EMERGING CONCEPTS AND TRENDS IN GEOMORPHOLOGY

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ABSTRACT

The most commonly accepted concepts in geomorphology, which deals with genesis of landforms, were Uniformitarianism, cycle of erosion, Peneplanation, universal effect of Pleistocene glaciation on the evolution of Quaternary landforms etc. Of late certain modifications have been rightly suggested and the trend in research is to study in detail the nature of materials and the processes involved, mapping of features in the field and in the laboratory with aerial photographs and quantify the data to the extent possible. Different models are also conceived to explain the evolution of landforms.

INTRODUCTION

A SERIES of observations made either in the laboratory or in nature by individuals or groups of persons independently at different times aids in evolving of an hypothesis. The hypothesis is tested after formulation by resorting to fresh observations. If any slight modifications are to be made in the light of new observations, they are incorporated. These result in the enunciation of laws or major concepts. Usually in the field of physical sciences, they are called laws and in the field of natural sciences, concepts. Perhaps the main reason for the difference in terminology is due to the fact that in a majority of cases, laws seem to hold good for a longer period, being better evolved and tested and sometimes with mathematical proof, than concepts. Further, there are too many variables involved in our study of natural sciences and with the passage of time and advance in techniques, it is possible and sometimes necessary to change some of the earlier concepts.

Geomorphology deals with genesis of landforms and is essentially a field science, though certain types of data collected over a large area, over extended periods of time can be subjected to theoretical analyses in the laboratory. There are instances where detailed analyses of sediments made in the laboratory coupled with the field data have enabled postulation of certain conclusions of far reaching importance in the field of geomorphology (*e.g.* Hjulström's studies of the morphological activity of the rivers). Similarly new approaches in the study of field and laboratory data (study of systems) have helped in better appreciation of and in certain cases recognition of errors in some of the earlier concepts. Listed below are some of the fundamental concepts well known to a majority of the geomorphologists[1] and which have been enthusiastically propagated over the past few decades.

(i) The same physical processes and laws that operate today operated throughout the geological times, although not necessarily with the same intensity as now. (ii) Geologic structure is a dominant control factor in the evolution of land forms and is reflected in them. (iii) Geomorphic processes leave their distinctive imprint upon land forms, and each geomorphic process develops its own characteristic assemblage of land forms. (iv) As the different erosional agencies act upon the earth's surface there is produced a sequence of land forms having distinctive characteristics at the successive stages of their development. (v) Complexity of geomorphic evolution is more common than simplicity. (vi) Little of earth's topography is older than Tertiary and most of it no older than Pleistocene. (vii) Proper interpretation of the present-day landscapes is impossible without a full appreciation of the manifold influences of the geologic and climatic changes during the Pleistocene. (viii) An appreciation of world climates is necessary for a proper understanding of the varying importance of the different geomorphic processes. (ix) Geomor-

phology, although concerned primarily with present-day landscapes, attains its maximum usefulness by historical extension.

EMERGING CONCEPTS

The present attempt is to see how far these concepts still hold good and if there are any modifications to be made in the light of recent studies.

1. A stage has been reached when many question if the principle of Uniformitarianism (the term was coined by W. Whewell, when reviewing the second volume of Charles Lyell's book on Principles of Geology) has relevance any more. It was then intended to drive home two ideas: (i) that the rate of any change in the landforms has been almost uniform and (ii) that catastrophism does not exist. According to some of the recent workers, the first is no longer true and the second is superfluous to insist. One of the main reasons for rethinking on uniformitarianism is the fact that many of the processes taking place now on the land surface is at a time when perhaps the earth is passing through a phase between a glacial period and possibly another one to follow. If this were so, how can it be postulated that throughout the earlier geological periods, conditions would have been similar to what are right now operating. Further, evidences have been found indicating that some of the land features, particularly related to mass wasting are due to, though infrequent, catastrophic causes. Hence neither a strict uniformitarianism nor a strict catastrophism can be assumed.

2. According to Davis, structure, process and stage were major controls in the evolution of landforms. But according to L. C. King process is more important than either of the other two. Structure (which includes lithology and attitude) is supposed to be a controlling factor only in recently uplifted landmasses, areas of thin surface cover and major tectonic landforms. Now it is generally agreed that process and material together under varying conditions control and modify morphology.

3. Both Penck and Davis mention about the 'imprint' of processes on surface forms and deposits. But according to the concept of 'equilibrium of landforms,' all topographical elements are eroding vertically at an equal rate with no change through time of slopes or areal arrangement of the topography[2]. Such 'equilibrium' landforms would be completely adjusted to the processes presently acting upon them.

4. The concept of geomorphic cycle had gained prominence, because of its familiar analogy with human growth and development (youth, maturity and old age). Although such an analogy may serve well to initiate a student to the study of landforms, a strong commitment to this concept is bound to prejudice the student especially when recent work is tending towards contradicting such a concept. There are many obstacles in nature to permit landforms from exhibiting clear-cut sequences. This is particularly evident in unstable areas. A certain amount of 'stability' was needed in the Davisian concept for the formation of sequential landforms. Walther Penck realised that 'mobility' was more common. Both Penck and Gilbert could recognise mobility in a vertical sense. Mobility in a horizontal sense is now accepted thanks to the appreciation of the theory of plate tectonics. This together with ocean-floor spreading has considerably reduced the impact of denudation chronology, a concept that held sway for a few decades in the minds of regional geomorphologists.

