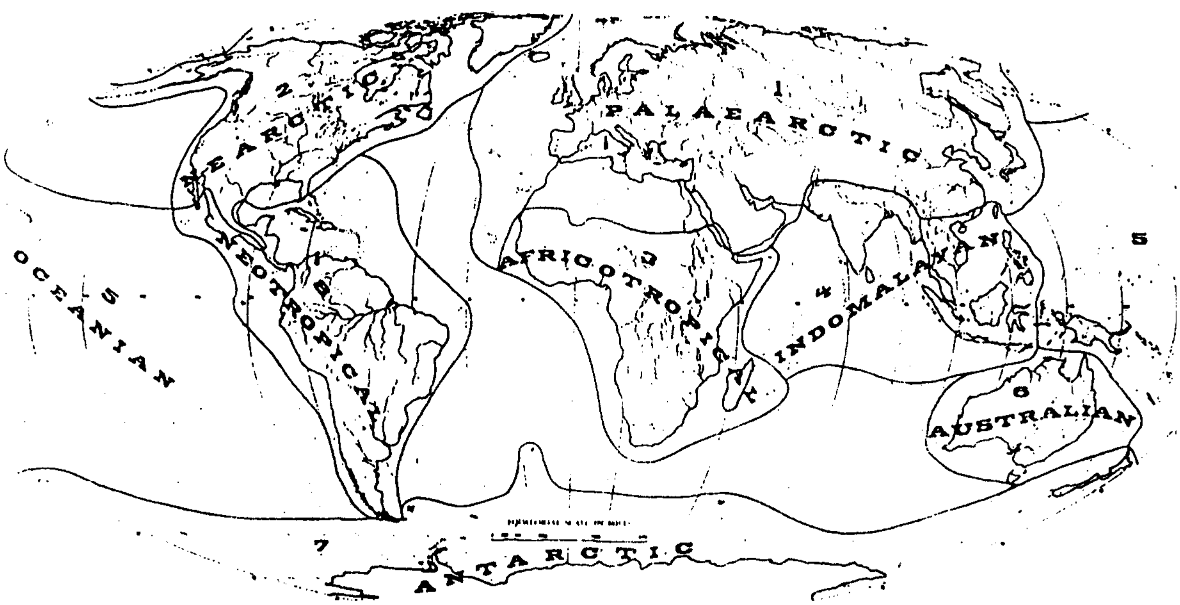
BIOREGIONS & BIOTECHNOLOGIES

A New Planning Tool for
Stable State Economic Development



By

Pliny Fisk III
M.Arch., M.L.A.
Director
Center for Maximum
Potential Building Systems, Inc.

Presented At

New Perspectives on Planning in the West
Arizona State University
May 1983

Introduction

This paper represents the barest beginnings by these authors to make use of a unique global resources classification system as it relates to the young but rapidly evolving discipline of appropriate technology. The formulation of this idea comes not from academic pursuits, but from the very real problems faced by our small non-profit appropriate technology organization in our work with governments, communities and other non-profit research groups wanting to share the knowledge and experiences gleaned from our regionally-based programs in Texas with their constituents in other parts of the world.

Technically speaking, we find the more we know about our region and its resources, the more useful are our technologies to our constituents since the technologies reflect--in a sense grow out of--our indigenous resource base. In this same sense, we find in many cases that these same technologies are not as useful to people living outside our regional boundaries.

In our quest to understand what makes some technology transfers work, while others are embarrassing failures, we turned to our background in ecological land analysis. Our first step was to map the location of resources upon which our regional technologies are based. We then extended this mapping procedure by identifying other regions around the world where our technologies could be used due to the presence of these same resources, indicated on our resource maps. It appeared that there was indeed a correlation between resources, and that we were on to a novel approach for technology sharing and regionally-based economic development.

Since each technology we work with is derived from a combination of local resource conditions, we were elated to find individuals working in other disciplines, principally in biogeography and ecology, also developing a methodology for recording vegetative resources on a global basis in mapped form. Our search for an accepted methodology for resource mapping led us to realize that the resource mapping classification system based around plant and animal species, developed within these two disciplines, closely fit our needs.

Of course, much work still has to be done to properly utilize this biogeographic classification system. We have realized that by incorporating the natural processes upon which these life forms are based--mainly soils, climate, and hydrology--that these could be the basis for matching basic components of indigenous technology categories. In this way, we could generate global indigenous technology patterns since the subsystem categories which in our case also include flora and fauna as principal subsystems were the basis for the development of indigenous soft technologies throughout the world for centuries.

