In Fig. 1, the average "off" duration for each presentation, for each group, and for each word is shown. Without burdening the reader with a detailed description of the illustration, four salient features may be noted. (i) There is a general decline of average "off" durations (Table 1); (ii) the increase of "off" durations at the onset of a different word was evident during the earlier trials and much less during the later trials; (iii) the initial average "off" duration associated with emotional words is greater than that for neutral words with the exception of the last trial; (iv) the initial response to a scrambled word was generally larger if the preceding word was an emotional word.

After an initial habituation by the first word, there was a partial recovery of the activation response with presentation of a different word. This result is completely consistent with previous findings. However, the average activation response to successive different words decreased. The initial recovery of activation when a different word was presented also decreased. These results are consistent with Sokolov's hypothesis. They show that habituation occurring over the series of different stimuli is not necessarily specific to a particular stimulus. The interpretation of this result as reflecting a generalized decline of response to all kinds of stimuli is not likely to be valid. The fact that one group of words from the start produced significantly briefer activation responses which remained briefer throughout the experiment reflects a differential response to that group of stimuli which could not occur on the basis of a generalized decrement of response to stimuli of all kinds. Previous research on the EEG has shown repeatedly that decrements of the activation response with repeated presentation are not due to generalized lowering of responsiveness such as might be produced by fatigue. In fact, the common interpretation of the decrement in responding after repetition of the same stimulus is that the decrement is specific to that particular stimulus. Our experiment does not indicate the extent of the class of different stimuli which are associated with briefer activation responses with repeated presentations. The subjects may be treating all "flashed words" as similar after a while, the specific response thus being reduced. However, this explanation assumes a decline of specificity, an increased generality, which is the point to begin with.

Though the response to the emotional words was similar to that given to scrambled words, the underlying process of activation may have been different. The emotional words, by reason of an overlearned autonomic response, could produce activation which would reflect some combination of the orienting and so-called defensive reflex. The response to scrambled words was perhaps due to a heightened orientation associated with the subjects' attempt to "unscramble" the words. All subjects reported this kind of activity.

In conclusion, habituation, defined here as a decrease in the duration of EEG activation, is not necessarily specific for a particular repeated stimulus (*6*). The complexities of the stimulus generalization which are implied await further research.

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1 March 1966

Monaco: The Shallow Continental Shelf

The water-covered sediments that have been deposited during past ages can be studied by coring (or boring) techniques. The results are limited to the small area where each of the samples is taken. Erroneous conclusions about a sediment situation may be made if the area sampled is not typical.

Detailed small-scale boring and coring efforts in a large area are seldom made because of the time and money required. For such situations seismic profiling offers an advantage, for a quick survey from a small, slowly moving boat can cover a large area in a relatively short time. However, the system is effective only where there is sonic reflection from the different layers of sediment; the layers that give a signal must be identified on the record.

The two sediment exploratory systems, coring and sonic profiling, are thus complementary. Profiling should be used first to map the area so that the cores can be taken in significant spots. Then the profiling data should be identified with the geological layers from the core sample. Next the extent of the layers established by the coring results should be extrapolated with the sonar to complete the survey.

The results we now report were obtained during a preliminary profiling effort that was made from the deck of the *Winnaretta Singer* in the bay out of Monaco. We used sonar and recording gear made available to Jacques Y. Cousteau's effort by the research committee of the National Geographic Society.

We now present one sample of a seismic profile to illustrate the detailed information obtained with a sonar boomer designed to utilize a short pulse without producing cavitation. We also call attention to a "knee" in the shelf off Monaco at a depth of about 110 m; the "knee" is clearly evident in the sonar record. Several layers become visible on the record when a short-pulse boomer is used; the slanted sediment layers can be identified some 100 m beneath the bottom.

The profile we obtained is shown in Fig. 1. The record (compressed about 10 to 1 in length) was made, with a precision boomer as a sound source, in an area east of Monaco harbor as indicated on the map (Fig. 2). A "knee" in the slope starts at a depth of 110 m (148 msec) and ends at about 150 m (200 msec). Similar knees are located at the positions marked on the map, and similar formations were found at about the same depth off Cap Ferrat near Nice and near Menton. We believe that the knee line runs along a considerable length of this coastline.

The sonar source that was used for this work was a special boomer excited from 48 microfarads at 3500 volts. A 4-mm aluminum plate was solidly

