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LINKS BETWEEN PHYSICAL AND HUMAN GEOGRAPHY: A SYSTEMS APPROACH

Robert Kates

Introduction

This is a position paper in physical geography presented by a social scientist currently engaged in psycho-geography. I believe that I find myself here in good company.

It ought to be helpful to define the base of preference, bias, and assumption on which my position rests.

First, I am not now, nor have I ever been a physical geographer.

Second, I am a geography-is-what-we-do adherent, a definitional coward, and a field delineation pacifist. What do we geographers do? Pattison said it well (Pattison, 1964): we study nature over the earth, focus on area or region, or thematically consider man-in-nature or man-in-space.

Third, my personal preference is for the man-in-nature problem (slightly expanded as man-in-environment). In so doing I acknowledge the less-equal-than-others position of Taaffe (Taaffe, draft) and regulate myself to a minority recognizing man-in-space as the dominant theme of the profession. If labels are desired, I would even answer the role call of environmental determinists, if by environment you would include the world as sensed within peoples' heads.

Fourth, to add to my shameful posture, I confess an inordinate attraction to system analytic thinking, finding therein not only the new jargon of the cognoscenti but a useful set of organizing concepts as well.

It is my intention to demonstrate this form of thinking and analysis in what follows.

Four Thoughts for an Introductory Course

There are four notions that I want to communicate to students in an introductory course and particularly in the physical geography section. They are:

1. The connectivity between phenomena, the interrelatedness of things on the earth.

2. The complexity of phenomena, a close look at almost anything reveals our ignorance of place and process.

3. Paradoxically for the foregoing, rudimentary knowledge of some general principles and distributions can explain a great deal about what is found where, on earth.

4. Physical geography is not simply earth science but must be related to human geography. The traditional man-land relationship might more accurately be viewed as the complex interaction between natural and human systems.

Given these four notions, I begin with a large system, global in character. I have chosen the hydrologic cycle, but others might consider the energy cycle, ecosystems, or some other global system. I chose the hydrologic

