The partitioning of larger subjects is, perhaps, more likely to reflect editorial decisions. Certainly, the editors had little choice other than to group subjects into larger themes; the alternative–to include a heading for every single topic–would have produced a dictionary rather than an encyclopedia. Nonetheless, there is a good deal of inconsistency in how subjects are broken down. For example, topics dealing with carbonate rocks are finely divided, including short, separate entries as limited in scope as "Tufas and Travertines", "Stromatolites", "Ancient Karst", and "Cements and Cementation". Most of these short entries are excellent; they summarize the recent literature and briefly discuss possible interpretations. By contrast, a large subject like "evaporites" is treated in a single entry, in which, in limited space, the authors attempt to produce an encyclopedic entry covering such disparate topics as the economic uses, social history, environment of formation, and geochemistry of evaporites, as well as the Phanerozoic evolution of seawater. Many of these topics could have used a separate entry. Yet, coverage of some topics is repetitive. Soft-sediment deformation structures are treated in detailed entries that focus on individual types of structure, but also in an overview article that is superficial and mainly repeats what is stated more effectively in the detailed entries. There are also strange overlappings and splittings of topics in some of the book's otherwise excellent historical/biographical entries. A brief biographical sketch of R.A. Bagnold is largely repeated in a more entertaining entry focused on his scientific contributions. "Sedimentology, History" is a useful overview but is focused almost entirely on Europe and North America; meanwhile, the history of Japanese sedimentology is in a separate entry. A section devoted to "Sedimentology–Organizations, Meetings, Publications" covers organisations reasonably well and provides a cursory discussion of journals and special publications. However, with regard to conferences, this section provides only a list of generalities and platitudes about what conferences are supposed to achieve. Treatment of economic aspects of sedimentary rocks also is regrettably patchy. Placers are well represented, but laterites are absent and the discussion of "Bauxite" focuses on spectroscopic characterization, omitting any mention of the origin of bauxite. Other sediment-hosted ores (SEDEX, banded iron, or MVT lead-zinc) are not treated.

As noted above, the illustrations are generally of good to excellent quality. However, there are strange omissions here as well; flame structures, which are strikingly visual features, are described without any accompanying photograph or sketch. Sizing and choice of images are not everywhere optimal. In the section on glacial sediments, Figure G12 takes half a page to show a braided river emanating from a glacier terminus that is not even clearly visible in the picture. Referencing is also somewhat uneven, as in the well-written section on "Substrate-Controlled Ichnofacies", which excludes some key references from the past decade. In some cases, the editors have missed an opportunity by not requiring contributors to develop more comprehensive bibliographies, which would have been a particular boon to novice users.

But enough of criticism, for this book's failings pale alongside its virtues. The book will be useful to graduate students, senior undergraduates, and practicing sedimentary geologists of all stripes; every practicioner of sedimentary geology should have access to a copy. It deserves a place on every desktop but the very high price–about $475 in Canadian funds at this writing–probably means it will be found only the desks of workers with generous paycheques or bountiful research grants. Inevitably, it will fall to libraries and research departments to make the book available, although in these days of tight book budgets the price may also give pause to institutional purchasers. Because we do not wish to divide this excellent volume, Solomon-like, into six equal pieces, we are donating the review copy to the G.S.C.'s Calgary library.

Finally, because this review is to appear in a Canadian journal, it is appropriate to comment upon the pleasingly high level of Canadian expertise reflected in this book. Canadian contributors include the editor, three of the associate editors, and many of the individual contributors. This is a tribute to the strength of sedimentology and its subdisciplines in this country. Professor Middleton can take pride in the tremendous accomplishment that this book represents. He can also take pride in the vigour of the sedimentary profession in this country, for this is owed, in no small part, to his sterling efforts and intellectual leadership.

Collapse

By Jared Diamond
2005, Viking

A Short History of Progress

By Ronald Wright
2004, Anansi Press

Reviewed by Ward Chesworth,
Department of Land Resource Science, University of Guelph

"You think that a wall as solid as the earth separates civilization from barbarism. I tell you the division is a thread, a pane of glass. A touch here, a push there, and you bring back the reign of Saturn."

John Buchan, 1916.

