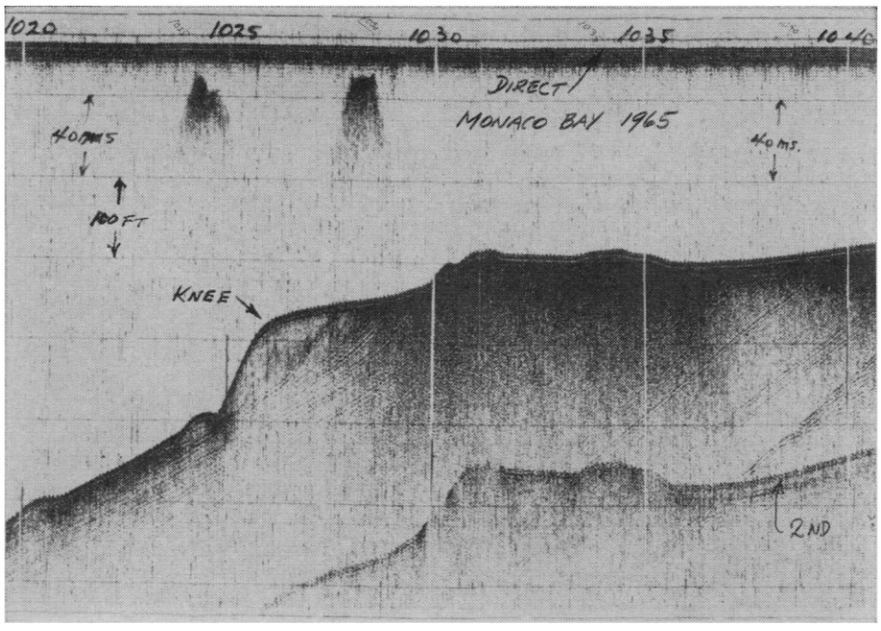

Fig. 1. Continuous seismic profile of 1.4 nautical miles (compressed about 10 to 1 in length, made with a high-precision boomer (300 watt-sec) having a pulse length of less than about 2 msec. See Fig. 2 for location and the line of travel. Ship speed, 3.5 knots.

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.

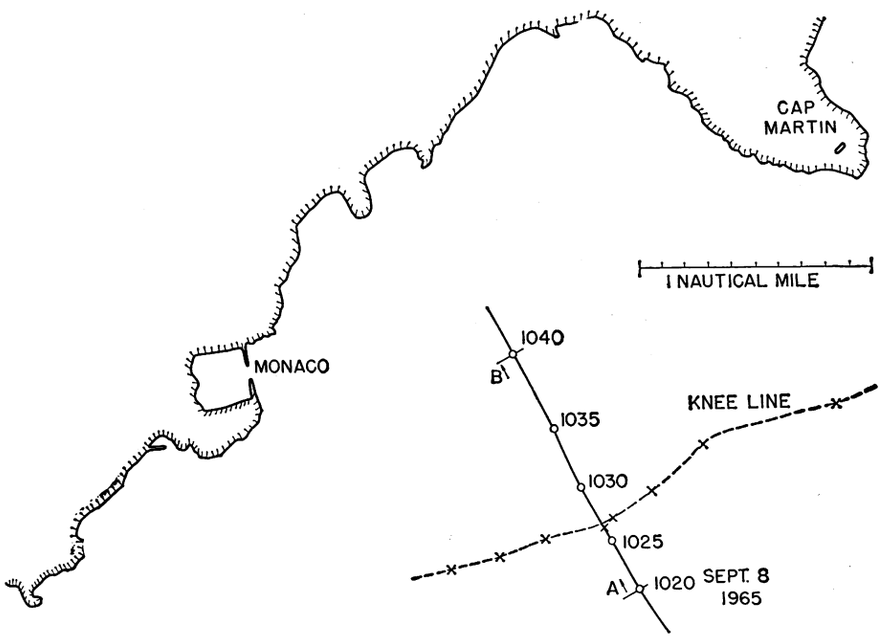

Fig. 2. Monaco Bay, showing the course of the ship that took the continuous profile of Fig. 1. The positions marked × show where the "knee" has been located.

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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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

is no reason to reject the view that, in general, selection is directly responsible for the maintenance of these polymorphisms. What is needed, of course, is not so much in vitro studies of enzyme activities as experimental evidence of selective differences between different genotypes.