If an information sharing system could be developed from an already accepted classification technique that dealt with similar areas of subject matter, then we could help our constituents in regions other than our own to tap into a global pattern of resources and experiences which parallel their own, and to find solutions for basic life support issues which they had possibly not yet considered.

We believe, therefore, that such an approach for information sharing could contain the search patterns needed to achieve responsible Third World economic development, and could eventually also provide the basis for a stable state land planning method for those societies of the world wanting to share the biotechnical path toward development.

Background

Over the past century, there has been a marked increase within the physical and life sciences to make use of the obvious pattern of recurrence in plant, animal, soil, climate, etc. resources on a global scale. Past efforts have focused primarily on improving classification systems for the purpose of proper comparison and in improving research methods in the life sciences.

It was not until the 1970's, however, that a classification system emerged which stood a chance of gaining world-wide acceptance, with many countries participating in its creation.*

----

* Contributors are A. Bannikov (USSR), Dr. G. Budowski (L.America), Dr. K. Curry-Lindahl (World), A. de Vos (World), H. Ellenberg (Europe), Dr. E.J. Fittkau (L.America), Dr. F.R. Fosberg (Oceania), W.A. Fuller (Canada) Dr. J.L. Gresitt (Oceania, Antarctica), O.Hedberg (Africa), M. Numata (Japan), Dr. D. Poore (Europe), H. Sjors (Scandinavia), P. Vanzolini (S. America), Dr. D.K. Varshney (Southern Asia).

Even though this most recent effort has focused on conservation policies, the potential use of this global view of resources is immense.

Many have pointed out the implications of such an acceptance in Education and Research (Clements & Shelford, 1939; Dansereau, 1957; Odum, 1959) and on responsible Economic Development (Holdridge, 1947; Dasmann, 1975), while others have concentrated on Land Use Planning (McHarg, 1974).

Biogeogphy

The Biogeographic Province System, as it is now referred to by Udvardy (the principal biogeographer carrying on this work for the I.U. C.N. at California State University) demonstrates these global patterns based solely on biological similarity as much as to identify where conservation practices of certain regions should occur due to their singular continental uniqueness.

A brief explanation of the biogeographic classification system will familiarize the reader with this important interregional vocabulary. Essentially, a realm, in the biogeographer's lexicon, is a continent-sized area identified by its unifying features of geography, flora and fauna. Eight such realms have been identified: Neotropical Realm; Nearctic Realm; Afrotropical Realm; Indomalayan Realm; Australian Realm; Palaearctic Realm; Oceanian Realm; and Antarctic Realm. What are referred to as biogeographic provinces are actually suborders of these realms, and are more identifiable with the specific natural life forms that statistically dominate different parts of a given realm.

Using this vocabulary, North America is called the **Nearctic Realm,** and is comprised of 22 provinces. The important realization to be made here is that each of these provinces in turn possess shareable biological characteristics with some other province or provinces, in some other realm, in some other geographic area of the world.

With this in mind, one can easily gain the awareness that your climate and an equivalent plant and animal association, soil and water conditions and other natural resource phenomena also exist in some other place or places in the world. These parallel geographic locales are referred to by the biogeographer as biomes. UNESCO recognizes 14 major global biomes.

Within each biome, one can identify similar niches used by different species, referred to by some as "ecological equivalents." It is within these biomes that we can expect to find a similar physical environment and resources which we can use as a point of comparison with resource bases depended on by the indigenously-based technologies we refer to as biotechnologies.

BIOME IDENTIFICATION OF THE TEMPERATE GRASSLAND

Soft Technologies

Biotechnologies differ from other technologies in that they are engineered around the use of regional, highly available resources, while utilizing these resources at a small or intermediate technology level so as not to change the existing material or energy flows already accepted by the natural processes within the environment. These biotechnologies therefore focus on retaining those economic levels of production and consumption that reflect the same flow levels within a stable biological community. Thus, these technologies clearly fit into the fields of stable state economics and stable state planning. Biotechnologies become the tools that could provide a long-term stable state means for life support within a given region.

Since biotechnologies by definition are engineered around the availability of local resources that have been put into use by a region's population at some level of local economy, it is necessary to clarify the definition of a biotechnology, and to identify the meaning of "local." By doing so, an approach for information sharing can be responsibly pursued.

