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ESEX Exchange

Continental drift

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The continent of Geomorphology is drifting away from Geography. Geography has become marooned on a passive margin. Curiously enough, the beginnings of the intellectual drift are, as near as one can date these things, just about coincident with the acceptance of continental drift in the Earth science community. But geophysical continental drift, though its sequel has become important, played only a small part in the commencement of geomorphological drift in the mid-1960s.

The initial culprit seems to have been the quantification of Earth science. Early quantification in geomorphology was associated with refocusing the subject, after 1950, towards understanding the processes by which landscapes change. In the first half of the twentieth century, geomorphologists were dominantly preoccupied with a mainly qualitative attempt to unravel the history of particular landscapes. The reason for the qualitative approach is easy to understand: individual landscapes present such complex boundaries, and are the product of histories of such singularity, that there is little to be gained by quantification beyond the simple citation of areas, altitudes and topographical gradients. Indeed, early quantitative geomorphology largely focused on attempting a quantitative and statistical description of landform, a topic to which geographers were able to make a fair contribution. Understanding process is an entirely different matter. In geomorphology it has been a matter of attempting to understand land-forming processes in Newtonian terms. This paradigm, prefigured in the work of G. K. Gilbert, in particular, seems to have gained its momentum largely from the needs of engineers to understand processes in rivers and on hillslopes for purposes of sound design, social protection and, increasingly, environmental stewardship. Consider, for example, the regime canal work of the early twentieth century and its development into the problem of finding the equilibrium geometry of rivers – a problem that, properly formulated, remains challenging today. That work demonstrated to Earth scientists the value of a quantitative, physical approach toward understanding processes at the Earth's surface. After about 1965, Anglo-American geomorphology almost completely assumed the Newtonian paradigm, even though much of the work remained rather superficially descriptive. For geographers, it meant, mainly, intensive field monitoring of local sediment transfers and the search for empirical correlations. Real Newtonian science entered geomorphology from elsewhere.

Continental drift inserted itself into the subject in an important way about 20 years later when geophysicists developing the plate tectonics paradigm recognized the need to understand the role of erosion and sedimentation in driving tectonic processes. These investigators have again refocused the discipline toward large-scale landscapes. But now, with large-scale numerical computation available, useful quantification can be had. The study of landscape-forming processes, at both topographical and regional scales, forms the central theme of geomorphology. The focus must be on the physics underlying the processes, not upon the specifics of place and time. The concern with generic physics brings geomorphology into the scientific mainstream. Physics is practised within a hypothesis-driven modelling framework informed by physical theory. Unfortunately, the skills required to conduct such work are not a part of the geographical geomorphologist's normal training.

Geographers are not alone in facing a dramatic need to shift their outlook. It requires a very different orientation and training than traditional Earth science has emphasized. Geology, too, is facing a radical reorientation, especially in the amphi-Atlantic world, as it turns away from a preoccupation with mineral discovery toward a broader concern with the 'Earth system'. The tools that must be applied in modern Earth science derive from physics and chemistry (and even from biology), and they are applied using the language of mathematics. Geographical curricula provide almost no introduction to these subjects beyond school level. Indeed, in many institutions, the notion that geomorphology, and physical geography more generally, must join the mainstream of physical science has been stoutly resisted by both the teachers and the taught. Geomorphological pedagogy remains largely descriptive.

The result is that geographical geomorphologists are slowly losing purchase in their own discipline. The major questions are no longer articulated by geographers; leading research programmes are rarely based in Geography departments. At the continental and regional scale, the initiative is firmly in the hands of geophysicists, in both Europe and America. Tectonics has to a significant degree become the study of the large-scale production and modification of Earth's relief. At more local and traditional geomorphological scales, the leading work is being conducted in refocused Earth science departments – mostly in America, in engineering research groups, and even in physics departments. The pages of this journal attest the wide variety of scientists who now interest themselves in geomorphology. The increasingly broad range of skills that is being brought into the field is undoubtedly good for the science. It is proof that geomorphology holds compelling scientific interest. It also represents a major challenge for training within the discipline since the main locus of undergraduate education in geomorphology continues to lie in Geography departments.

A geographical education in geomorphology is becoming disconnected from the research discipline because it does not teach the students the things they need to know in order to participate in research or professional application. The very best students still survive, I think because they go away and learn for themselves the things they are not taught: how to recognize and articulate critical problems (by which I mean ones that will move scientific understanding forward); how to set the problem in a physical framework (or 'how to set up the model' within theoretical reason); how to design field or experimental observations, or simulation exercises, that will efficiently move the problem toward a solution; and how to find and apply the mathematical skills necessary to make the problem workable. Mostly, geographical curricula do not encourage students to learn the underlying mathematical and physical foundations necessary to do science. Indeed, the way in which curricula are structured militates against it.

What, then, are geographical geomorphologists doing? Mostly, they are tackling local problems with purely local perceived contexts, by almost entirely empirical means. There usually are deeper lessons to be learned in a 'local', empirical study, but the larger scientific context is not being recognized and articulated, often to the detriment of the proferred conclusions. There seems to be increasing emphasis, amongst geographers, on 'applying' geomorphology to help resolve problems of environmental stewardship, or regional or local land management planning, as if that will qualify the scientific value of the discipline. The work is useful, and it often attracts a bit of much-needed financial support, but it will not earn geographers a directing role in the science.

Where is this issue taking us? We may simply be witnessing the natural evolution of intellectual disciplines. In many ways, geography is the repository of 'natural history', the pre-Victorian study of the world around us. Over more than two centuries, most of the modern environmental scientific disciplines have been distilled out of it. At the turn of the nineteenth century, Alexander von Humboldt was geographer, geophysicist, biologist and anthropologist. At the beginning of the twenty-first century, geomorphology may be being distilled out of geography into a disciplinary niche of its own, much like soil science. Alternatively, it may be in the throes of takeover by a more active and more focused Earth science discipline within which it is increasingly recognized as an important link in the chain of geophysical understanding of the planet, as has already happened to climatology. The latter certainly is well under way in America, where discussion is increasingly about a discipline of 'Earth surface science' (at least our journal can be credited with some prescience).

Can geographical geomorphology survive without a place on the research frontier? It possibly would have an important role to play, perhaps even more important than advancing the science. It is plain that, in today's world, environmental stewardship, in both regional and global contexts, is a dominating megaproblem. Solutions will come in small pieces. They will not, in the main, be put into place by the scientists. It will require analysts who know a good deal of environmental science, but who also have considerable sophistication in the political and policy arts, to know what should be done and what is feasible to do. That sounds like a possible role for the geographical geomorphologist or – more likely – the broadly trained physical geographer.

But is that where geographical geomorphologists wish to go? And where, in disciplinary terms, will those who want to advance the science of geomorphology be able to flourish?

