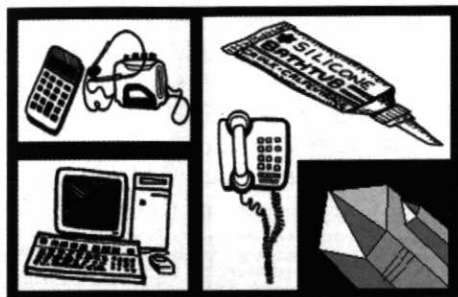


ARTICLES



The Earth and its People: Repairing Broken Connections

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SUMMARY

Humans are losing touch with the Earth. They tend to ignore the strong linkages between earth resources and the level of civilization they enjoy. They also tend to ignore the forces of earth processes, rendering themselves insensitive to natural processes and hazards. The disconnection is strongest in the developed, first world of which Canada is a part. Earth scientists hold the key knowledge to repair this disconnection between the Earth and its people. It is critical that we place more of a social context on earth science, especially as it is communicated to the public. We need to re-establish the connections between our well-being and the earth resources that make it possible. We also need to educate society about how Earth processes affect our everyday life. By the

same token, we also need to elaborate more of the social context of earth sciences to students of earth sciences.

RÉSUMÉ

Les humains perdent de plus en plus contact avec la Terre. Ils ont tendance à oublier les liens importants qui existent entre les ressources de la Terre et le niveau de vie dont ils jouissent. Ils ont aussi tendance à ignorer les grandes forces des mécanismes terrestres en jeu, ce qui les rend inconscients des processus et des dangers ambiants. Cette inconscience est d'autant plus prononcée que le pays est développé et, le Canada est l'un des premiers pays de la liste. Les géoscientifiques détiennent le savoir clé permettant de rétablir la conscience des liens existant entre la Terre et ses habitants. Il est crucial que nous fassions l'effort de mieux situer les sciences de la Terre dans leur contexte social, particulièrement à l'occasion de communications à l'intention du grand public. Il est impérieux que nous réussissions à re-démontrer l'existence des liens entre notre bien-être, et les ressources terrestres dont il est issu. Il est également nécessaire que nous instruisions la société sur le mode de fonctionnement des processus terrestres qui affectent quotidiennement nos vies. Par la même occasion, nous devons insister davantage auprès des étudiants sur les applications sociales des connaissances géoscientifiques.

THE BROKEN CONNECTIONS

Human inhabitants of the Earth, especially those who live in urban centres of first world countries, do not seem to have a clear understanding of the relationship between their civilization and the use of Earth's resources. Most humans no longer make the connection between the exploration, development, and consumption of Earth resources and their personal comfort

and well being. In fact, we now face a situation where many decision makers think of natural resources as a thing of the past, inherently dirty and inefficient, and perhaps more in tune with the industrial revolution of the 19th century. They believe the 20th century represented the transition from that dirty, resource-consuming, industrial age to the brand-new, globally connected, technologically advanced, information age. They distinguish an old and a new economy on this basis (see Nowlan, 1998). The 21st century, they think, is to be characterized by this clean and efficient information age. They fail to connect our current level of civilization and technological sophistication to the Earth resources necessary for their construction. In other words, they see computers as a kind of abstract clean tool of the future, not realizing that the plastic box, the circuitry, the drives, and the chips are made of resources that come from the Earth (Fig. 1).

Worse yet, they seem to miss the connection between the consumption of coal, hydrocarbon, uranium or water resources, and the provision of power necessary for our civilization. Our society not only shows disregard for the value of

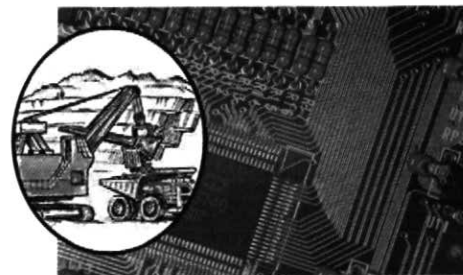


Figure 1 People regard computers as clean abstract tools of the future, not realizing that the plastic box, the circuitry, the drives, and the chips are made of resources that come from the Earth.

natural resources but also tends to stress the negative environmental consequences of extracting and using those resources. It doesn't help that earth scientists have been so good at finding those resources that over the last 20 years, they have proved inexpensive. The recent rise in the price of oil and gas and electrical generation has been highly illustrative of first world attitudes to resources. Instead of encouraging people to reduce consumption in the face of high prices, governments at all levels are providing rebates to consumers in order to cushion them against increased cost. If people had to pay more for the resources they use, they would value them more highly. Earth scientists know the importance of resources, and the importance of managing those resources well; they must convince their fellow citizens of the intimate connection between human civilization and the Earth's natural resources. We have used these resources from prehistoric times to the present: the nature of the most sought-after resources may have changed over time, but their importance for human survival and development has not (Fig. 2).