5. The complexity of geomorphic evolution is due to the fact that a region is subjected to change from an initial state to different agents and to different intensity. Besides it is known now that the complexity is enhanced due to the problem of 'relicts.' An agent or a process functions in one manner and with one result in the presence of relicts and in a distinct manner and with a different result in the absence of these relicts[3].

6. Recently a few tchniques have been evolved which give a reasonably good idea, indirectly though, of the age of certain landforms. Study of isotopes of carbon (C^{14}), oxygen (O^{18}), earth magnetic reversals and volcanic ash studies (tephrochronology) aid in arriving at the age of certain deposits constituting the land-

forms. It is now generally agreed that most of the landforms as seen today are Quaternary, except those that might have been exhumed after stripping away of a Quaternary/Tertiary cover.

7. The present-day features over the globe directly or indirectly have been influenced by Pleistocene glaciation. Particularly the effect of lowering and rising of sealevel is well-known in the northern hemisphere. In the earlier decades it was assumed that there was a rhythm and periodicity in the advance and retreat of glaciers. It is now known that this is not so. Further current studies on plate tectonics and sea-floor spreading have opened up complexities which must have affected significantly the landforms in the coastal zone, onshore and off-shore.

8. Though early geomorphologists were aware that climate has not been the same at any given place over a long period, yet they relegated the role of climate in morphogenesis to the background. Earth scientists belonging to the French and German schools, in recent years have collected a wealth of data to emphasize their point that climate is a major factor in the genesis of landforms. The complexity of landforms is better understood when one is able to correlate distinct types of landforms with certain types of climates and processes, and cognizance is taken of spatial migration of climatic belts over a region, even during Holocene, more often recognised based on anomalous drainage dispositions[3]. The expression 'environmental dynamism' implies a concern with possible changes in climate, apart from glaciation, and with the geomorphic implications of these changes. Nearly all landscapes are polycyclic, as a result of fluctuations in sealevel and crustal motions, and polygenetic as a result of climatic fluctuations.

9. The concept of usefulness of geomorphology by historical extension is appreciated now better than ever before, particularly in studies of hydrology, surficial deposits, residual deposits, engineering geology and terrain evaluation in general. For example it has been shown that recognition of soil pattern and genesis is very much aided by a better appreciation of landform analysis. Soil mapping is also made easier and is effectively used[4]. Urban studies involving the need to exploit and/or conserve resources carried out in many parts of the world amply substantiate this. A series of publications (many edited by D. R. Coates) of the Proceedings of the Seminars held in the State University of New York, Binghamton, between 1971 and 1982 have brought out the applied aspects of geomorphology. Geomorphology is branching out into a number of fields like pedology, sedimentology, photogrammetry, oceanography, mathematics, physics and also into fields like archaeology (ancient human habitat), economics (flood plain zonation) and psychology (hazard awareness).

10. Now there is growing interest in the study of systems in geomorphology. It is a viewpoint rather than a concept, although the two are related. A systems approach focusses attention on interrelationships among different elements of landscape and the many variables upon which the processes and the response to them depend. Landscape is viewed as a developing and changing entity composed of mutually dependent parts. The importance of scale of study, both spatially and temporally, is stressed and the tempo of change plays an important part[5].

MODERN TRENDS

A brief survey of the modern trends in geomorphic studies has been made by King[6].

1. Even though *processes* (fluvial, periglacial, slope, coastal etc) have been studied since a few decades, they have been desultory in the initial stages. Where there was a detailed study, it pertained to one process in one locality only. Now, the trend is to monitor the process, which is more important if one is to understand the changing forms resulting from time to time. This has been made possible due to development of sophisticated equipment. It is here that aerial photographs and remote sensing provide the required aid in monitoring.

2. In a majority of cases *materials* formed out of processes are unconsolidated. Sedimentary size distribution of these enables collection of evidence which lead to the recognition of both the process involved and the morphology resulting therefrom. It can be said that study of

material is more often a link between the study of process and the study of morphology.

3. Earlier study of landforms was by description and illustration by means of sketches and photographs. This was followed by measurements of certain parameters of landforms and then mapping of the same to the extent they were mappable units. Thus the spatial relations of the *morphology* could be analysed. The objectives of the investigations of the terrain varying, different units/criteria had to be adopted in mapping[7]. The result has been that today, it is common to find different types of geomorphic maps on the same scale of the same area (Verstappen Volume, ITC Publication, Enschede, Sep. 1982). Each has its own value. Aerial photographs are being extensively used in geomorphic mapping now.