We have found that there are different levels through which a technology becomes a regionally-derived biotechnology, and it appears, at present, that the identification of these levels helps not only in information sharing within a global biome, but also represents a strategy for development once we are working at the province level.

The first level of biotechnical identification derives from the spatial existence of the physical or biological resource upon which a technology is based, or with which a technology is used. We call this spatial existence the **Area Resource.** The area resource, since it can be spatially mapped, is an all-important defining tool since it directly relates to the biogeographer's mapping procedure. Thus, the potential for building with adobe is based on the presence of adobe soils on an area resource map. One could easily see how a great number of these maps could be produced for any region to identify available resources which could meet the basic human needs of a given society.

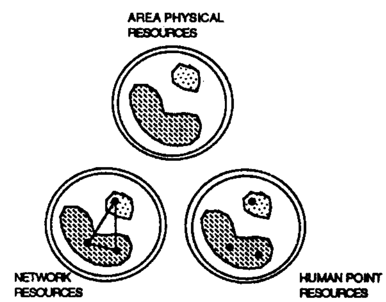
The second level of identification is the recorded use of the technology, either spatially coincidental or adjacent to the area resource. In this sense, "use" represents a human recognition of local resources being used in a small-scale technical process. "Use," therefore, has a broad definition since each area resource and each biotechnology can be used for many purposes. But "use" also implies a time component for it can be historical, it can be at the research level, and it can be in use by separate entities utilizing appropriate skills. These points of use (which actually constitute a gathering of a given area resource) are referred to as **Point Resources.** These point resources must be spatially identified so they can be keyed into their associated area resource.

For example, we have collected information on organizations around the world conducting research on earth materials for low-cost building. We find there are approximately 70 such groups. Out of these, we find spatial coincidences within our biome of 14 with whom we could hope to be able to share useful information.

The third and final level of biotechnical identification is represented by the degree of activity in the actual use of a resource and is represented by the flow of local materials, energy, or information that results from the use of an area resource by point resources within a defined region. These we call **Network Resources.**

The means of transaction is not as important at this stage of investigation as knowing whether or not a network of flow exists at all, and whether it can be tapped into in order for economic development to occur through any number of transactional means.

For instance, if we were to introduce a brick machine using unfired earthen materials for building within a region, assuming the area resource and point resources needed to do so existed within that region, we could tap into an existing network of masonry contractors, or a brick union, or a women's construction cooperative that builds with mud. If there is no existing network resource that comes close to the use of this local material, i.e. when there are carpenters but no masons in an arid region, we find there is much work to be done in order to create relevant networks.



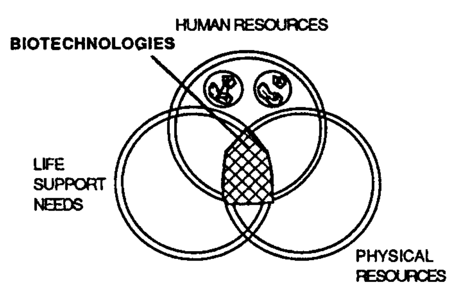
Since each of these three levels of biotechnical recognition represents a deeper, more integrated incorporation of that technology within a given region, the technologies that are most worthy of being transferred fit all levels of recognition. While those that fit the area resource criterion but have been developed in only the research level of the point resource category have limited credibility, a carefully monitored tracking program should parallel their application if they are to be used at all within another province of the biome within which they exist.

Biogeographic Biotechnic Matching

When biotechnologies are brought together to represent the entire means of human life support within a region, relying only on that region's resources, we find that there are eight basic human life support categories: (1) food; (2) water; (3) energy; (4) waste disposal; (5) building materials; (6) climatic comfort; (7) clothing; (8) medicine.

In order to make the biogeographic classification useful to the biotechnologist, and vice versa, we need to develop a transferable level of resource information that overlaps the biotechnical and biogeographic world views.

