The cultures of *Paramecium* supplied by Glaser appeared to be pure and, in so far as could be determined, were free from living yeasts or bacteria. They multiplied and remained actively motile for two months in the medium of Glaser and Coria.

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SPECIAL ARTICLES

DETAILED SURVEYS OF SUBMARINE CANYONS

IN recent years the United States Coast and Geodetic Survey have constructed charts which make it possible to draw contours of submarine canyons off both the east and west coasts with a considerable degree of accuracy.[1] These charts, however, fail to give many of the fine points which are desirable in obtaining an accurate appreciation of the form of these canyons. For example, they do not give the data necessary to determine the exact slope of the walls and gradients of the floors, nor do they show whether the floors contain small basin depressions and whether the tributaries come in at grade as do the tributaries of land river valleys. In order to obtain this additional information the writer has made surveys in canyons near La Jolla and Carmel, California, which are from 10 to 20 times as detailed as any ever constructed by a coast survey party. Also, because of the methods used, somewhat greater accuracy of positions should have been attained than is possible in ordinary surveys.

This work involved no complicated mechanism and required only a rowboat, so that any one with a rudimentary knowledge of surveying and some simple equipment may make the same type of chart of any submarine or sub-lacustrian topographic feature which might interest them. In this machine age it may cause some amazement to state that neither were any motors used in the work nor would they have been of any material assistance. The modern method of echo sounding could not have been used, since it does not give accurate depths where steep slopes are involved, nor does the method allow a high degree of accuracy of location. Using a boat with an engine would not have given the maneuvering ability which is possible with oars and was vital to this type of survey. Also, since it was only necessary to pull in the sounding lead once or twice in an hour and depths did not exceed 1,000 feet, a hand reel proved quite satisfactory.

A range system of surveying was used (Fig. 1). Sextant angles give accurate locations at sea if angles between three or more land objects can be obtained. Where two of the objects are in range and thus only one angle is necessary a greater accuracy is obtainable than where two angles between the three objects are necessary. Also with a range it is possible through previous determinations to tell how much of a change of angle is necessary in order to move the desired number of feet for the successive soundings in running a cross section and furthermore the range makes the section a straight line. These ranges were developed before running the lines by using shore objects located at the proper positions or if necessary planting flags or even buoys.[2] While running each of the lines developed by these ranges it proved desirable to make many checks on the position of the line by taking two angles.

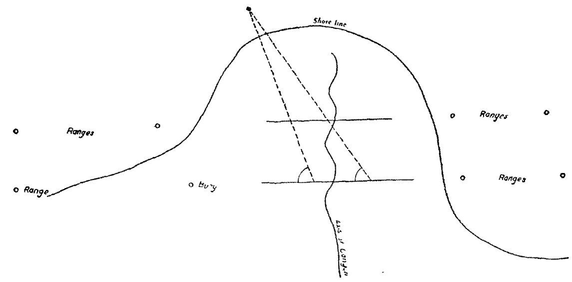

FIG. 1. Illustrating the method used in surveying the submarine canyons. Soundings were made at close intervals along these range lines and the exact positions obtained by taking angles to some shore object. In many cases it was not practical or possible to use ranges on both sides as are here indicated.

The soundings were made by running a wire with lead attached over the stern from the sounding machine and through a sheave hung from a small davit. The sheave had a depth indicator which operated like a speedometer. In making transverse sections of the submarine canyons the soundings were started on the shelf adjacent to the depression. After letting out the wire for the first sounding, it was not pulled in again, but the boat was rowed ahead trailing the lead and wire behind. Then before taking the next sounding the boat was backed till the wire became vertical and then the sounding made. Since most soundings showed an increased depth going down the side of the canyon the method was quite satisfactory and saved much time. Also in places where there were pinnacles or ridges on the canyon sides dragging the line served to detect their presence, where successive soundings might have straddled them. In a few places the lead caught on bottom and it was not always possible to free it, but this trouble was unusual, and out of almost 2,000 soundings off La Jolla not one lead was lost.

[1] The original survey sheets should always be used for this purpose, since they contain many more soundings than the published charts.

