Responsible Geosciences, or Earth/Geoscience Literacy for Urbanites

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Take home message: Earth/Geoscientists are co-making the urban realm. This feature comes with responsibilities.



l like to thank many colleagues, including Silvia and Eduardo.

Much that I show here does originate from their works.

Dr. Martin Bohle

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Contribution inspired by E-an Zen, 1928-2014

We, You, They - wizards of the Ergosphere !

Jürgen Renn (2018), *The Evolution of Knowledge: Rethinking Science in the Anthropocene* [p. 7] – quote:

With their rapidly evolving culture, humans have introduced an "ergosphere" (a sphere of work, as well as of technological and energetic transformations) as a new global component of the Earth system, in addition to the lithosphere, the hydrosphere, the atmosphere, and the biosphere, thus changing the overall dynamics of the system."

Journal of History of Science and Technology 12:1–22. https://doi.org/10.2478/host-2018-0001



The Urban Realm is the primary manifestation of the *Ergosphere* and Earth/Geoscientists are among *the wizards* building it.

Conceptual Claims, Axioms & Statements

- 1. <u>Primary Claim</u>: Urban people's Earth/Geosciences literacy is a key-aspect of sustainable urban life, *although urban life keeps them illiterate*.
- 2. <u>Axioms</u>:
 - 1. Earth/Geosciences refer to a wide range of STEM disciplines investigating Earth's / non-living material phenomena. *Urban life depends on these phenomena.*
 - 2. Earth/Geosciences literacy is about the public's Earth/Geosciences insights, including educational resources for all citizens whether urban or not.
 - 3. Responsible [geo]science means tackling... (see Axiom 1.)
- 3. <u>Secondary Claim</u>: Earth/Geosciences disciplines could learn from Meteorology how *to heal* Earth/Geosciences illiteracy.

<u>Footnote</u>: Planetary scale anthropogenic change (PSAC) amplifies the need for people's Earth/Geosciences literacy. PSAC is not the subject of this essay. Instead, this talk looks at the ordinary features of a planetary human niche.

Multiple Findings

- > Urban life is profoundly connected with the geosphere, i.e., Earth's non-living material sphere.
- Often, the connections are invisible because material/technical environments (technosphere) manage them.
- Primarily, urban environments are built to protect people from natural (geoscientific) phenomena and to emphasise social interaction.
- Urban people experience the intricate relationship between urban life and natural (geoscientific) phenomena in a moderated manner.
- <u>Consequently</u>, urban people's cultural, economic, social, and political choices risk happening under a *'systemic veil of Earth/Geoscientific ignorance'.* Such ignorance is a risk.

<u>Footnote:</u> Contemporary urban areas form an interconnected realm of metropoles, cities or towns spread over the globe, including their '*Hinterland*'. The concept of an urban realm should not be reduced to the physical environment, which includes climate, geomorphology and hydrology, the engineered environments, including buildings for housing and work, infrastructures above and below ground, and managed open spaces. Instead, the concept of an urban realm acknowledges that life in urban areas is complex and multi-dimensional, shaped by various social, economic, and environmental processes. Together they function as profoundly entangled *complex-adaptive social-ecological systems*. The social milieu of the urban realm is of primary visibility. Often it eclipses the tangible physical features, i.e., natural (geoscientific phenomena), upon which it is built. Earth/Geosciences literacy renders these tangible physical features and phenomena visible.

Sources: https://nagt.org/nagt/past_projects/literacies.html; https://www.geosociety.org/GSA/gsa/positions/position21.aspx



In case you never heard about Earth Science Literacy...



1928-2014

EARTH SCIENCE LITERACY PRINCIPLES

The Big Ideas and Supporting Concepts of Earth Science

ww.earthscienceliteracy.or

https://scholar.google.be =1&q=%22e erth+sc =en&c e/scholar?as_vis +literacy%22&hl

nttp://www.earthscienceliteracy.org/

Zen E-an (1990)

Science Literacy and Why it is Important. J Geol Educ 38:463–464. https://doi.org/10.5408/0022-1368-38.5.463

Science literacy involves the comprehension not just of basic concepts, but just as important it requires comprehension of the importance of "falsifiability" of scientific theories and hypotheses, the knowledge that scientific inquiry is value-laden, and an understanding of the problem-solving nature of scientific inquiry

Earth-science literacy has a pivotal role in addressing critical environmental problems, including the influence of explosive population growth on the consumption and depletion of natural resources and the avoidance of natural hazards.

Multiple Findings (cont.)

- The urban realm is a social-ecological system on a planetary scale; that is,
 - it is a firmly twinned structure of social and physical features
 - exhibiting complex-adaptive dynamics.
- The planetary dynamics are accentuated in the urban realm, because the urban realm
 - connects human practices and the geosphere (e.g., buildings, mines, shipping),
 - causes massive fluxes (e.g., energy, water, materials),
 - requires
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- extensive *civil-engineering works* (e.g., housing, transport, infrastructure), and
- robust *Earth/Geosciences expertise* (e.g., foundations, drainage, position).

