

LEVEL OR FLAT?

GEORGE D. HUBBARD,

Oberlin College

I have been annoyed sometimes by the use of the words "level" and "flat." They are too frequently used synonymously or at least, flat is too often used where level is the correct word.

This discussion, I think, can be started at a place where all will agree. According to Huxley's *Physiography*¹ level means parallel with the surface of the sea. Sea level is a familiar term, and, barring many little technical differences as to just what to adopt as sea level for a datum plane in surveying, men will agree with Tarr,² Hobbs,³ and Salisbury⁴ that "level is a curved surface." Tarr and Martin⁵ make a point in a special paragraph that "sea level is a curved surface, conforming closely to the oblate spheroidal form of the earth." They also state that the ocean floor is in the main level, and they explain that they mean that it is roughly parallel to the surface of the sea—a curved surface. While the matter is not always so clearly and fully stated, in most books in our fields level seems to mean parallel with sea level. In many books too, the earth's surface is said to depart from level by the flattening at the poles, or to be less level, less convex, or less rounded toward the poles.

Some authors point out that "horizontal" is parallel with sea level or the sea surface, or that it is at right angles to the perpendicular. Others say that "level" is at right angles to the perpendicular or to the earth's radius; some add "at right angles to any radius or to all radii."

Dictionary definitions are derived from usage. Webster's *International* gives literal and figurative definitions and the

¹*Physiography*, T. H. Huxley and R. A. Gregory, pp. 214-215, 349-350. Macmillan and Company, London, 1905.

²*The New Physical Geography*, R. S. Tarr, pp. 9, 179. The Macmillan Company, New York, 1904.

³*Earth Features and Their Meaning*, W. H. Hobbs, p. 245. The Macmillan Company, New York, 1931.

⁴*Physiography*, R. D. Salisbury, pp. 400, 707. Henry Holt and Company, New York, 1913.

⁵*College Physiography*, R. S. Tarr and Lawrence Martin, pp. 640, 644. The Macmillan Company, New York, 1914.

first group all involve horizontality, rectilinearity, or equipotentiality as to gravity.

With this unanimity of usage and definition it ought not to be difficult for physiographers and geologists to be reasonably consistent in the use of "level."

The term "flat" may be made as valuable as "level" has become if we were willing. I turn to the Thesaurus and find the whole discussion of when to use flat centers on flatness as opposed to convexity, protuberance, and roundness. In geometry a flat surface and a plane are used synonymously, and a flat surface can stand in any position with reference to the perpendicular. In usage it has nothing to do with perpendicular, or with horizontal, or with gravitation. It may be as smooth as a level surface but it is not level. It may be thought of at times as tangent to a level surface but never coincident with it.

With reference to drainage, flat and level have meaning. A level surface cannot be drained because it is everywhere at right angles to the perpendicular; there is no grade, no slope, no difference of potential as to gravity. A flat surface of land must be tangent to the sphere or to a level surface at some point. It drains with ease because the potential upon it increases everywhere toward that point of tangency. Suppose the position of a flat surface were that of tangency of the earth, and at right angles to our radius. It could not be at right angles to any other radius. With reference to the earth's surface, the level surface, it would rise on all sides or in all directions from the point of tangency.

Six such flat surfaces tangent to a sphere and placed at radii equally spaced, 90° apart, would constitute a cube. The edges of such flat surfaces inclosing the earth would make dihedral angles of 90° , mountain crests rising 1,300 to 1,400 miles high with slopes of 45° ; and the trihedral angles of the circumscribed cube would be still higher. On an earth of the size of ours, bounded by six flat surfaces, our seas, if uniformly distributed, would be six similar deep seas and there could be no communication between the several seas until much leveling had taken place. No doubt gravity would manage most of the leveling.

This study resembles two others that only need to be suggested. The first may be approached by the question, "Do you go uptown or downtown? up to Cleveland or down to Cleveland? up or down to Cincinnati?" In the use of maps

do you describe everything as "up" that is toward the top of the map, or even toward the north? Do you go down the Atlantic coast and down to South America? up to the north pole or Greenland? One might go up or down stream but not up north or down south. Let's get over such unscientific statements.

The second is equally obvious when indicated. Do you say, in pointing to a map illustrating your talk, "The waterfalls are right here?" Why not say, "up the river 9 miles from Columbus." One still might then point to Columbus and Hayden's Falls on the map without affirming that they have been brought into captivity or spread upon the wall.

One might here open the discussion of the use of the terms "plane" and "plain" in physiographic description. If plains are due to degradation or to aggradation most of them are more or less level and not flat. The geometers have reserved "plane" for flat surfaces. Let us let them have it. I do not care to push this point further today, even in the interest of more exact scientific expression.