4. Though *quantification* of data connected with process (fluvial) was initiated in the early part of this century, it was only since three decades commencing with Strahler's concerted efforts on the study of slopes and drainage morphometry that quantification in geomorphology can be said to have come to stay[8]. This has led to (i) precise descriptions of landforms, (ii) shift in emphasis from stage to process, specifically to the dynamics of the process, (iii) prediction of geomorphic events with practical utility and (iv) effect changes in concepts, in view of unexpectedly new relationships being recognised between process and materials. The range of numerical techniques used is rather high extending from simple non-parametric statistics at one end to procedures at the other end of the scale involving complex multivariate, multidimensional techniques, requiring a large computer. Sometimes, the results obtained from these techniques tend to be unrealistic and it may not be possible to utilise them in the solution of problems connected with landscape analysis.

5. The latest to come on the scene is the 'model'. The main aim of a *model* is to simplify reality, omitting apparently less important constituents in the system, and establish meaningful relationships among the known attributes. These may also be controlled. The earliest is the simple model conceived by Davis in his cyclic concept or erosion. Now the conception of a new model based on the trilogy of morphology, process and material might turn out to be very useful. Another possible framework can be based on certain approaches like (i) chronological or historical, (ii) dynamic, (iii) areal or spatial and (iv) descriptive or empirical[6]. Besides these, there is scope in geomorphology to develop (i) scale of hardware models, (ii) theoritical models or deterministic mathematical models, (iii) dynamic mathematical or physical models and (iv) simulation models. There have been studies under each one of the above categories in the recent past and it is quite likely that the coming decades would witness many more studies in geomorphology using the above mentioned types of approaches and models. It should however not be forgotten that all these are only tools and means to understand better the processes taking place in nature and hence, investigations in the field should not be relegated to the background or lost sight of.

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ANNOUNCEMENT

SEMINAR ON CHITIN INHIBITORS
14th December 1983, Madras

A Seminar on Chitin Inhibitors, organised by the Fredrick Institute of Plant Protection and Toxicology, Padappai was held on 14.12.1983 at Indag House, Spur Tank Road, Madras 31. Dr Maas, General Manager and Mr S M Ishpahani of Duphar B V Amsterdam, leading scientists in India who have done research on Chitin Inhibitors besides Research scientists and Officials from Pesticides Industry participated in the Seminar.

After the welcome address by Mr James Fredrick, Trustee, Fredrick foundation who stressed on the importance of Chitin Inhibitors in the present context of Plant Protection, Mr Ishpahani addressed the gathering and informed that Duphar B V was the first to discover the Chitin Inhibitor "DIMILIN" in 1979. Dr Maas gave a detailed account of Dimilin and its success in the control of pests in agriculture, forestry, horticulture and public health. Dr Maas further stressed the importance of particle size of Dimilin in the control of pests.

The Seminar was conducted under the Chairmanship of Dr M Balasubramanian, Director of Research, Tamil Nadu Agricultural University, Coimbatore. Dr B V David, Director, Fredrick Institute of Plant Protection and Toxicology, Padappai explained in detail the work done with Dimilin at his Institute as well as in other parts of India on different pests. Dr M Balasubramanian, explained the Research work conducted with Dimilin (diflubenzuron) and BAY SIR8514 on cotton, castor, rice, coconut, brinjal and groundnut at Tamil Nadu Agricultural University, Coimbatore. He explained the good biological activity of the Chitin Inhibitors on eggs, larvae and pupae of different crop pests. Dr Balasubramanian further informed that the early instar larvae recorded more mortality. Combination of diflubenzuron with chloropyriphos had no significant additive effect.

Dr A H Shah, Professor of Entomology, Agricultural College, Gujarat Agricultural University, Navasari gave an account of the work done with Dimilin on cotton against *Spodoptera litura.* Though 80–90% kill was obtained, he informed of the delayed action by Dimilin.

Dr O D Singh, Senior Scientist, Central Cotton Research Institute, Nagpur while explaining the work done with Dimilin on cotton said that Dimilin had little effect on tissue borers *viz.* bollworms but the effect on *Spodoptera litura* was good especially on eggs and first instar larvae. Dr M S Chari, Senior Entomologist, Gurarat Agricultural University, Anand explained the work done on tobacco against *Spodoptera litura* with diflubenzuron and triflumuron. He said that the Chitin Inhibitors proved very effective in preventing the development of *Spodoptera.*

Dr Abdul Kareem, Professor of Entomology, Agricultural College, Madurai outlined the work done with Dimilin on *Pericallia ricini* an important pest on castor. Dimilin can well be integrated in pest management.

Dr Azam, Principal & Head of the Department of Entomology, Agricultural College, Rajendranagar, Hyderabad informed that Dimilin had both ovicidal and larvicidal action and the field trails have given encouraging results and the results are similar to those obtained at other centres.

The Chairman in his concluding remarks observed the following;

1) the Chitin Inhibitors have an important role to play in pest management as the mode of action of Chitin Inhibitors is different from conventional pesticides. There is every possibility of including them in the spray schedule in plant protection. (2) Chitin Inhibitors are useful in the control of lepidopterous and colepterous pests that are more exposed outside. (3) Chitin Inhibitors have a major role to play in public health and veternary fields.

The Seminar concluded after vote of thanks by Mr K K Unni, Director (Marketing), Coromandel Indag Products (P) Ltd., Madras.