[2] A network of buoys may be used for this type of survey where it is run out of sight of land.

When the center of the valley had been crossed and soundings became shoaler, the lead was pulled in and the counter checked to see if the depth indications were correct. Then the boat was rowed over to the other side and the other half of the line was run in the same fashion. At the end of the second half of a line there was an opportunity to check the method at the point where the soundings crossed the same position as was obtained on the first half. Till some experience had been acquired it was sometimes found that the soundings did not check. This error was due either to the use of ranges which were either not sufficiently distinct or too closely spaced so that the boat could not be kept on a narrow line or it was due to insufficient backing of the boat before sounding to allow the wire to attain a vertical position. The use of a heavy lead helped eliminate the second of these sources of error and streamlining the lead proved to be some advantage.

The survey was carried on by a crew of three. One took the sextant angles and notes, the second took the soundings and the third rowed and kept the boat on range. The sextant reader increased the speed of operation and obtained some exercise by taking one handle when the sounding wire was reeled in.

Results of the Survey: It is not the purpose of the present paper to discuss the scientific results of these detailed surveys, but a few of the outstanding observations will be noted. Very steep slopes were found in both canyons, particularly in the one off La Jolla, where a maximum of 84° was measured on a 200-foot cliff. Outward from the canyon heads each section showed some increase in depth over those inside, so that no evidence of enclosed basins was discovered. Terraces, probably of rock, were found on the sides of the La Jolla canyon, and many ridges and hummocks of rock were detected on the sides of the Carmel Canyon. Tributaries entering at grade were found in both canyons.

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ACCESSORY HEARTS IN THE OYSTER

IN various animals, notably insects, certain blood vessels are specialized as pulsating organs which serve to pump blood into tissues either too distant from the heart to receive a rapid flow of blood or separated from the arterial system by capillaries. Such accessory hearts apparently have not been described in Lamellibranchs.

In oysters (*Ostrea gigas, O. virginica* and *O. lurida*) such structures may readily be studied, though they appear to have previously escaped observation owing to their location within the walls of the cloacal chamber. In a large specimen of *O. gigas* about 12 to 15 centimeters long they may be seen as a pair of elongated vessels on the inner surface of the mantle lobes which form the lateral boundaries of the cloacal chamber. At the posterior extremity of this chamber the two lobes of the mantle are united, forming a place of attachment for the posterior ends of the paired gills. The accessory hearts in a large specimen may be 2 to 3 centimeters long and extend from the kidneys (organ of Bojanus) almost to the posterior border of the cloacal chamber. At their distal ends each opens into the large blood vessel which runs completely around the corresponding mantle lobe. In the contracted state they have a diameter of about 1 millimeter, but when filled with blood they may be 5 millimeters or more in thickness. The pulsation consists of a wave of contraction beginning at the central, or kidney, end and traveling rather slowly distally.

The activity of these organs was best observed in specimens from which portions of the right valve had been removed, without damage to the underlying tissues. The border of the mantle grew back over the edge of the remaining shell, exposing the cloacal chamber and the accessory hearts. By looking through the cloacal chamber it was possible also to see the pericardium and count the beats of the heart. It was immediately obvious that the rhythmicity of the accessory hearts was entirely different from that of the heart itself, and that the two accessory hearts need not pulsate at the same rate.

The rate of pulsation of the three organs was measured by repeated successive counts of the time required for a given number of pulsations by each and the results for each organ averaged. A typical series averaged as follows: heart, 20.7 pulsations per minute; right accessory, 4.8 per min.; left accessory, 7.6 per min. Generally the left accessory beat more rapidly than the right, possibly due to the fact that the specimen lay in its left valve. It is probable that the rate of pulsation of the accessory hearts depends upon the rate at which they fill with blood. The above measurements show, at any rate, the independence of the three organs in initiation of pulsation.

Failure to observe the pumping activity of these organs has perhaps led to incomplete understanding of the circulatory system of at least some of the Lamellibranchs. These accessory hearts appear to be homologous to the gill hearts of Cephalopods, which are well known and which function to pump