Similar kinds of disconnections between people and the Earth render them insensitive to natural earth hazards. These disconnects allow them to build dwellings or business structures in totally inappropriate places and then expect governments to bail them out when their structures are destroyed by landslides, coastal erosion, volcanic eruptions, or earthquakes. They are still barely aware of the drastic consequences of global climate

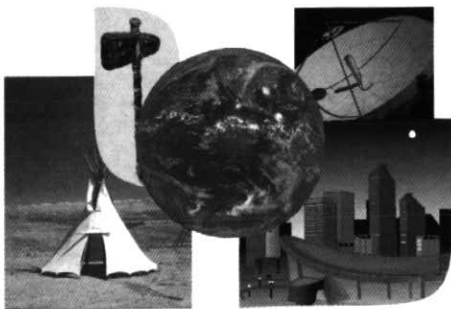


Figure 2 Humans have used Earth resources from prehistoric times to the present: the nature of the most sought after resources may have changed over time, but their importance for human survival and development has not.

change. They would still rather argue about whether it is naturally or anthropogenically produced than prepare for the consequences.

The crucial pieces of knowledge that are commonly missing relate to the intimate connection between the Earth, its resources, and human civilization. If earth scientists don't emphasize and elaborate this connection, the relationship between the Earth and its residents may grow weaker. Citizens, especially city dwellers, tend to lose all intimacy with the Earth and forget that what they, and their ancestors, have constructed is composed entirely of materials extracted from the Earth. They then exacerbate this disconnection by holding views on the state of the environment that are completely incompatible with the rewards of civilization that they enjoy. They commonly hold views locally that are not sustainable on a national or global level. This has been referred to successively as the Nimby Syndrome (Not In My Back Yard) and, more recently, as the more extreme Banana Syndrome (Build Absolutely Nothing Anywhere Near Anybody). Because of a lack of knowledge they are unable to hold a balanced view of management of the Earth's resources and environment. It seems that nations with the most voracious and sophisticated use of Earth resources, are the nations that are most disconnected. Canada is surely one of these.

REPAIRING THE CONNECTION BETWEEN PEOPLE AND EARTH RESOURCES

If you visit an elementary or junior high school class you can play a game with the students and their teachers in which they try to find something in the classroom that was not produced from the Earth. For example, the glass in the windows from quartz sand pits, the wallboard from gypsum mines, and the plastic chairs from hydrocarbons (Fig. 3). Many often think computers are different because they are part of the new clean information age and so it is important to point to the copper wiring, solder, silicon, steel, glass, and plastic of the computers. By the end of the game, there is nothing in the classroom, except the students themselves, that is not made from something ex-

tracted from a hole in the ground. Once this is established, you can easily reconnect them to their planet. This can be a revealing exercise for students and teachers alike. In my experience it is common to discover that a majority of people in an elementary classroom do not know, for example, that plastic is made from hydrocarbons or that metals are extracted from mines. The fact that much of this personal experience is based in Alberta, the home of the oil and gas industry in Canada, makes the lack of understanding particularly disturbing.

Another example might be local resistance to the opening of a gravel pit. It is common for the general public not to understand that deposits of any natural resource are localized and that the exploiter can't just move over the hill and mine the same resources. Again this is a fundamental piece of knowledge that seems self evident to earth scientists, but is often lost in public debate. If people have trouble understanding the distribution of resources at the Earth's surface, then consider how much more difficult it must be for them to develop an understanding of the distribution of resources that are out of sight underground, such as groundwater, oil, and gas.

Therefore I would urge any corporation, learned society, or government agency that wants to improve Canadians' knowledge of earth science to start at the very beginning by linking the Earth to the resources extracted from it.

REPAIRING THE CONNECTION BETWEEN PEOPLE AND EARTH PROCESSES

While it is encouraging that surveys show

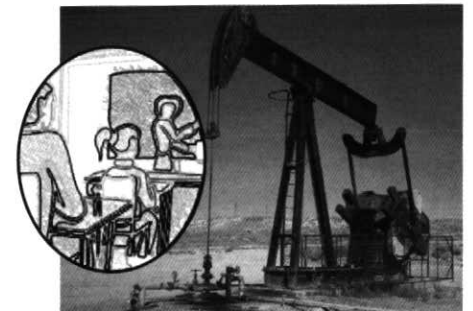


Figure 3 It is common to discover that a majority of people in an elementary classroom do not know, for example, that plastic is made from hydrocarbons.

that a majority of Canadians are at least aware of the general existence of plate tectonics (Fig. 4), how does the process affect the majority of Canadians? It probably doesn't. It does affect those who live in the westernmost part of the country directly because of the risk of major earthquakes and volcanic eruptions. For the rest it is largely an interesting theoretical, but unobservable concept.

