because this is legally a part of that province. Canada includes this water area in its total area, because Ontario is a legal part of the Dominion. They rest their case convincingly on the Quebec Act of 1774; the Treaty of Paris of 1783; the Constitutional Act and an Order in Council in 1791; the Union Act of 1840; and the British North America Act in 1867.

The Great Lakes region between the international line and the southern shore of the Great Lakes is a part of the United States and should be included in its total area, by virtue of the Treaty of Paris of 1783.

The Great Lakes region between the international line and the Michigan shoreline of the Great Lakes is within the boundaries of and constitutes a part of the State of Michigan, by virtue of the Ordinance of 1787; Act of Congress for the division of Indiana Territory, 1805; Act of Congress, June 15, 1836, admitting Michigan to statehood; and three Supreme Court decisions (270 U. S. Rep., p. 295; 272, p. 398; 297, p. 550–552).

The proposition that title, jurisdiction and proprietorship of the land under the waters of the Great Lakes is in the adjoining states is recognized and established by the following authorities: *Illinois Central Railroad Co.* v. *People of the State of Illinois,* 146 U. S. Rep. 387; *Murphy* v. *Dunham,* 38 Fed. Rep. 503, Eastern District of Michigan, Brown J.; *Bigelow* v. *Nickerson,* 70 Fed. Rep. 113, 7th Circuit Court of Appeals; Attorney General's Opinions, Volume 6, page 172.

The foregoing citations were given us by the Honorable Edward Gearing Kemp, former Assistant U. S. Attorney General, now chief counsel of the Budget Bureau at Washington. This eminent jurist, after reading the entire correspondence with the Federal bureaus, commented that the "old method of reporting water areas is obviously misleading, and in my opinion, inaccurate."

We have no quarrel with the Census Bureau. Their task is vast and tedious and its difficulties too little appreciated. They have gone forward, in many ways, since the time of Gannett, as they say. Nevertheless, their attitude toward this Great Lakes question gives grave room for suspicion that they need a speedier adjustment to this fast-moving world. Why should they, at a time when this continent is leading the earth in countless ways, hark back for precedents to the chaos of old-world geography, where boundaries are about as permanent as the wake that a ship leaves in the water? Above all, why do this in relation to the great transcontinental boundary of North America, the fixity of which marks a new epoch in history, is the envy of the world and a model for the future?

If the Bureau of the Census persists in being concerned exclusively with statistical involvements, and the General Land Office to be interested in nothing but land areas, and the Geological Survey is motivated chiefly by a desire to cooperate with the foregoing agencies, where is the world and its reference books to look for the answer to the simple arithmetical question: What is the total area of the United States and the Great Lakes States? At present, the prevailing inaccuracies are a shadow on the record of the Census Bureau.

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SCALE CURVES IN CARTOGRAPHY

IT is well known that a sphere can not be mapped upon a plane with a uniform scale. Various types of maps are faithful with respect to angles or areas or geodesics, but not to all of them. In the Mercator projection, the scale varies from latitude to latitude. In a general conformal map, the scale varies from point to point (and therefore is a function of the latitude and longitude).

However, if the mapping is not conformal (angles not preserved), then the scale necessarily depends not only upon the point but also upon the direction. Hence the situation is essentially non-isotropic.

We define a *scale curve* as a locus along which the scale does not vary. In the conformal (or isotropic) case, we have merely ∞^1 scale curves; whereas in the non-conformal mappings, we have ∞^2 scale curves. In all conformal maps, the scale curves form a simple family; but in all non-conformal maps, the scale curves form a doubly-infinite family.

Among the famous non-conformal maps are azimuth equidistant projection, azimuth equi-area projection and the various gnomic and orthographic projections. For each of these, the scale varies in a complicated way not usually described geometrically but only analytically. A faithful graphical representation would involve the construction of the double infinity of scale curves. We study these curves (all of which are complicated) in detail. We prove that no mapping of the sphere exists with ∞^2 straight scale curves. *A new class of surfaces is discovered with straight scales.*

The two most famous conformal maps of the sphere are the Mercator projection (1560) and the stereographic projection, essentially known to Ptolemy (150 A.D.). In the former case, the ∞^1 scale curves are parallel straight lines, and in the latter case, they are concentric circles. We prove that these are the only maps where the single infinity of scale curves forms an isothermal family (connected with the Laplace equation). They are also the only maps where the scale curves are parallel. If we demand that the scale curves (in a conformal map) be straight lines,

the unique solution is the Mercator projection. On the other hand, if the scale curves are circles, the only solution is stereographic projection.