HYDROLOGIC CYCLE

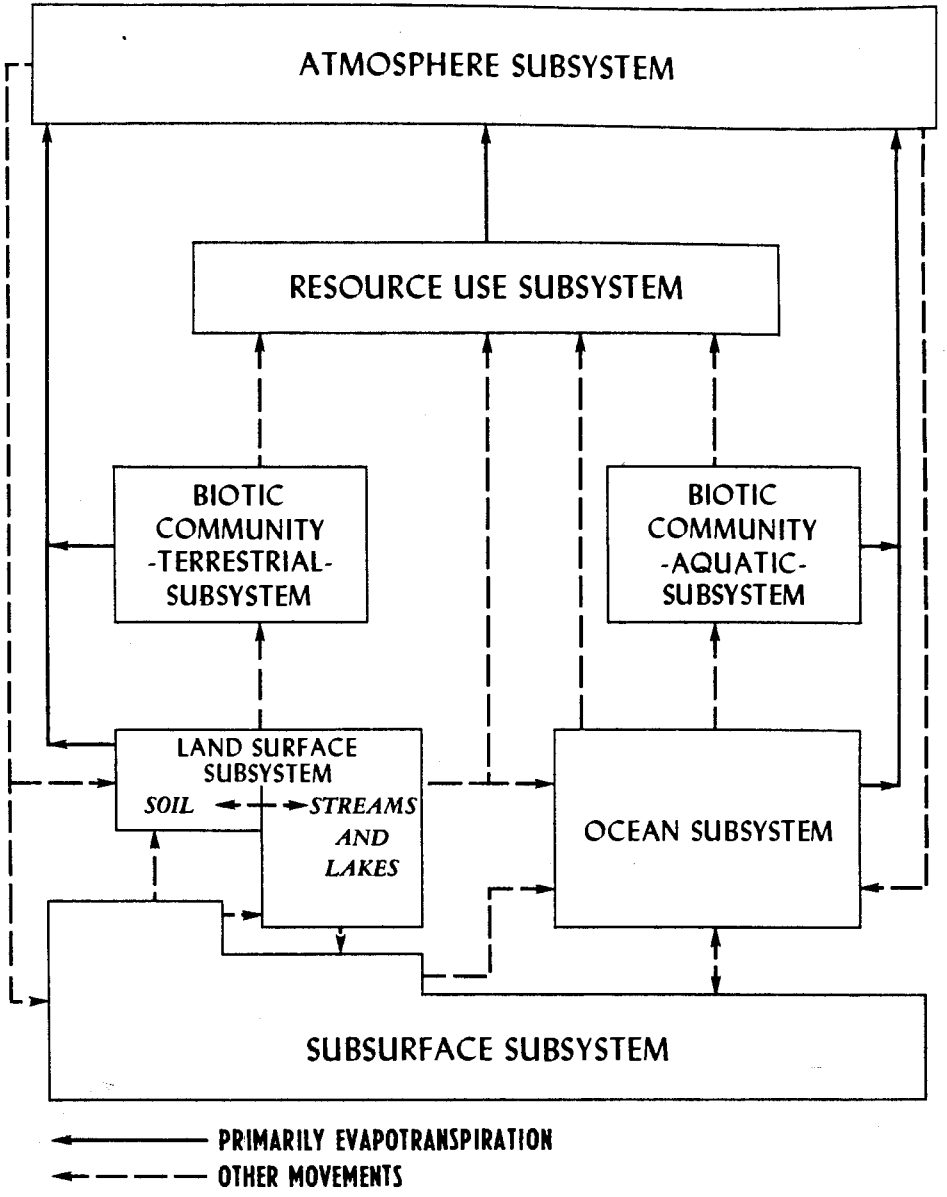
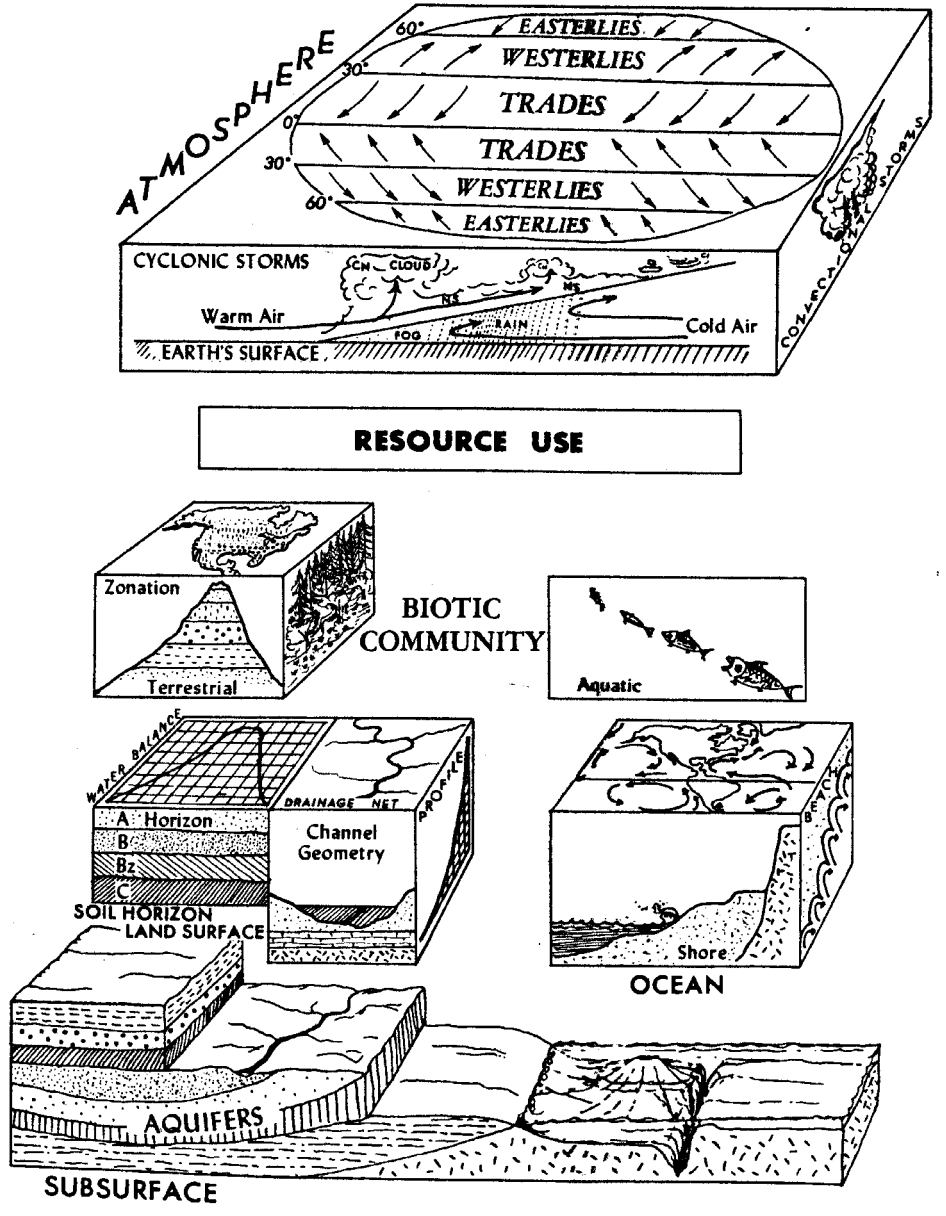


