rock formations. Near Croton-on-Hudson an excellent example of topset and foreset delta beds was seen. This delta was formed when the Hudson River stood at a higher level. While members were viewing the glacial delta, a small landslide occurred in the gravel bank. As the bank slid into the pond a small tidal wave was generated.

The unmetamorphosed Wappinger limestone of Cambro-Ordovician age was studied near the Pumping Station at Peekskill. Evidence for and against its correlation with the more highly metamorphosed Inwood limestone of the New York City area was discussed. Nearby, the Hudson River phyllite and the Canada Hill granites were studied. The party paused long enough on Bear Mountain bridge to study the gorge of the Hudson. Luncheon was served at Bear Mountain Inn. The bus party then ascended Bear Mountain and made a study of the general topography of the region. The return from Bear Mountain was made by way of the west shore highway and at Tomkins Cove the Wappinger limestone was again studied. Here the limestone stands at a high angle and shows the same stratigraphic relations with the Hudson River phyllite as were shown at and near the Peekskill pumping station.

Before returning to New York City the entire Bear Mountain group was entertained at a buffet supper in the home of Dr. Armin K. Lobeck, of Columbia University, in Englewood, N. J.

Saturday evening was spent visiting the various departments of geology throughout the city. The Geological Society of America House was also open to visitors, who were entertained by Drs. Charles P. Berkey and H. R. Aldrich.

The final excursions of the conference were held on Sunday. George F. Adams was the leader of a party that studied the glacial geology of Long Island. The knob and kettle topography of the Harbor Hill (Wisconsin) moraine, the scarp between the moraine and the outwash plain, and the Ronkonkoma moraine were the chief points of interest on this trip. Thomas W. Fluhr, of Columbia University, was in charge of a group that studied various engineering projects in New York City. Of special interest to this group was the fact that the New York pier and the anchorage of the George Washington bridge rest on Manhattan schist, but the New Jersey pier is on Triassic shales, and the New Jersey anchorage is on diabase. A fine sedimentary section was shown in and near the new Lincoln Tunnel under the Hudson River.

Dr. Robert S. Balk, of Mt. Holyoke College, led a group of nearly 100 geologists to view the area in which he has made a thorough study of progressive metamorphism of the Hudson River series. The trip began at Billings, New York, where, in the vicinity of Sprout Creek, black and greenish gray Hudson River slate shows numerous zigzag holds, fracture cleavage and is unmetamorphosed. The route of the trip was planned to pass from these unmetamorphosed pelites northward and eastward across the series to near Camby, where calcareous interbeds were studied. Here the limestone is finely crystalline, occurs as lenses, and is isoclinally folded and sheared. From Camby eastward, the characteristics of the series change. Biotite crystalloblasts make their appearance; then occurs a garnet zone, and finally a staurolite zone. Progressive metamorphism of the Hudson River series seems to have been well established and well illustrated by Dr. Balk. It was also the feeling of some of the members of this final trip that the more highly metamorphosed phases of the Hudson River series are closely similar lithologically to the metamorphosed rocks of the Manhattan area.

The thirty-fourth annual field meeting of the New England Geologists will be held in southern Vermont, with Dr. George L. Bain, of Amherst College, acting as host.

LLOYD W. FISHER,
Permanent Secretary

BATES COLLEGE

SPECIAL ARTICLES

SHIFTING BOTTOM IN SUBMARINE CANYON HEADS

THE writer has previously called attention to the slight shifting of the bottom observed in the heads of several submarine canyons along the California coast.[1] Since some skepticism was aroused in regard to the basis on which these shifts were reported, it seemed advisable to test the methods employed. Accordingly, soundings along ranges used for these comparisons were repeated on the same day. The results of these checks showed errors of negligible amounts. Even on relatively steep slopes the soundings could be repeated with a difference of not more than 0.2 fathoms (.35 meters) whereas changes of as much as 3 fathoms (5.46 meters) were observed when long intervals had elapsed. A further test was made by the running of a line in relatively deep water along the same range that had been used in 1934. Here, despite the extremely steep slopes which would make the most minute differences of position or variation in the vertical show up as large changes of depth, the comparison gives a very gratifying agreement (Section 3). This indicates both that

[1] F. P. Shepard, *Am. Geophys. Union Trans.*, pp. 221–223, 1936.

there has not been any appreciable change and that the method is accurate. Therefore it seems justifiable to conclude that sections run near shore along clear ranges can be used confidently to show changes of depth.