Ok, what to do now?

Healing Earth/Geosciences illiteracy requires a *concerted effort* from professionals in Earth/Geosciences, educators, policymakers, and urban dwellers.

Found @: Meteorology

- Experiences in Meteorology provide a *blueprint* how to make Earth/Geosciences a visible and enhance the public's understanding of Earth/Geosciences' role in urban living.

p.m. Morris B (2023) WMO Weathered the Cold War, but Can It Survive Capitalism? Eos (Washington DC) 104:. https://doi.org/10.1029/2023EO230242

...towards public weather forecasts.

- The weather is the example to illustrate the role of 'Earth/Geosciences literacy' in modern societies, given that it significantly impacts humans' lives, whether for settlement, food, mobility, production, or battle. Weather news became a 'prime time' event decades ago, substituting individual experiences and traditional wisdom.
- Since the early 1950s, regular broadcasting of weather forecasts has become common. Before broadcasting weather news, systematic weather observations were practised for centuries, supported by the development of instruments, communication technologies, and standard observation protocols and organisations. Weather reports for specialised professional audiences have been produced manually and published since the mid-nineteenth century with increasing regularity. Numerical weather forecasting has become feasible since the early 1950s.
- Nowadays, in a single narrative, the modern media combine the weather forecast with additional information. The reliability and accuracy of weather forecasts directly influence the work and life of millions who depend upon reliable, professional practices and insights on how to contextualise the weather forecast. Today's meteorologists effectively demonstrate how weather forecasts influence and shape individuals' work and lifestyle decisions, illuminating the value of geoscientific information and the role of professional practices.

What to learn & do?

What were the strategies in Meteorology?

How to enhance public understanding and appreciation of the role of Earth/Geosciences?

How to do this for a good (urban/rural) living?

Going public regularly, i.e., forecasting geoscientific phenomena relevant for production, consumption, and well-being; *that is <u>the</u> essential*.

Conclusion

Responsible Earth/Geosciences means *having the guts* [*] to go public regularly,

forecasting geoscientific phenomena relevant for

production, consumption, and well-being.

p.s. Likely, it will be possible to plug-in weather reports, first with hydrological information and related phenomena or phenomena like threats to harbours because of the sea-level rise.

[*] ...stand in front of millions of spectators and tell them about the rain that will spoil their party !

The Citizen-Geologist **GSA Presidential Address. 1992** E-an Zen

Department of Geology, University of Maryland, College Park, MD 20742

I'd like to talk about a matter that calls for our collective attention: What the role of GSA and of geologists should be in the future well-being of For over a century, GSA has enjoyed the respect of the geological community, earned by a superb record of promoting and spreading scholarly information on geology. If the selfimage of an institution can be measured by the people it chooses to honor, then our Penrose Medalists may gauge our ideal. Searching among the names of only those medalists no longer with us. I find Charles Schuchert, Norman Bowen, Reginald Daly, William Morris Davis, Arthur Holmes, William W. Rubey, Preston Cloud, and Harry Hess. Discoverers and innovators all, their thoughts have shaped the way we look at Earth and at our science.

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With a few notable exceptions owever, these honored men (for they are all men) spoke mainly to other geologists. We have not expected our leading scientists to reach out to the public or to the political leaders. Should GSA play an active role in public outreach, or should it keep to the traditional focus of propagating scholarly knowledge? These questions deserve serious debate. Science is too important to be left to the scientists. Geology directly

impinges on human welfare and so cannot be an ivory-tower science. Conservation of the environment, discovery and recovery of Earth's resources, avoidance of natural hazards, disposal of wastes, forecasting of global change, decisions on land use, equity for the future-these and other issues need geological knowledge both for technical resolution and for guiding public policy. Public policy needs public support; we ignore the public at our own peril.

That peril is something we geologists know only too well. We feel frustrated that we are under-represented in science, in education, and in the shaping of public policy; that earth science is often regarded as a second-class subject in schools; that when the news media describe our natural world they often omit geological information; and that in a budget crunch, departments of geology and state geological surveys are among the first casualties. These sit uations cry out for us to improve the visibility of geology and to widen its public role. Public outreach is a responsibility from which we may not shirk. We can help improve people's appreciation of geology by building a record of timely, useful, and visible contributions to their welfare. We can also set an example for interdisciplinary cooperation in matters that affect society's well being. Physicists in the United States enjoy their political credibility partly because they rose to meet the demands of the Second World War, symbolized by the Manhattan Project. To save our planet may well be the next, global, Manhattan Project or, using Albert Gore's (1992) more positive metaphor, a globally shared Marshall Plan Such an undertaking will involve many disciplines and different kinds of institutions, but geology should have a central role. Will we

be ready with wise and specific plans

to steer decision makers toward good

choices? Let's prepare ourselves for that happy prospect. Clearly, better science education is a key to any long-term effort to inform people about our natural world, and GSA is actively promoting earth-science literacy. Scientific literacy is part of a public agenda because it can enhance ballot-box competency. We must relate scientific knowledge to society's sense

of value-what is right, what is wrong,

what is important-so that people can

meld scientific knowledge with their

own lives. How do we begin?