Fig. 1


ATMOSPHERE
60°
EASTERLIES
30°
WESTERLIES
0°
TRADES
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TRADES
60°
WESTERLIES
EASTERLIES
CYCLONIC STORMS
CLOUD
Warm Air
Cold Air
RAIN
FOG
EARTH'S SURFACE
RESOURCE USE
Zonation
Terrestrial
BIOTIC COMMUNITY
Aquatic
WATER BALANCE
DRAINAGE NET
PROFILE
A Horizon
B
Bz
C
SOIL HORIZON
LAND SURFACE
Channel Geometry
BEACH
Shore
OCEAN
AQUIFERS
SUBSURFACE

Fig. 2

and lakes and between land and fresh water surfaces. I would introduce the water balance here to illustrate the complexity and generality of evaporative processes and to relate structure, texture and process of soil formation to the overall system. The need to specify a soil moisture holding capacity for the water balance leads naturally into a discussion of texture and structure and the passage of water through the soil provides an opportunity to discuss percolation, leaching and the relationship to different zonal soils.

In the discussion of streams and lakes the broad generalizations related to drainage nets, profiles, and channel geometry can be introduced along with the complex problem of answering other deceptively simple questions of why streams meander or why braided streams braid.

The Subsurface Subsystem

Water as groundwater provides the opportunity of introducing the student to subsurface phenomena, major types of rock formation, tectonic processes and the like. Aquifers can be used to illustrate the variability of rock type and the complexity of underground formation.

The Biotic Community Subsystems

I would probably spend less time on the aquatic community than the terrestrial one, but this might be a convenient place to introduce the concept of a food chain. The terrestrial biotic community could be used for a unit on zonation: vegetational (within a forest community), vertical (on a mountain), and continental (within the U.S.). These zonations can be directly related to the interplay between the atmospheric and land surface subsystems.

The Resource Use Subsystem

Here a new set of relationships are introduced for the resource use subsystem is a point of major intersection between natural and human systems. I have tried to sketch this intersection in Figure 3 with the resource use in a horizontal plane and the hydrologic cycle in a vertical plane.

The resource use subsystem employed in this schema is a generalized economic geography of the production process. Productive inputs of land, labor and capital are combined in the three traditional sets of functional economic processes. Note that alternative systems could be used as well. Kinship systems, land tenure and use systems, social, legal or political systems all lend themselves to this format, for to a greater or lesser degree they intersect with the hydrologic cycle and the choice of system can depend on the bent of the teacher and the other material in the introductory course.

I have crudely quantified the flow of water through the resource use subsystem utilizing as a base a set of annual average estimates made by Abel Wolman (Wolman, 1962). Of the water available to the conterminous United States from precipitation, aquifers and storage (4,760 maf or 29.35" of depth over the entire land area) 46.0 per cent enters the resource use subsystem but only 7.4 per cent through direct human intervention.

Direct withdrawal is only one of the many systematic modifications made by man, and students seem to profit from exploring present and potential modifications of the hydrologic cycle. The perturbations in the system created by one or more of these modifications can also be traced in part–for example, the storage in and release from a reservoir of substantial amounts of water in an arid area. The varied effects on micro-climate,