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Dermo-optical Perception

In "Dermo-optical perception: a peek down the nose" (*1*) Gardner takes exception to my research on tactual color discrimination, on the grounds that the various subjects (particularly Mrs. Stanley) were able to see the stimuli through "nose-peeks" and were not making the judgments from sensations in the fingers and hands. Gardner's comments are made on an a priori basis, since he has never seen my apparatus or witnessed my procedure, although his article conveys the impression that he has. His article combines details from my mimeographed reports with assumptions for which there appears to be no basis. Mrs. Stanley is not a magician. She is a housewife who, by chance, was found to have some tactual discriminating ability when she was in high school in 1939, ignored it for 24 years, and consented to some experiments in 1963. During the experiments, Mrs. Stanley was carefully observed. She was required to put her arms into the box containing the stimuli through thick black sleeves fastened around holes in the box and tight around her wrists, and she wore a sleep mask. She could not, as Gardner suggested, have poked the stimuli up a sleeve and used a "nose-peek," nor could she have observed the test material as it was being placed in the experimental box. Nor did she keep up "a steady flow of conversation with the observers, asking for hints on how she is doing." Nor did careful and continuous observation "seem unnecessary." Also, her ability was observed and confirmed by Donald DeGraaf, chairman of the physics department of Flint College of the University of Michigan.

My hypothesis of "wavelength temperature" discrimination seems more tenable. That a wide range of electromagnetic wavelengths, including the visible and infrared, does penetrate mammalian skin to a significant depth is shown by various investigations (*2*). Oppel and Hardy (*3*) showed that human skin has different absolute thresholds for different ranges of electromagnetic wavelengths. The sensitivity threshold, apparently in terms of subjective "temperature," is lower for wavelengths longer than 3 microns, as measured in gram-calories per square centimeter per second. For wavelengths of 0.8 to 3 microns the threshold in the same terms is 50 percent higher. And for wavelengths of 0.4 to 0.7 micron, the visible wavelengths, the threshold is still higher, being 2.2 times the threshold value for 3 microns or greater.

In each of my reports (*4, 5*) I have stated as my hypothesis that the tactual discrimination ability evidenced by the subjects was a product or variation of the cutaneous temperature sense. This has now been confirmed by further experiments of mine (*6*) and independently by W. L. Makous (*7*). When color discriminations are made with the hands and stimuli in a light-tight experimental box, the differences between the stimulus objects are related to the differential absorption, reflection, and emission of infrared wavelengths. The energy comes from heat emission by the hands in the range of 4 to 14 microns (*3, 8*).

In the 1963 investigations Mrs. Stanley was successful in her tactual discrimination judgments (85 to 95 percent, $P < .001$) when the colored materials were covered with Wratten neutral density filters down to about 13-percent transmittance; also when colored materials were covered with 0.003-inch cover glass or with clear plastic about 0.010 inch thick. She was not successful (her judgments were at chance level) when the stimuli were covered with 1/16-inch picture glass; or when her finger temperature was below 24°C; or when plastic stimuli and her hands were under water at 32°C. Her judgments were also at chance level with bits of colored wood or pieces of colored sponge rubber. These results were obtained during 55 to 60 hours of testing in the summer of 1963. The subject was less successful, although her score was still above chance, when tested in January 1964, and was not successful on 20 April 1964 or during 3 days of testing in June 1964.

From tests of 133 women college students, done with bib-screen plus blindfold, I estimate that 10 percent of the female college population have the ability to make statistically reliable discriminations of colored stimulus materials when the stimulus materials are illuminated (*5*). The hypothesis is again temperature discrimination. On the grounds of "parsimony," such explanations as "ESP" have been rejected. "Telepathy" has been excluded by double-blind experiments.

In view of the information now available, it is difficult to see how Gardner's comments on my investigations have any basis in fact.

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14 March 1966

I found Gardner's critique of DOP refreshing, but I feel compelled to come to the defense of Richard Youtz and his experimental subject. Having been invited by Youtz last August to test Mrs. Stanley's powers, I had the opportunity to observe her and her performance.

Indirect evidence leads me to the conclusion that Mrs. Stanley is not trying to cheat. When discovered by Youtz, she had not been employing her presumed powers for profit, and she agreed to ignore any attempts at commercial exploitation (she has been approached by television people). She does indeed talk while trying to discriminate the colors with her fingers, asking how she is doing, talking also about day-to-day topics. This, however, appears to be conversation to lessen the tedium and discomfort of the sessions rather than persiflage to misdirect the experimenter. Observing her, one gets the impression that she is a personable but not at all extraordinary housewife.

Gardner remarks that he was "unsuccessful in persuading" Youtz to put a box over Mrs. Stanley's head during