and impulses.

themselves

Another element affecting the

image of a scientist has to do with

human population enticed by the

support acknowledges that we are

E-an Zer

Let's first consider the public image illustrate some of my points. In 1988 of a scientist. This is not a frivolous George Bush proposed an environmen consideration; public perception of a tal policy that included "no net loss" of wetlands. Today, an executive redefini scientist reflects and affects how the tion of wetlands reduces that protecpublic reacts to science. A scientist is often depicted as an egocentric white tion. This legal juggling might put the male, a brilliant weirdo in a white lab integrity of significant wetland areas at risk (Alper, 1992; Nicholas, 1992). Is coat, deficient in common sense, working like a fiend, driven equally by curthe mere preservation of the total area of wetlands enough to ensure their iosity and by greed. This caricature per meates science fiction, comic strips, TV, long-term robustness? Can wetlands he and even serious newspapers. I suspect created or repaired fast enough to comthat this image feeds partly on misunsate for losses, yet sturdily enough to fully perform their natural functions derstandings and partly on revulsion against research that offends some peo (National Research Council, 1992)? How does one create new wetlands, ple's moral sense. We have not fully faced this issue, and we aggravate the and in whose backyard? Yours or mine? problem every time we duck people's As geologists, we can help discover questions about science or scientists. the natural processes that sustain a wetland, as well as clarify how human ac-As a start, we need to show people that scientists are normal human beings tivities might modify these processes. having the same basic human concerns That's our normal job. But we also need to tell lawmakers and voters why wetlands are important, why they must be protected, and how their protection scientific ethics. Issues involving ethics goes beyond satisfying legal definitions

are rightly newsworthy, and cases of and filling administrative pigeonholes scientific misconduct do catch public A different subject that demands attention. People now realize that sciattention is the public appreciation of entists, being human, are not only fall where earth science fits into the school lible but temptable, and that research curriculum for kindergarten through organizations sometimes fail to police twelfth grade. Does earth science qualify as a lab science? This question Ethics does indeed permeate scidirectly affects the ability of earth science. Every step we take, from obser ence to attract students. Confusion is vation to publication, involves ethica rampant, in part because we geologists decisions. When may I throw out are schizophrenic on this matter. Earth

anomalous data? How do I interpret science encompasses the lab sciences, mbiguous information? Should I meaning chiefly chemistry and physics admit an error in judgment? Who because first, we need these tools to should be my coauthors? Is my recalibrate and project natural relations search topic intrinsically immoral? and second, we need the constraints of These decisions shape the quality of these disciplines to help us distinguish the results. Because science is a public what's plausible from what's fantastical enterprise and because ethical factors However, earth science is more than underlie the relation between the tax just applied chemistry and physics. payer and the scientist, we need to because geology is at its core. Geology is also a historical science that draws develop serious dialogue with our fellow citizens, and cultivate shared valinferences from unique events, a proues as well as shared interests, based cess that gives our science its imp on our common stake in the future. tant concepts of time, sequence, and Environmental ethics is an area correlation.

where geology has a natural role. I am Let me put it another way. Labora thinking specifically of our responsibiltory studies are usually so designed that ity to protect the long-term ability of the initial and boundary conditions, as well as the variables, are carefully con-Earth to sustain life in its myriad wondrous forms in the face of a growing trolled, so that one could gain detailed understanding of idealized systems. prospect of resource-hungry technol Earth science must practice this kind ogy. To ask how much life Earth can of discipline, but it also must deal with the real world. This real world is not simple and neat. It is nonlinear, it is concerned with Earth as a habitat for all, and not just for Homo satiens. The contingent, it is time-dependent, and decision makers have to know that the it usually consists of a complex and needs of the other life forms, the entire messy overlay of events. Thus, when ecosystem, require adequate attention we apply to Farth precise understandif humankind is to thrive. They need to ings gained from simplified systems, we be reminded that decisions on land use have to extrapolate to situations where wipe out future options; option itself is we cannot run away from nature's untia nonrenewable resource (Zen. 1983). diness. The two approaches are as woof Perhaps the issue of wetlands can and warp in weaving: neither can serve

...make Urbanites Earth/Geosciences literate...



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Preprint at: https://www.researchgate.net/publication/372646227_Why_Should_Ur banites be EarthGeosciences Literate

GSA TODAY, January 1993