Changes in Scripps and Newport Canyons: Using the range method, soundings have been made in the case of Newport Canyon off Newport, Calif., in 1934, 1935 and 1937 (Section 1) and in Scripps Canyon near La Jolla in 1935 and 1937 (Section 2). Both of these canyons have heads coming into the shallow water near the coast. Altogether five sections were compared, three at Newport and two in Scripps Canyon. All these comparisons showed changes. Between 1935 and 1937 the changes were principally those of decreasing depth, indicating that there had been fill in both of the canyons. This is in contrast with the deepening which is indicated in the comparison between 1934 and 1935 at Newport. Previous soundings in Scripps Canyon which, unfortunately, were not based on the same ranges suggest that here also there had been deepening.

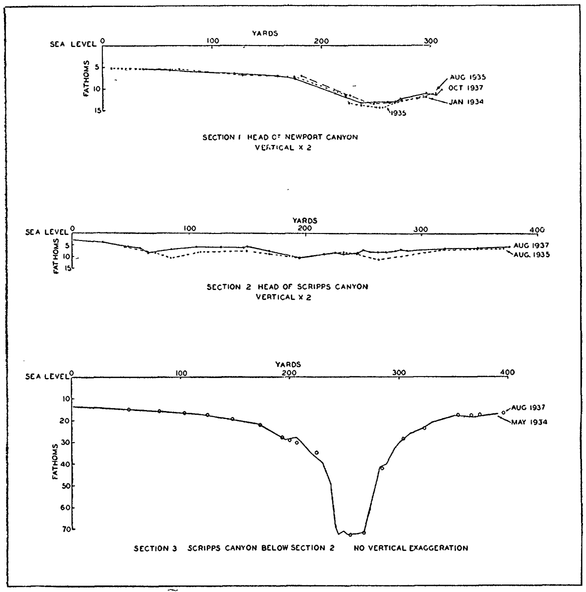

FIG. 1. Sections showing relation of old soundings along ranges to recent soundings at the heads of Newport and Scripps Canyons. Note that there has been deepening followed by fill in the case of Newport Canyon. Also note that the deeper section of Scripps Canyon shows no appreciable change except on the left hand side near the break in slope. In Section 3 the new soundings are shown by circles. Note that the first two sections have vertical exaggeration, while the third is true scale.

Shifting depths at Redondo Pier: The pier at the city of Redondo extends out into the head of a submarine canyon. Here considerable changes of depth are reported. Fill takes place gradually over a year or more and then deepening succeeds as a rapid process consuming not over several hours. The last observed deepening, which occurred in May of this year, changed depths of six feet to thirty-one feet. These changes took place during calm weather with only moderate-sized rollers. A previous deepening, however, had occurred during a sudden wind storm.

Significance of these depth changes: Several tentative conclusions seem to be warranted from the observations made to date. First, it is evident that the canyon heads do receive sediment from time to time, but that they remain unfilled because this sediment is subsequently removed. Secondly, the cause of the removal, judging from the Redondo Pier case, must be of the nature of a submarine slip or mud flow. Thirdly, the channels at the head of the submarine canyons appear to be subject to some moderate shifting in position.

It is still difficult to say how far down the canyon the depth shifts are transmitted. The available data in Scripps Canyon, part of which is shown in Section 3, do not indicate that it is very extensive. On the other hand, the shifting at the head may be more frequent and rapid, whereas there may be shifting of sediment at depth at long intervals. A case of such shifting is indicated in the Sagami Bay submarine canyon by the comparison of the soundings before and after the great earthquake.[2]

It is hoped that repeated checking of a number of sections in the future will make it possible to tell to what extent the deepenings are the result of unusually large waves and to what extent they are due simply to the flowing of muddy sediments down the canyon floor when the sediments have been deposited to such an extent as to exceed the angle of rest.

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TEMPERATURE AND STARCH-SUGAR CHANGE IN SWEET POTATOES

THE effect of temperature on the starch-sugar change in Irish potatoes is well known.[1] In sweet potatoes it has not been so completely studied, although it is known that sugar accumulates at the expense of starch at low temperatures and that this begins to take place at a higher temperature than in Irish potatoes. The work of Hasselbring and Hawkins[2] shows that sugar increases in sweet potatoes at 6° to 7° C. to a greater extent than at 12° to 30° C.

The present authors have completed a careful study of the physiological and chemical changes in sweet potatoes of the Triumph variety at controlled tempera-

[2] F. P. Shepard, *Jour. Geol.*, 41: 527–536, 1933.

[1] H. Müller-Thurgau, *Landw. Jahrb.*, 11: 751, 1882; C. O. Appleman, *Md. Agric. Exp. Sta. Bull.*, 167: 327, 1912; E. F. Hopkins, *Bot. Gaz.*, 78: 311, 1924.

[2] *Jour. Agr. Res.*, 5: 509, 1915.