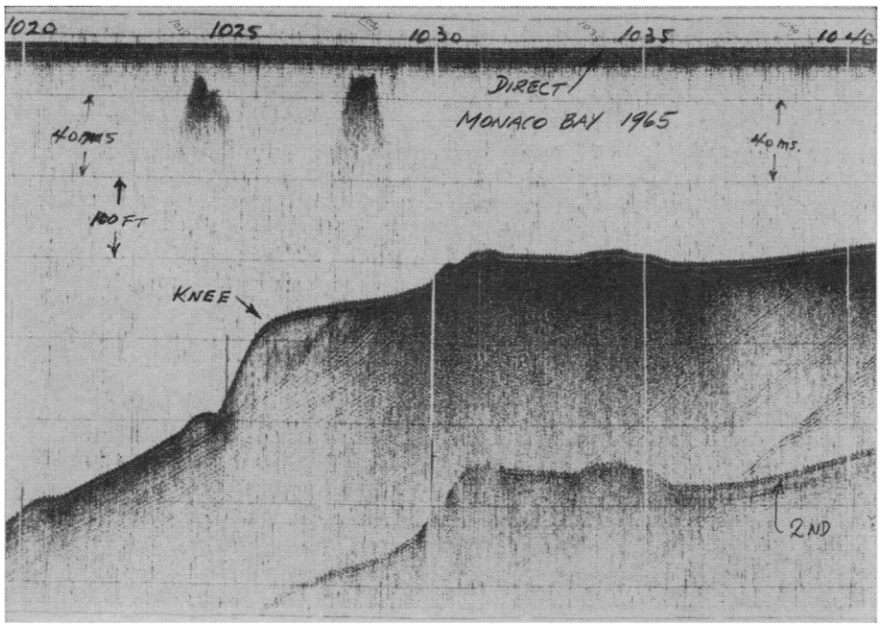

Fig. 1. Continuous seismic profile of 1.4 nautical miles (compressed about 10 to 1 in length, made with a high-precision boomer (300 watt-sec) having a pulse length of less than about 2 msec. See Fig. 2 for location and the line of travel. Ship speed, 3.5 knots.

bolted at the four corners; a central bolt and spring arrangement is usually used (*1*). The pulse length was less than 2 msec; the basic frequency was about 3500 cycles per second, which records as two half cycles, with a 1.7 msec spacing to show a thin, double-line record. There was no appreciable cavitation-bubble pulse from this transducer.

The boomer transducer (51 by 51 by 4 cm) was supported on a wooden frame which was held at a depth of about 30 cm along the side of the ship. A Chesapeake "8 ball" hydrophone was held at a depth of about 30 cm some 2 m off the bow and ahead of the bow wave by a pole. The hydrophone was rigidly mounted 4 cm ahead of a 20-kg fish-shaped weight which in turn was supported by a thin steel wire.

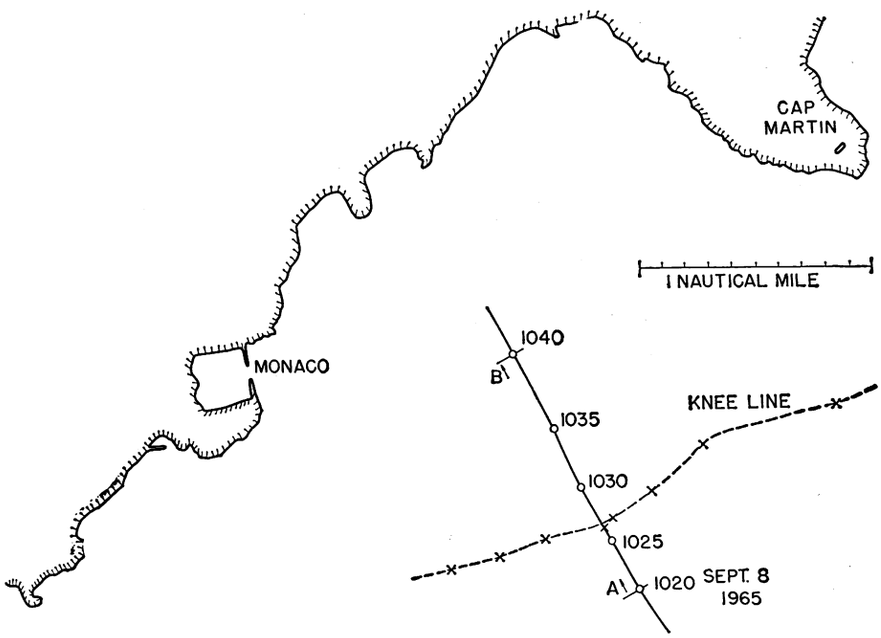

Fig. 2. Monaco Bay, showing the course of the ship that took the continuous profile of Fig. 1. The positions marked × show where the "knee" has been located.

The record of Fig. 1 was made at a ship speed of 3 to 3.5 knots. At higher speeds noise appears in the hydrophone and the sonar signal becomes weaker because air bubbles flow through the sonar transducer. At slower speeds the records are better.

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28 February 1966

Electrophoretic Variants in Enzymes

In "Electrophoretic variation in enzymes" [*Science* **149**, 936 (1965)], C. R. Shaw notes that in many systems the variants appear not to differ in biological activity, and this provides a puzzle in trying to explain their universality, since direct selective advantage and disadvantages then seem to be unlikely. It seems quite probable that, with organisms such as *Drosophila*, differences in optima and range of factors such as temperature and *p*H for the different variants would be sufficient to account for balanced polymorphisms of this type. In mammals temperature is presumably of far less importance, but it may not be unreasonable to think, for example, of differential enzyme efficiency as being partly dependent upon particular infective bacteria or viruses. We should also not forget the point stressed 12 years ago by Haldane, in *The Biochemistry of Genetics*, that enzyme polymorphisms may be important not only in relation to diversity of selection pressures in the environment but also to diversity of use in different tissues. As we now know, in the lactic acid dehydrogenase system of many organisms, tissue-specific needs are met by the five alternatives provided by a tetrameric enzyme with two different monomer building blocks. It is also relevant here to note that, as Bruce Wallace has suggested to me in discussion, some duplicate-locus monomorphic systems are likely to be derived in evolution from single-locus polymorphisms.

Although on the basis of present evidence these suggestions cannot be considered as other than speculative, there