If we were to carefully study our list of eight biotechnical life support categories, we would find that many of these are based on vegetative and animal resources (i.e. food, clothing, building materials.) If we were to break down vegetation and animal resources to the physical resources upon which they depend, i.e. soils, surface geology, hydrology, and climate, we would find many of our other human life support categories also depend on these same resources, i.e. **water:** hydrology and climate; **building materials:** plants, animals, soils, and surface geology; **energy:** vegetation, animal, hydrology, and climate. It is immediately apparent that many of the biogeographic resource categories can be directly related. Furthermore, the resource base is identifiable in spatial map form and becomes the area resource earlier described. It is also clear that a further breakdown of both the resource base and our technical categories would have to occur in order for matching to be facilitated, i.e. **vegetation resource/food biotechnologies:** grains, fruits, vegetables, grasses, gourds, oil-confining species, reeds, fibrous plants, aquatics, nut-bearing hardwoods and softwoods, etc.



A Workable Definition for a Bioregion

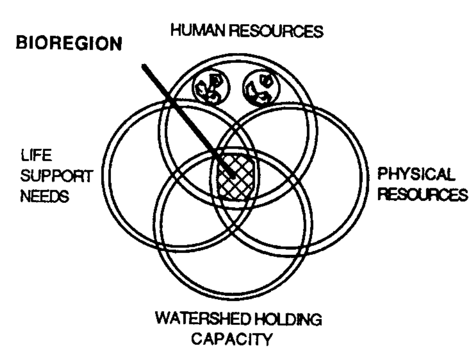
Our procedure for applying appropriate biotechnologies begins with the resources found at the province level. The most convenient spatial unit with which to plan and manage these biotechnologies is the watershed found within each province. Thus, our bioregional exchange model actually begins with the watershed as the organizing entity.

More specifically, the watershed is used because a majority of actions occurring in a region's physical development can be traced to water quality as an indicator of overstepping or staying within the bounds of nature's own assimilative capacities. Monitoring at the point of tributary junctures thus offers a direct means of spatially tracing cause and effect relationships.

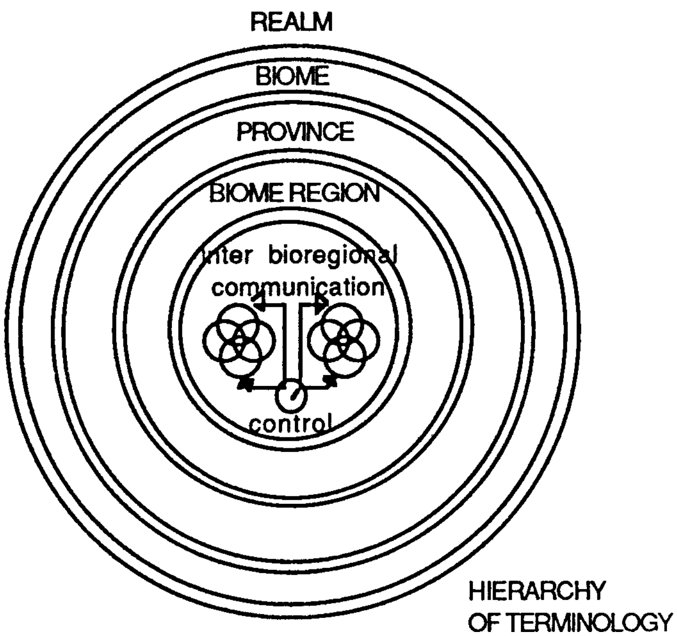
Once we have identified a particular provincial watershed boundary, we are able to isolate those resources within the watershed that can fulfill all eight categories of human life support requirements, which themselves are associated with numerous biotechnologies. This resource base is never confined to the watershed but actually overlays the watershed. These resources, however, are often contiguous to the provincial boundaries. We find it useful, therefore, to define the actual extent of this boundary. We can spatially include all those resources that have spatially impinged on the watershed as being potentially part of the watershed unit because their use does not change the carrying capacity, i.e. chemical balance of the watershed itself, unless they are overused in quantities that micro- and macro-biota cannot absorb.

In this sense, the metabolic unit of the watershed is not compromised in any way that cannot easily be managed. Furthermore, by including the full spatial extent of the life support resource base, we are able to more closely match the second and third level criteria of biotechnology definition. This spatial expansion of the watershed is also important in order for a thorough geographic search for other relevant biotechnologies in the province and biome.