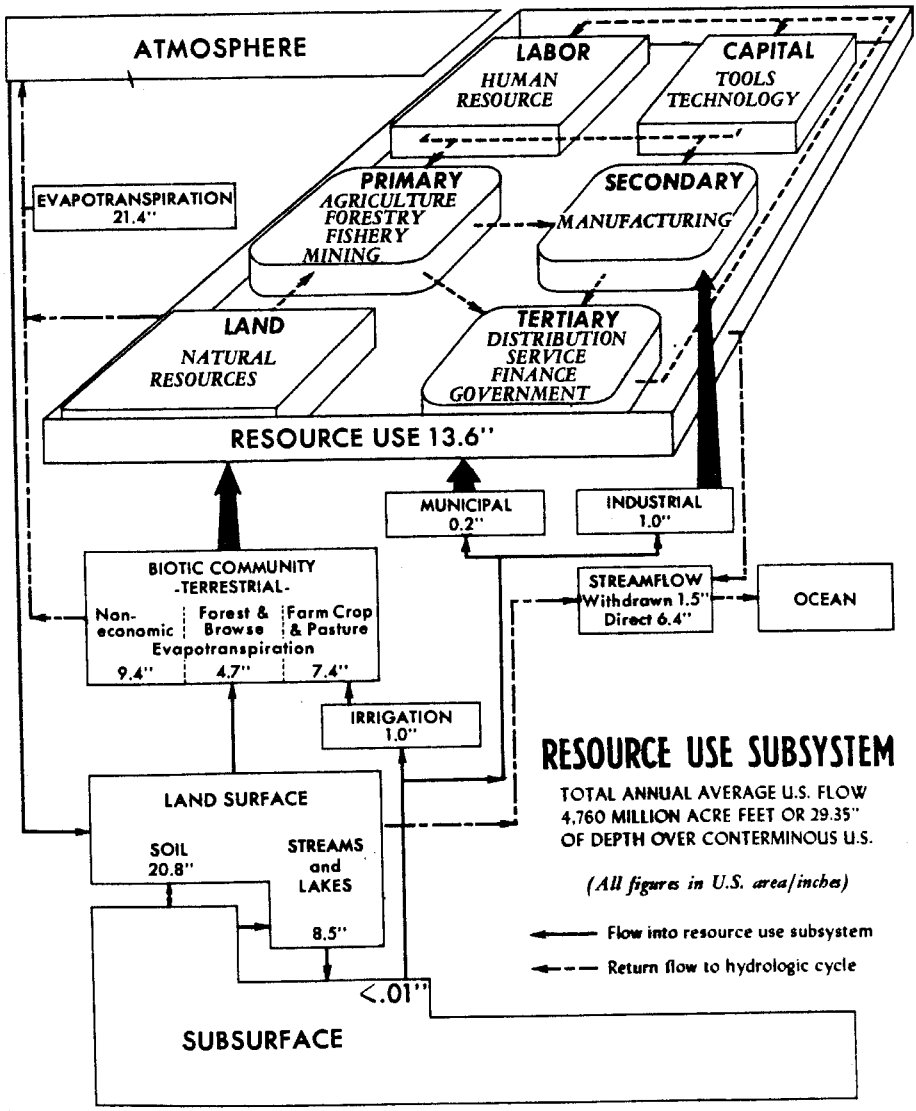
ATMOSPHERE
LABOR
HUMAN RESOURCE
CAPITAL
TOOLS TECHNOLOGY
EVAPOTRANSPIRATION 21.4"
PRIMARY
AGRICULTURE
FORESTRY
FISHERY
MINING
SECONDARY
MANUFACTURING
LAND
NATURAL RESOURCES
TERTIARY
DISTRIBUTION
SERVICE
FINANCE
GOVERNMENT
RESOURCE USE 13.6"
MUNICIPAL 0.2"
INDUSTRIAL 1.0"
BIOTIC COMMUNITY
-TERRESTRIAL-
Non-economic
Forest & Browse
Farm Crop & Pasture
Evapotranspiration
9.4"
4.7"
7.4"
STREAMFLOW
Withdrawn 1.5"
Direct 6.4"
OCEAN
IRRIGATION 1.0"
RESOURCE USE SUBSYSTEM
TOTAL ANNUAL AVERAGE U.S. FLOW
4,760 MILLION ACRE FEET OR 29.35"
OF DEPTH OVER CONTERMINOUS U.S.
(All figures in U.S. area/inches)
LAND SURFACE
SOIL 20.8"
STREAMS and LAKES
8.5"
<.01"
SUBSURFACE
Flow into resource use subsystem
Return flow to hydrologic cycle

Fig. 3

evaporation, vegetation, fluvial geomorphology, etc., while not as well understood as desired, are sufficiently known to give students further feel for the interrelatedness of things.

Afterthought

This then is my notion of a physical geography course that can be related to the dominant social science themes in geography. But, in retrospect, I wonder whether I am fighting a rear guard action by trying to make relevant an area of study and research that is but a superfluous fringe of the burgeoning earth and geo-physical sciences or a vestigial appendix to an exciting social and behavioral geographical science. As I review my experience with three separate groups of disciplines over the past three years, I find grounds for a cautious negative answer. For in work dealing with water resources, earthquakes and weather modification potential involving physical scientists in atmospheric, geologic, hydrologic, oceanographic, and seismologic science I note a convergence between social scientists and physical scientists in the areas in which the great physical systems interact with the human systems of settlement, production, consumption, transport and the like.

The convergence is a social convergence. It arises from a concern based on contrasting observations of the potential of science and technology to alter some systems with ease and to reveal in other systems magnitudes of energy that dwarf the most devastating of man's weapons. How to understand the long term implications of the former and to adjust to the latter is a broad general problem that provides a communality of interest regardless of whether one is concerned with efficient use of water resources, rational patterns of settlement in earthquake areas, or inadvertent weather modification through urbanization. In this community of interest, geographers who have traditionally sat as mugwumps astride the social and physical sciences can find a most exciting and useful place.

I think traditional physical geography is at a crossroads, having suffered from the erosion of its domain by the many earth science specialties and the ageing of its competence and concepts. But 102 years after its publication, Marsh's physical geography as modified by human action (Marsh, 1965 ed.) is still uniquely our own. It is this physical geography with a unique focus on man that can survive as it is an economic, cultural and political geography with sensitivity towards nature that has demonstrable utility. If this is so, then our introductory courses should reflect it, but in a form and content compatible with modern and rapidly progressing science.

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