Something that many more Canadians may experience in a personal way has to do with their own interface with the surface of the Earth. First, they may experience landslides and have no idea of their cause, whether natural or anthropogenic. The first thing that may cross the mind of a motorist delayed by a landslide in the mountains is why the government allows this kind of thing to happen and why it didn't put up barriers to prevent this inconvenience.

On a more local scale, the public may fail to understand processes that affect their own property. Why do people continue to build on flood plains, on rapidly eroding cliffs, or on unstable rocks or soils (Fig. 5)? They seem surprised when their property slips downslope or becomes flooded and they expect society to do something about it. This shows a much more critical lack of understanding about their Earth than does a lack of understanding of diurnal or annual planetary cycles about which they may

have been tested during the science literacy survey.

This is not to say that knowledge of important earth processes like plate tectonics or planetary cycles is unimportant for people; it is just that we should take care to include other more immediate and basic earth science topics in our school curricula and in our outreach efforts to the public.

CONNECTING EARTH SCIENCES AND THE REGIONS OF CANADA

Everyone takes social studies (what used to be known as geography and history) in school, and one of the key components of those studies is a regional view of Canada. One of the most effective ways to get across the importance of earth sciences to students is to review the geographic regions of Canada for a social studies class using a geological map, rather than the more familiar political or topographic map of the country.

The regions of Canada are generally considered to be the Maritimes, the Canadian Shield, the Great Lakes, the Arctic, the Prairies, and the Cordillera. If an earth scientist recites these while looking at a geological map of Canada, he or she will quickly realize that the geographic regions are differentiated primarily by their geology, although that will never be a reason given in the social studies text book.

The mixed economy and rapidly changing scenery of the Maritimes are clearly rooted in the complex geology of the Appalachian orogen. It is the reason there are frozen french fry factories in one valley and a copper mine in the next.

The Canadian Shield is explicitly delimited by the reds and pinks of Precambrian rocks. An earth scientist can relate the lack of good soil to low levels of agriculture, the long and complex history of the rocks to the relatively high incidence of mines, and point to the likelihood that anyone who grew up on the Shield likely was born in a town whose economy was based on the extraction of Earth resources: wood or minerals.

The Prairies are clearly delimited by the wide swath of green representing Mesozoic rocks. One can use this to connect to the monotony of the landscape, the excellent agricultural conditions, the oil and gas resources beneath,

and the tourism developed around the magnificent dinosaur fossils. The establishment of these connections often astounds the listener.

The Cordillera on the west are clearly defined by the north-south trending patterns on the geological map. One can readily relate tourism to mountains, mining to orogenic processes, earthquakes and volcanoes to the active mountain building, and the mixed economy to the great geological diversity. Again, most Canadians do not make these simple connections.

DO WE MEASURE EARTH SCIENCE LITERACY PROPERLY?

When scientific literacy is measured in surveys around the world, the key questions asked are usually simple, straightforward questions on scientific knowledge (see for example, Einsiedel, 1990 and the 1995 National Science Literacy Survey for Canadian examples). In the field of earth sciences such questions include true or false responses to statements such as: "The centre of the Earth is very hot," "The continents are moving slowly about on the surface of the Earth," or "The earliest humans lived at the same time as dinosaurs." In addition, questions such as "How long does it take for the Earth to go around the sun?" are posed directly to the person being surveyed. Canadians answer these questions reasonably competently (Fig.4).

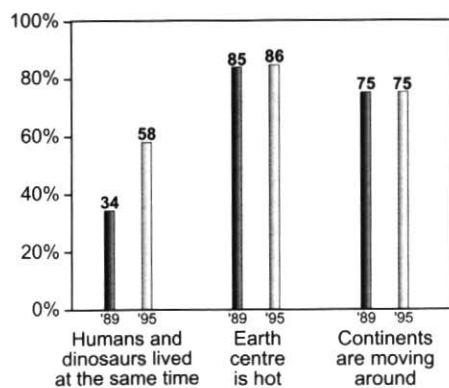


Figure 4 A graph representing the percentage of correct answers to questions in the two national surveys of Canadians: results from 1989 published in Einsiedel (1990) and for 1995 in a study commissioned by the Discovery Channel. With respect to the first question, the movie *Jurassic Park* came out between 1989 and 1995 and educated a lot of people.