Since the sub-province boundaries now being defined are based on both natural and human resources working toegther within a definable spatial field of integrated activity while respecting the **holding capacity** of the watershed as the ultimate limit for this activity, we have created what might be called the **bioregion.**



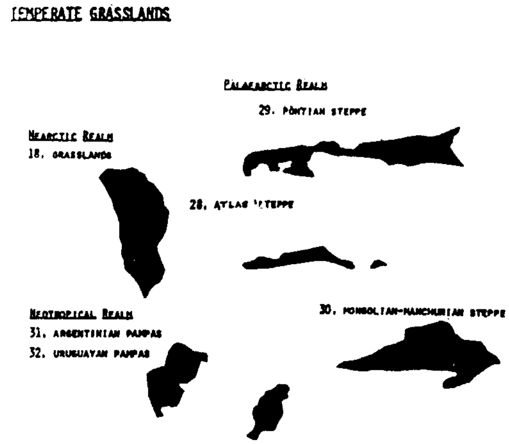
Ideally, this bioregion contains all the human resource knowledge and experience necessary to utilize properly its physical and biological resource base. If the bioregion itself does not contain this knowledge, one may go to the biome level to find the necessary biotechnical information. The bioregion process is mapped below by going through Vegetation, Soils, and Climate Identification of the Colorado River Bioregion in Texas.



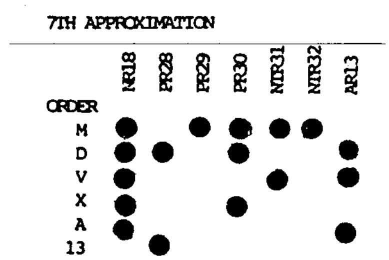
Testing Sub-System Categories as a Basis for Information Exchange

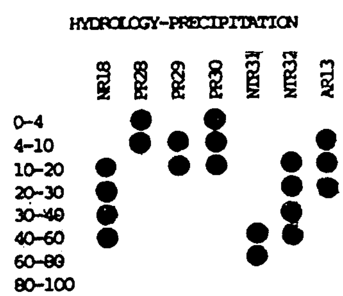
The temperate grassland biome is made up of seven provinces on a worldwide scale.* Vegetative and animal correlations have been made by the I.U.C.N. under UNESCO. One of our aims is to see whether or not the other physical resources--surface geology, soils, hydrology, climate--have any similar correlations among these same provinces. We have taken Soil, Hydrology and Climate, each utilizing an accepted classification system: Soils utilizing the 7th Approximation; Hydrology represented only partially as precipitation; and Climate using Linton's Method. The land areas below show the Temperate Grassland Biome.

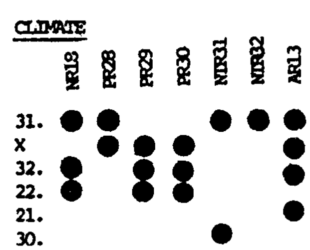
----
*Nearctic Realm #18. Grassland Neotropical Realm #31 & #32. Argentinian Pampas & Uruguayan Pampas Palearctic Realms #28, 29, 30. Atlas Steppe, Pontian Steppe, Mongolian, Manchurian Steppe & Australian Realm #13, Eastern Grasslands & Savannas.



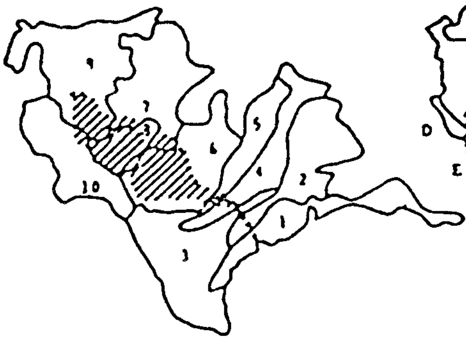
The following charts indicate the occurrence of these suborders in each province within the singular biome of temperate grasslands.





