cycadophytes are forms resembling *Nilssonia*. A plant that is conspicuous because of the size of the leaves, but that is never present in great numbers, is a species of *Macrotaeniopteris*. Ferns are represented by *Cladophlebis* and other genera.

The Colville group is less productive of fossil plants than the Nanushuk group, although a good collection was secured from the nonmarine Prince Creek formation three miles below Gubic, near the junction of the Anaktuvuk River with the Colville. *Sequoia*-like conifers are abundant, and dicotyledonous foliage is present in larger quantities than in any of the collections from the Nanushuk group.

The fossil plants of Naval Petroleum Reserve No. 4 are of special interest because of their bearing on the age of the rock formations that contain them. Originally almost the entire mantle of sandstones and shales covering the greater part of Alaska north of the 69th parallel was believed to be of Upper Cretaceous age, and was so regarded by F. H. Knowlton, who examined several fossil plant collections secured by earlier exploring parties (*2*). Knowlton formulated his conclusions from the few dicotyledonous leaves in the collections. He said that since dicotyledons did not appear until middle or late Cretaceous time, the presence of even one leaf fragment would show that the rocks are not older. If dicotyledons are present, he would reject all other plants as indicators of age (*2*).

Knowlton's elimination of all plants except dicotyledons as age indicators was done on the assumption that these plants did not appear on the earth until mid-Cretaceous time, which of course is not true. The fact that he knew of their existence in earlier rocks is shown by his list of plants making up the Lower Cretaceous Potomac flora (*3*), in which there are several dicotyledons. In his exclusive use of dicotyledons for correlative purposes, and the complete disregard of all other plants that might be present, he was ignoring the essential fact that dicotyledons are sometimes present in Lower Cretaceous rocks.

In distinguishing between Upper and Lower Cretaceous on the basis of plant remains, the criterion is mainly the relative abundance of dicotyledons and other plant types. In the Upper Cretaceous of the Yukon Valley and the Alaska Peninsula, for example, dicotyledons outnumber other plants by a proportion greater than three to one. In the Dakota group, which contains the largest of known early Upper Cretaceous plant assemblages, dicotyledons make up about 90% of the flora. Other Upper Cretaceous floras show a similar high proportion of dicotyledons, although they are not necessarily as high as in the two examples given here. However, in the Nanushuk group, where dicotyledons are scarce or absent entirely, the proportion is no greater than in the lowest member of the Potomac group (the Patuxent) where dicotyledons make up an approximate 5% of the flora. If by chance one were to happen only upon those localities in the Nanushuk group where there are no dicotyledons, evidence of Jurassic age would be as strong as Cretaceous. In view of the few dicotyledons that are present in the group, Lower Cretaceous age practically amounts to certainty.

The plants collected from the Colville group are insufficient to characterize it definitely as either Lower or early Upper Cretaceous, but the absence there of cycadophytes and *Podozamites*, and the presence of more dicotyledons, indicate a later floral development than that revealed in the Nanushuk group.

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Nomographs for Determining Seiche Periods

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Small variations of water level can be measured accurately; nevertheless the limnologist must still compute the theoretical seiche period. Seiches are found on all lakes but because of their small amplitude may escape notice. Seiches may be very significant in current analysis and to the ecologist. The nomographs (Figs. 1 and 2) express the seiche period in minutes or hours, and are based on Merian's formula, which was simplified by William Thompson (*1*). The formula is expressed as

$$t = \frac{2L}{\sqrt{gh}},$$

where t = seiche period in seconds; L = length of the center line along the seiche axis in feet; g = gravity (32.16 ft/sec/sec, 41° Lat.); and h = average depth of the basin in feet.

For an accurate computation this formula must be applied to small increments along the seiche axis (integration by approximation), but in many cases the average depth, for a small lake, will give a sufficiently accurate estimate.

A sample computation, using Fig. 1, for Lake Erie is given. The center line through the lake is 213 miles long (top line), and the average depth is 61 ft (bottom line); a line drawn between the two points shows a period of about 14.2 hr on the diagonal line, a value which agrees with computations made by Endros (*2*) and Olson (*3*).

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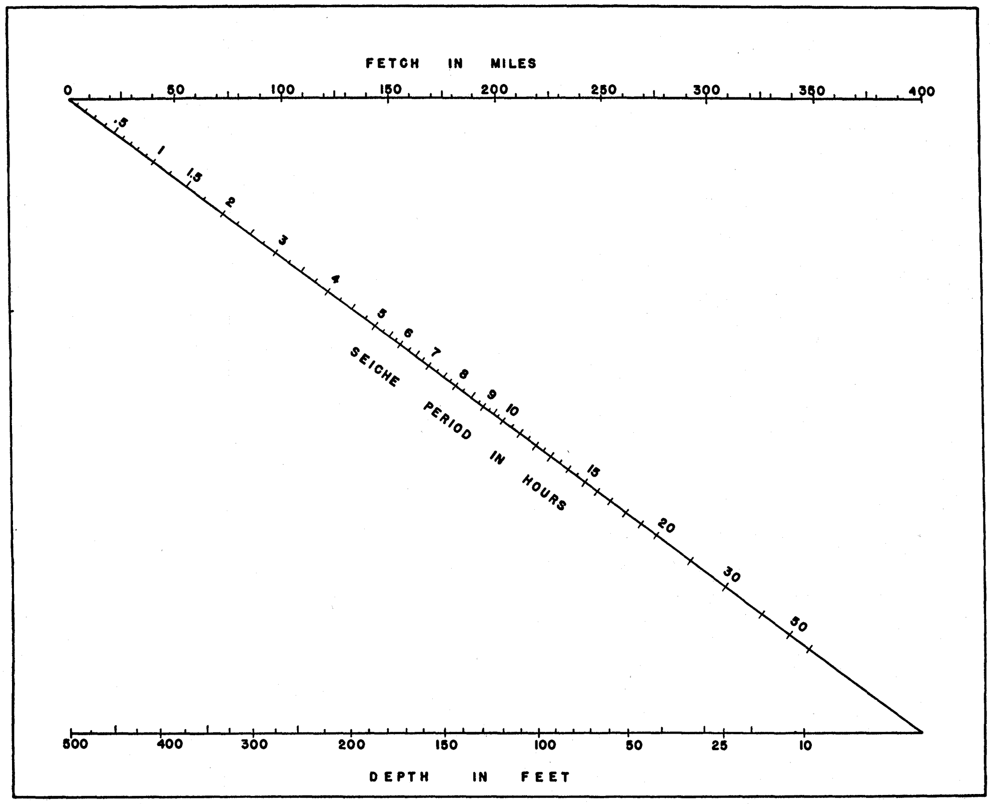

FIG. 1. Nomograph showing relationships between length, depth, and seiche period for very long or very deep lakes.

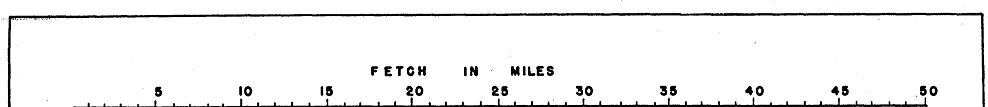

FIG. 2. Nomograph showing relationships between length, depth, and seiche period for short or shallow lakes.