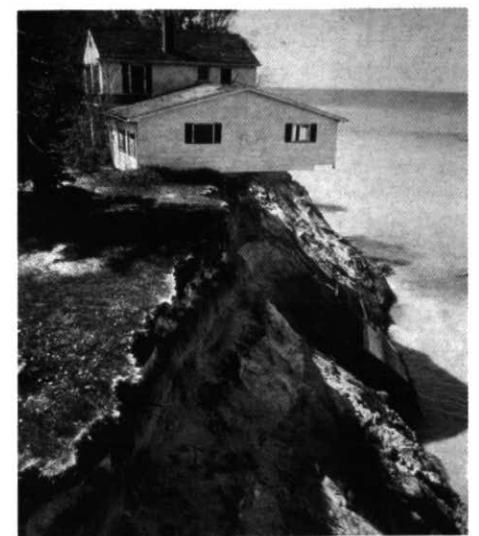


Figure 5 The public commonly fails to understand Earth processes that affect their own property.

While these questions do measure a certain kind of scientific knowledge, is it the kind of knowledge that we, as earth scientists, agree should be the *highest priority* knowledge for members of the general public? I don't think so. There is another whole level of knowledge that is much more fundamental for the public that is often overlooked and ignored because it is so self-evident to scientists themselves. However, such knowledge is often key to the possession of essential life skills and critical to decision making in the community.

In surveys, Canadians and citizens of other countries that want to have their populations measured for scientific literacy are asked what must seem almost hypothetical questions about the Earth with a right or wrong answer that can be measured. What is not measured is their understanding of the complex relationships between extraction of resources, their use and value, and their effect upon the general environment. Many also harbour misconceptions about natural hazards that may affect their lives from time to time. Furthermore, they commonly fail to understand much about their actual interface with the surface of the Earth on which they live. Think of the importance to humans of earthquakes, soil degradation, landslides, metals, plastics, and energy resources, and ask yourself what the general public knows about these.

GETTING THE MESSAGE OUT

As earth scientists, we have only ourselves to blame for the fact that North Americans are relatively unaware of the influence of Earth processes and Earth resources on their lives. We have tended to reach out by teaching the public the same things we teach our students in earth science departments. We believe that everyone should understand our science in exactly the same way that we understand it. In fact, we need to place a much stronger social context on earth science so that people can relate to it more easily. By the same token we often neglect to put a social context on the things we teach to our own earth science students, rendering them more ignorant than they should be about the social and ethical context for their work. We have commonly neglected to tell both the public and our students

about the very simple connections between the Earth and our lives. There is cause for optimism in this area, however, especially with the production of posters under the Geoscape Project (Clague *et al.*, 1997) and a new series of posters on climate change (Clague and Turner, 2000). These simple communication tools provide the basis for more direct connections of earth sciences to everyday life. Another positive development is reflected in the publication of a book of essays by earth scientists that provide direct and accessible stories of Earth processes and human interaction with the Earth (Schneiderman, 2000).

Canadian agencies and corporations involved in earth sciences should renew, refocus, and redouble their outreach efforts. Any group that intends to go out and provide something to increase the public awareness of earth sciences should aim at making connections between the Earth and the economy, environment, and general well-being of the citizens of planet Earth. Don't aim too high, keep it simple and straightforward, and as far as possible put your explanations within the scope of activities of ordinary people.

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REFERENCES

- Clague, J.J., Turner, R.J.W. and Groulx, B.J., 1997, Reinventing the geological map: Making science more accessible to Canadians: *Geoscience Canada*, v. 24, p. 161-172.
- Clague, J.J. and Turner, R.J.W., 2000, Climate change in southwestern British Columbia: Extending the boundaries of earth science: *Geoscience Canada*, v. 27, p. 111-120.
- Einsiedel, E.F., 1990, Scientific literacy: A Survey of Adult Canadians: Department of Communications, University of Calgary, 50 p.
- Nowlan, G.S., 1998, The changing landscape of earth sciences in Canada: A story of erosion and uplift: *Geoscience Canada*, v. 49, p. 49-56.
- Schneiderman, J.S., 2000, ed., *The Earth Around Us: Maintaining a Livable Planet*: W.H. Freeman and Company, New York, 455 p.
- The 1995 National Science Literacy Survey,

1995, prepared for the Discovery Channel in collaboration with The Royal Society of Canada, the Ontario Science Centre and Science Network Ontario, 27 p.

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