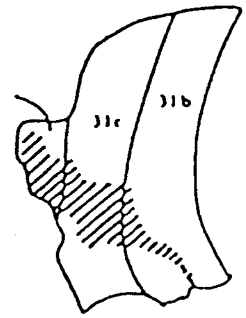


DEFINING THE VEGETATIVE RESOURCES OF THE COLORADO RIVER WATERSHED

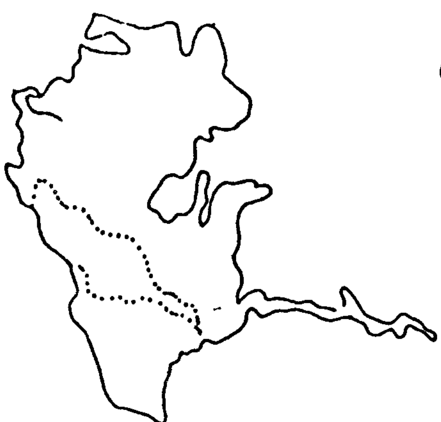


DEFINING THE SOIL RESOURCES OF THE COLORADO WATERSHED

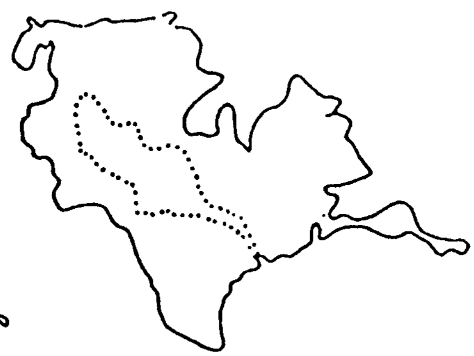
DEFINING THE CLIMATIC RESOURCES OF THE COLORADO RIVER WATERSHED



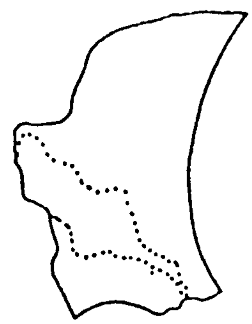
COLORADO RIVER BIOREGION BASED ON SOILS



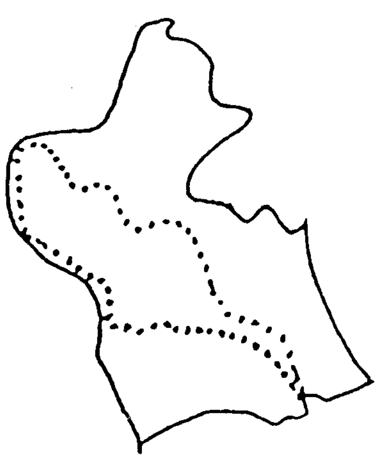
COLORADO RIVER BIOREGION BASED ON VEGETATION



COLORADO RIVER BIOREGION BASED ON CLIMATE



COLORADO RIVER GRASSLAND BIOREGION BASED ON SOILS, CLIMATE & VEGETATION



We are unable to show at this time the actual complete spatial definition of this bioregion due to a lack of data. Ideally, we would like to present this sequence within the Grassland biome, of which our province is a member, so we could show exactly where these physical, biological and human resource similarities occur spatially in a global context. We refer to this global information pool as the **biome region** due to the specific shareability of its contents.

Our brief analysis at the biome region scale has produced little overlapping of resource conditions. We believe this to be due primarily to our lack of information. However, it is interesting to follow through with some examples which are actually being used by our Center in an effort to learn more about the Colorado River Bioregion, and to disseminate information we think would be of value to our Grassland biome.

Two Case Study Examples

At this time we know of over 70 research groups and housing agencies around the world which concentrate on, or would like to increase their knowledge in, the use of indigenous materials for building to help decrease costs and to provide an employment multiplier for people by absorbing as many of the steps in material processing as possible within a particular region. We find there are 14 organizations with which we can directly communicate due to the resource similarity of their bioregion with our own. Our R&D work has been successful in utilizing a variety of indigenous soils and plants. Since we are located in a semi-arid/arid zone, we have had to find ways of reducing the usual use of vegetation for lumber and only use those species which are drought resistant. Some of these species are so successfully adapted to our region that they are becoming pests.

One of these pesty species is mesquite, part of the mesquite-oak-acacia-juniper savanna. The mesquite wood contains a high BTU per pound ratio with about the highest energy value as charcoal of any wood in the Nearctic Realm. Mesquite has tremendous wear resistence as well as being twice the hardness of hickory and oak, and with a density close to ebony. Mesquite, however, does not grow tall and straight, limiting its use as marketable lumber.

Having been targetted as a pesty weed, thousands of acres of mesquite are being eradicated by Texas ranchers with the reknowned herbicide Agent Orange. Our search in our own biome of the fate of this same tree led us to two sister bioregions: the Argentinian and Uruguayan pampas. In these bioregions, mesquite is extensively used as parquet floor tile. Many of the manufacturing facilities necessary for making these wood tile are relatively small-scale, staffed by five to seven employees. Yet, even with seemingly small productive capacity, the quantity of the mesquite parquet floor tile actually produced in parts of Argentina is about that of the amount of carpet used in our own bioregion. Our Center is presently studying the technology and economics of scale that our biome neighbors have discovered to see whether this technology could have use in the U.S. At the same time, we see ourselves as sharing techniques we have developed which uses the mesquite sawdust to make into an insulating building block, as well as how portable charcoal kilns can be used to make mesquite scrap material into a high BTU, clean burning fuel.