In the most general conformal mapping of a sphere upon the plane, the scale function is never harmonic; but it may be a function of a harmonic function. We prove that this phenomenon occurs only in the stereographic and Mercator projections.

The double infinity of scale curves which we find for the general non-conformal mapping of a sphere (or any surface) has special geometric properties. If we consider the curves of the family passing through a fixed point, the locus of centers of curvature is necessarily a *cubic curve*. In a particular case this locus becomes a straight line, that is, the scale curves form a velocity family. This can happen only for a certain class of surfaces, which will be described in detail elsewhere.

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VITAMIN C FROM EVERGREENS

IN the interesting and informative letter by B. Shishkin to the American Association of Scientific Workers published in a recent issue of SCIENCE[1] there is a description of the search by Soviet botanists for a plentiful supply of vitamin C.

> Quite recently it was discovered that needles of ordinary pine trees contain large quantities of vitamin C. . . . During the long siege of Leningrad lack of vitamin C made itself particularly felt, and the decoction made from pine needles played an important role in the prevention of scurvy.

This is an interesting example of the rediscovery by modern scientists of a fact known to a primitive civilization. Francis Parkman,[2] in "Pioneers of France in the New World," written in 1865, describes the trials of Cartier and his men during the winter encampment of 1535–36.

> A malignant scurvy broke out among them. Man after man went down before the hideous disease, till twenty-five were dead, and only three or four were left in health. The sound were too few to attend the sick, and the wretched sufferers lay in helpless despair, dreaming of the sun and the vines of France. The ground, hard as flint, defied their feeble efforts, and, unable to bury their dead, they hid them in snow-drifts. . . .
>
> Cartier, walking one day near the river met an Indian, who not long before had been prostrate like many of his fellows with the scurvy, but who now, to all appearance, was in high health and spirits. What agency had wrought this marvellous recovery? According to the Indian, it was a certain evergreen, called *ameda*, (a spruce, or, more probably, an arbor-vitae), of which a decoction of the leaves was sovereign against the disease. The experiment was tried. The sick men drank copiously of the healing draught,—so copiously indeed that in six days they drank a tree as large as a French oak. Thus vigorously assailed, the distemper relaxed its hold, and health and hope began to revisit the hapless company.

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SPANS TWO CONTINENTS

AS a result of extensive studies I have discovered that Hokan, an American Indian language spoken in California and other parts of North America, extends to South America. Hokan previously had been found to extend only as far south as the Subtiaba language of the Pacific slope of Nicaragua, Central America. Evidence for this discovery has been put in the form of a report to the Bureau of American Ethnology which demonstrates the affinity of Hokan to Quechua, an American Indian language spoken in Peru and adjacent parts. This affinity was discovered to comprise completely the phonetics and morphology, and to the identity with Hokan of 258 Quechua words. Quechua wi-qe, tear, is found for example to mean eye-water, and to be composed of wi-, eye, compare Pomo ui, eye, and -qe, water, compare Pomo -xa, water.

JOHN P. HARRINGTON

BUREAU OF AMERICAN ETHNOLOGY

SCIENTIFIC BOOKS

STRUCTURAL GEOLOGY

Structural Geology. By MARLAND P. BILLINGS. 473 pp. 336 text figures. 19 plates. New York: Prentice-Hall, Inc. 1942. $4.50.

THIS carefully designed and executed new text devotes sixteen chapters (331 pages) to structural geology, grouped as follows (chapter numbers in parentheses): Mechanical principles (2); Folds (Description, 3; Field study and representation, 4; mechanics and causes, 5); Failure by rupture (6); Joints (7); Faults (Description and classification, 8; criteria for recognition, 9; thrust faults, 10; gravity or normal faults, 11); Secondary foliation and lineation (12); Unconformities (13); Salt Domes (14); Plutons (15); Granite tectonics (16); Extrusive igneous rocks (17).

[1] B. Shishkin, SCIENCE, 97: 354, 1943.

[2] Francis Parkman, "Pioneers of France in the New World." Little, Brown and Co., nineteenth edition, p. 194, 1882.