

GEOGRAPHIC PRINCIPLES AND RELATIONSHIP SEQUENCES

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One of the major problems in teaching elementary college geography is the development of the beginner's ability to reason logically. All too often the student merely memorizes explanations without understanding them; consequently, he is unable to apply them in other similar situations.

A partial remedy for this condition lies in the listing of basic principles, but a thorough understanding of relationships may be attained only through a study of cause and effect sequences. These may be presented conveniently by means of diagrams which permit easy visualization of the explanations. At the left side of each diagram are placed statements of fundamental principles which, for the most part, are laws of physics or facts from other natural sciences and from mathematics. At the right of these and connected to them by lines which indicate relationships are facts of lesser importance resulting from the general principles or representing applications of them. From these, in turn, are derived facts of a third order of magnitude and so on until the complete sequence of cause and effect has been plotted for various observed geographic phenomena.

One advantage of this system is that it permits the representation of complex relationships. For example, several basic principles may be required to explain one secondary fact, and this, in turn, may exert a causal influence upon several phenomena of tertiary importance. The plan is applicable in varying degrees to the different classes of geographical material. In meteorology, climatology and soil science, the basic principles of which are well known, it functions very well. In land-form studies it encounters some difficulties, due to the impracticability of determining experimentally the causes of some observed phenomena. And finally, in the investigation of cultural landscapes it should be used with

caution and the statements duly qualified, for, here, we are dealing not only with natural processes but with the little-known field of human motives.

Before constructing a diagram, it is necessary to isolate basic facts, some of which may be stated as follows:

1. The earth rotates.
2. The earth revolves about the sun.
3. The inclination of the earth's axis is constant in amount and direction.
4. Great circles on the same sphere always bisect each other.
5. Moving masses travel in straight lines with respect to points in space unless acted upon by external forces.
6. The sun's rays become progressively less direct poleward from the vertical ray.
7. The energy imparted by rays of sunlight becomes progressively less concentrated with increasing deviation from the perpendicular.
8. Other conditions being equal, the effect of insolation varies with its duration.
9. Gases and liquids expand when heated and become less dense; contract and become more dense when cooled.
10. The moisture-carrying capacity of a given space (with or without air) increases with rising temperatures and decreases with falling.
11. The specific heat of water is greater than that of land or rock which, in turn, is greater than that of air.
12. Air moves from areas of high pressure to areas of low; it descends in highs and ascends in lows.
13. The steeper the pressure gradient, the stronger the wind.
14. Like pressure areas attract each other; unlikes repel.
15. Ascending air expands and cools; descending air is compressed and becomes warmer (adiabatic).

In addition, we may recognize the following as some of the basic principles affecting landform development:

1. Under identical conditions soft rocks weather and erode more rapidly than do hard.
2. The height of the land above base level determines the maximum possible relief.
3. Running water tends to maintain a balance between carrying capacity and load.

For cultural geography three principles seem to form the starting points for the various relationship sequences. They are:

1. The essential requirements for human existence are food, water, shelter and, in some climates, clothing.
2. Man regulates his activities to conform to what he *conceives* to be his own best interests.
3. People as groups ultimately attain a more or less satisfactory adjustment to their environment with the result that certain human activities the world over characteristically are associated with definite physical landscape complexes and economic conditions.

To illustrate a relationship sequence, we may consider the causes and effects of the deflection, with respect to the compass directions, of moving masses. The starting point is the principal that the earth rotates. Because of this fact, any parallel and meridian intersecting at a point *not on the equator* rotate about that point with respect to directions in space, the rotation being clockwise in the southern hemisphere, counterclockwise in the northern. But, to introduce a second basic fact, moving masses travel in straight lines with respect to points in space unless acted upon by external forces. Therefore, moving masses, although following straight courses in space, trace curved paths on the earth because of the constantly changing directions of parallels and meridians. One of the numerous phenomena which result from this deflection is the diversion from due north-south courses of the winds of the planetary circulation, giving rise to southwest-

erlies, northwesterlies, northeast and southeast trades and polar northeasterlies and southeasterlies. A further result is the determination of the width of these wind belts, the limits being set by the complete elimination, due to deflection, of continuous north-south motion.

Another phenomenon dependent upon deflection is the circulation of ocean water. In this case, however, supplementary lines of reasoning are necessary for a complete explanation. These lines originate in the basic facts of the existence of friction and the density changes of gases and liquids when heated and cooled. The prevailing wind directions in middle latitudes and in the trade wind belts must be considered also.

One variation of the method outlined above is especially suitable for representing the complex interrelations of soil characteristics. A few important soil properties serve as the starting points for the relationship sequences which extend through several stages and include numerous cross-connections. As an illustration, one sequence would be: Coarse texture—high permeability—good internal drainage—low water table. Good internal drainage also results in good aeration—low specific heat—warm soil. Good aeration gives rise to two other branches of the diagram: 1) rapid soil weathering—abundant plant nutrients; and, 2) nitrogen fixation by bacteria on the roots of legumes. Another minor series is: High permeability—small run-off—slight erosion. A second major sequence is: Adequate lime content—sweet soil—numerous earthworms—high humus—dark color—high absorption of insolation—warm soil. This latter series has many branches which can be represented adequately only by means of a diagram too large to be reproduced in this study.

Diagrams of the type described in this paper may readily be constructed to meet individual needs and should prove extremely useful as reference material for students of elementary geography, meteorology and conservation.