Geomorphology and Society

A defining trait of mankind is its thirst for knowledge and its ability to communicate and record its findings. Originally, those endeavours were directed at the day-to-day needs of survival - shelter, and the means to locate, gain, and protect resources; no doubt aspects of what we now know as geomorphology formed an important part of that accumulated knowledge. But the prosaic needs of survival, as today, were also accompanied by the bigger 'supernatural' questions on the origin of mankind and the origin of the earth its home. From the earliest times, gathering information about the terrain and its processes was an essential and integral part of social survival.

As the ability to travel great distances and explore the world became widespread in the 18th and 19th centuries, the natural sciences became part of a rapidly expanding frontier, represented by scientific expeditions such as those of Cook, Agassiz, Humboldt, Darwin and Wallace, to name a few. As with other philosophies, those concerned with geomorphology compiled detailed observations, descriptions and classifications. New theories emerged, many of which sorely tested strongly held conventional beliefs of the time. Scientific discoveries were therefore not only a source of wonder and social advancement but also a challenge to the established beliefs of society.

As the flood of new information became increasingly difficult to master, the age of the polymath, represented by the early global explorer, inevitably gave way to a plethora of specialists. For instance, the geographer ultimately became either a human or physical geographer, the physical geographer became a climatologist, biogeographer, hydrologist or geomorphologist. In turn, geomorphologists began to identify themselves with components of their discipline such as rivers, tectonics, coasts, glaciers and the Quaternary, and more recently, by subdivisions such as, modelling, dating, paleoenvironment, etc. In many cases, this sectorisation spawned an esoteric technical language that obscured research findings from society's view.

This increase is specialisation has demanded and been driven by the replacement of observation by measurement and the consequential quantification which allowed new and sophisticated ways of establishing and verifying relationships. In geomorphology, from the 1950s, measuring devices diversified and multiplied. Initially manpower requirements and expense meant that research was confined to small catchments and specific processes, rather than the large scale features which had occupied the energies of earlier geomorphologists. The advent of automatic electronic recording (e.g., pressure transducers and data loggers) extended the duration and intensity of both laboratory and field studies. Processing of increasingly large amounts of data was facilitated by expanding computer capacity. The perspective of geomorphology has also been influenced by capabilities to digitise, rectify and geo-reference aerial photography, increasing precision of Global Positioning Systems, the advent of remote sensing capabilities, such as satellite multi-band imagery, surface and airborne radar and laser technology. These advances, together with the expanding use of Geographic Information System (GIS) platforms, have seen a re-widening of the geographic scale of interest. The shift from small catchment and plot-scaled studies to GIS driven regional studies has been mirrored by the increased focus on the temporal/historic spectrum. In particular, this has been stimulated by the increasing range and precision of dating techniques and techniques to unravel paleoenvironmental conditions (for example, exposure dating, and isotope analysis).

This increased specialisation and technological sophistication has placed much of geomorphology beyond the reach of society - science has in some quarters been seen as self indulgent and only marginally relevant to society. Government research support in a number of countries has reacted by defining the category of 'public good science' and funding it to a greater extent than 'blue sky ' (curiosity driven) research. The adaptive response of some researchers has been to re-orient their research goals or at least re-label their endeavours to make their research more socially relevant. Polar research and paleoenvironmental research have found relevance by informing the climate change debate while process studies are readily adapted to hazard issues. Scientific ethics are also being promoted - even my current Hydrological Society subscription contains an amount directed to 'water for survival'.

There is a rubric that says 'there is not such a thing as "applied geomorphology", only geomorphology to be applied.' Whatever construct you place on this statement, geomorphologists, as with other scientists, are currently confronted with increasing opportunities, if not an ethical prerogative to apply their science. The reasons for this are the dramatic contemporary changes in two of the most important drivers within our environment, climate and human population. Geomorphologists have long studied the role of climate and humans in controlling process behaviour and landform development. Furthermore, increases in population, urbanisation, social infrastructure and economy are accelerating the risk and impacts on the human condition, irrespective of the threats from accelerated climate change.

In the period between 1650 AD and 1850 AD, world population doubled from 550 million to 1,200 million. But in half that time, from 1900 AD to 2000 AD the world population increased fourfold to almost 6 billion and economic activity increased forty-fold. While population increase is placing huge demands on food production, the capacity to produce is being severely limited by anthropogenic and climate driven soil degradation and erosion. Recent research indicates that during the 40 years between 1955 and 1995, nearly one third of the world's arable land had been lost by erosion and losses continue at a rate of 10 million hectares per year.

Population increases together with increased urbanisation and increased standard of living have created unprecedented levels of intervention within the geomorphic system. Spiralling demands for resources such as aggregates are impacting river and coastal systems, while demands for hydropower and irrigation affect the quality and quantity of surface and subsurface hydrological systems. Mineral, timber, and soil resources are also being exploited at unprecedented rates, in many cases with unanticipated and disastrous results.

It is against this background that the geomorphologist has an important social role to play. Collectively and individually we can inform society of how systems will respond to human intervention and enhanced climate activity. We can identify the outcomes and risks and communicate them effectively to resource managers, planners, industry, government and the public. In jurisdictions where resource management legislation exists there are frameworks such as environmental impact assessment procedures that are well suited to geomorphological input.

Environmental and resource law has also inadvertently spawned what might be referred to as 'forensic geomorphology'. Some examples from New Zealand illustrate the nature of the geomorphic challenge. Recently the agency responsible for the national hazard insurance scheme refused a multi-million dollar payout to a community, because it deemed that the damage was caused by a flood (their schedule excludes flood damage but not mass movement damage). Expert geomorphological opinion was sought and resolved that the damage was in fact caused by a debris flow - the decision was reversed. Similar issues are confronted by coastal geomorphologists. In some jurisdictions, foredunes are protected from development, resulting in protracted legal debates as to what actually constitutes the real foredune. In property law, ambulatory property boundaries, often defined by the centre line of a river, allow conjoint property owners to gain or lose valuable land as the river shifts course. But this rule applies only if the migration is 'natural' (slow and imperceptible) and does not apply if the migration is rapid and event related. Robust resolution of such issues is the realm of forensic geomorphology and requires expert geomorphic evidence to resolve.

The effectiveness of the geomorphological contribution however, ultimately relies on the integrity and rigour of our science and continued exercise of curiosity. My conclusion therefore is that there is 'geomorphology to be applied' and that its application is desperately needed by society. Given the immensity of current global change and its impact on the wellbeing of mankind, perhaps we should learn from our hydrology cousins and institute an initiative of 'geomorphology for survival'.

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