THE FUTURE OF SCIENCE AND TECHNOLOGY

Forecast: The small-scale geography of patterns and processes will become instrumental in exploring nano-scale worlds

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Description:

Since antiquity, geographers have been at the forefront of expeditions to explore, chart, and navigate new spaces and the frontiers of human territory. Of course (and with the exception of the oceans), the area of terrae novae on the Earth's surface shrunk to relatively modest sizes quite some time ago and that which we cannot explore tangibly—say, in the Antarctic or atop mountain chains—is now easily traversed vicariously through near-surface aerial photography or orbital remote sensing. Geographers, in recent decades, have cast their attentions upon novel geographies, infusing spatial thinking into the debate in many related fields: culture, health, cognition, globalization, and so on. Other branches of geography have set about developing, applying, and refining methodologies and tools for studying, measuring, classifying, and analyzing the geographical patterns and processes that govern the world's dynamical systems. Yet, since the age of the great explorers, geographers have had comparatively few opportunities to cast their eyes upon entirely new spaces. That is changing and opportunities for geographical exploration are emerging anew.

The massive shift toward nano-scale science has established a veritable land grab and gold rush for scientific inquiry at hitherto relatively underexplored scales, within the earth, within the body, within objects, within anything to be found between 1 and 100 nm. Geographers missed out on the last bonanza at small scales and were mostly absent from teams tasked with mapping the genome. The cartography required to visually map the genome is trivial and the processes that govern genomic patterns are completely alien to most geographers' skill-sets, so their exclusion from these endeavors is understandable. The science and engineering surrounding nanotechnology differs from this situation, however, in that it is primarily concerned with spatiotemporal patterns and processes and the scaling of systems to new dimensions. These areas of inquiry are part of the geographer's craft.

Geospatial information technologies will become increasingly relevant to nano-scale industry

Geographers generally, and Geographic Information Scientists particularly, form a core cohort of emerging research initiatives to build cyberinfrastructure for future-generation research [1]; expect them to play a significant role in charting new emerging geographies at nano-scales. Geographers have, for example, a long-standing tradition of working with remote sensing and remote monitoring technology and science to study the earth's surface and systems. Aspects of geospatial technology from such endeavors have translated to medical imaging within-the-body (particularly in pattern-recognition, cluster detection, and change detection) and are likely to shape the examination of phenomena and entities under the microscope at nano-scales, particularly when they manifest as miniaturized versions of human-scale processes and objects. Spatial databases, ontologies, and geosearch could feasibly feature as prominently. Similarly, there may well be a surge in interest for very small-scale positioning technologies at the nano-scale. At least initially, these are likely to follow existing geospatial technologies and sciences in miniaturized form.

The geographical sciences will be instrumental in explaining nano-scale phenomena

Geographers turned away from questions of what is where and when on the earth's surface some time ago, and honed their craft on the "why" of these things. Geography, as a discipline, has decades, if not centuries of expertise in explaining, measuring, quantifying, and modeling spatial processes such as diffusion, locomotion, allometry, action-at-a-distance, action-by-proximity, fractality, heterogeneity, homogeneity, clustering, polarization, spatial self-organization, and so on. Understanding these processes—and whether they hold true or not—at nano-scales will be incredibly important in forging tools for nano-scale engineering, in building nano-scale structures, and coupling nano-scale systems.

References
[1] U.S. National Science Foundation (2007). “Cyberinfrastructure Vision for 21st Century Discovery”. Washington, DC: National Science Foundation Cyberinfrastructure Council.

Signals:
Cyberinfrastructure Vision for 21st Century Discovery

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