Technologies related to earth construction become equally shareable on the biome regional level. Recent work by our organization in testing enzymes for two different manufacturers in the wouthwest for use in stabilizing soils is of particular interest. Essentially, the process includes growing enzymes in a culture at certain termperatures and pH conditions in a renewable process similar to alcohol production. These enzymes are then mixed with water, and then the soil at very low concentration levels. The soils used in this matter must be of certain types in order for the reaction to work. The enzymes act at an ion exchange level to help soil compaction. The small amount of organic matter in the soil is utilized in the process and becomes a cement during the latter stages of chemical reaction. So far, our tests indicated that soils reacting with these enzymes achieve compression strength capacities twice that of the Unified Building Code.

Perhaps of greatest interest is the fact that these enzymes can be borrowed from insect populations within the microbiotic level of our bioregional resource base. Certain wasp species, such as the potter wasp (Eumenes) and the mud dauber (Oplomerus) in the Southwest, mix their saliva with soils of certain types and consistency in order to help stabilize these soils as nests. Since parameters of rainfall, humidity, temperature play a large role as to whether these soils will stay intact, the regionalism of these building processes are thus revealed.

It is apparent that an almost endless source of enzyme solutions from many types of insect populations already exist and could become the basis for organized regional research that could only be accomplished through a bioregional/biome type investigation.

Conclusion

Although the present level of investigation is not adequate to promote large scale use of the bioregional concept, enough has been brought together that would indicate a possibly significant area of pursuit relative to information processing regarding indigenous technologies, the steady state planning field and research and educational techniques as well.

There are a number of difficulties that have not been brought up in this paper as it now stands, which would become immediately obvious to one trying to enter into this level of investigation. Hopefully, a short list will not deter the reader from pursuing these interests. Let us name a few:

(1) The different classification systems within many of the life support resource areas mentioned (i.e. climate, soils.)

(2) The matching or different classification systems that have been accepted in one part of the world and not another.

(3) The total lack of existing data in certain areas of the world.

(4) Forcing similarity at detailed levels where conditions are not totally similar.

(5) Respecting cultural differences that will not permit transfer, although this latter condition is somewhat accounted for with the introduction of the point and network resource sequence levels earlier described.

Because this attempt is so young (these authors are unaware of similar efforts underway, and would appreciate feedback if any reader does,) there are no doubt major holes in this approach of inquiry which we have presented. Still, we are encouraged by our meager use of this concept, and hope to improve upon its potential uses with interested populations around the world in the years to come.

BIBLIOGRAPHY

Berg, Peter and George Tukel. Renewable Energy and Bioregions: A New Context for Public Policy. Planet Drum Foundation. San Francisco, 1980.

Clements, Frederic E. and U.E. Shelford. Bio-ecology. John Wiley & Sons, Inc. New York, 1939.

Critchley, Michael. "A Conscious Poliics of Austerity." 34 Bedford Square, London WclB 3ES, England.

Daley, Herman. Steady State Economics. W.H. Freeman, 1977.

Dansereau, Pierre. Biogeography: An Ecological Perspective. Ronald Press. New York, 1957.

Dasmann, R.F. "Biotic Provinces of the World." I.U.C.N. Occasional Paper No. 9, 1973.

Holdridge, L.R. and J.A. Toxi. The World Life Zone Classification System and Forestry Research. Proceedings of the Seventh World Forestry Congress, Buenos Aires, Argentina, 1972.

Koenig, H.E., T.C. Edens, and W.E. Cooper. ecology. Engineering & Economics. Electrical and Electronics Engineers, Inc., Annals No. 503PR020, 1975.

Robinson, A.H. and B.B. Petchenik. The Nature of Maps: Essays Towards Understanding Maps and Mapping. University of Chicago Press, Chicago, 1976.

Udvardy, Miklos D.F. A Classification of the Biogeographical Provinces of the World. I.U.C.N. Occasional Paper No. 18. International Union for Conservation of Nature and Natural Resources, Morges, Switzerland, 1975.

Wilkinson, Richard G. Poverty and Progress: An Ecological Model of Economic Development. Metheun & Co. London, 1973.