Opulent materialism can only be sustained for the relatively few in society - the king and his court, the tyrant and his favourites, the president and his bagmen. The eighteenth century radical, Tom Paine, believed that the prototype of them all was the thief and his gang. The rest of us aspire to the more modest version of opulence called affluence. The problem is that the most fortunate part of the human population has now attained an affluence that approaches historical opulence. The affluence of a Canadian or American for example, is roughly the equivalent of 10 to 15 inhabitants of the third world, in terms of life-time consumption and waste generation (Zen, 2000). All 10 to 15 hope to enjoy our level of luxury someday, and indeed the Brundtland report states its goal to be exactly that (WCED, 1987). If achieved, it would scar the biosphere so badly that the downfall of the civilization we currently enjoy would be assured. Ten thousand years of trial and error, reaching back before Sumer, would simply be another failed experiment. And even if the goal is not achieved, as seems more likely, the stress

between the haves and the have-nots would leave little chance for the development of a stable world community.

People who contemplate the downfall of society are commonly criticised as pessimists, and labeled as being too negative to deserve a hearing. However, pessimism as much as optimism has survival value or natural selection would have removed it from our heritage long ago. In any case civilizations have collapsed in the past, so it is no more than prudent to consider the possibility of a collapse in the future. It is part of the due diligence we must exercise if we wish to sustain any but the most brutish existence over the long term. The authors of both books under review perform their due diligence, and both believe that there are important lessons to be learned from history.

Civilizations, says Ronald Wright (Progress p. 33), are "a special kind of culture: large, complex societies based on the domestication of plants, animals, and human beings". They "vary in their makeup but typically have towns, cities, governments, social classes, and specialized professions." It's what we pay taxes for, and I am grateful to Wright for exhuming a quotation of Oliver Wendell Holmes (Progress p. 127): "I don't mind paying taxes, they buy me civilization."

Wright's reference to domestication in the previous paragraph (with its sly inclusion of Homo sapiens) is an allusion to farming and to the fundamental importance of the farmers' surplus in support of a civilized existence. Look a little deeper and you find that the real basis of civilization is geological. We use a geological substrate, the soil, to grow our food; we rely on geological delivery systems – the water, weathering and erosional cycles – to keep our crops irrigated and supplied with nutrients; and we exploit geological resources, particularly oil, gas and fertilizer raw materials, to maintain the high yields needed to support our growing billions. As a result we have largely taken over two biomes in the temperate regions – the grassland and the forest. Like a doomsday parasite, we are consuming the biosphere from within. Progressive deforestation, soil erosion, excessive demand on water resources, and a loss of biodiversity, are amongst the most obvious effects of our depredations. Reform is called for if we want our civilization to continue for much longer, and both Diamond and Wright call for it.

Jared Diamond scored a great popular success with his Pulitzer Prize winning book Guns, Germs and Steel. It dealt with the origins of civilized societies and of inequalities in the wealth of nations. The book gave new life to old ideas, including the notion that "earth resources, particularly arable land and useful minerals, are strongly localized, so that some areas 'have' while others 'have not'" (Whittlesey, 1939). His current book "Collapse" examines the complementary problem – why complex societies fail. Incidentally, Ronald Wright reviewed the book in the Globe and Mail for January 15, 2005.

Diamond states that his objective is to investigate societal collapses "involving an environmental component, and in some cases also contributions of climate change, hostile neighbours, and trade partners, plus questions of societal responses." He insists that he makes no claim that environmental problems are at the root of all societal collapses, perhaps hoping to avoid the charge of environmental determinism. This is the doctrine that history is determined by some environmental cause that leaves humanity with little or no control over its fate. Northrop Frye (1957) made a waspish academic wisecrack on the subject: "the fallacy of what in history is called determinism, where a scholar with a special interest in geography or economics expresses that interest by the rhetorical device of putting his favourite subject into a causal relationship with whatever interests him less." The charge of environmental determinism was leveled at Guns, Germs and Steel by heavyweight professional historians such as William H. McNeil in the New York Review of Books for May 15, 1997, and Richard Evans in a debate with Diamond, broadcast on BBC Radio 4 in Melvyn Bragg's programme "In Our Time" (March 11, 1999).

It is Diamond's contention that every one of a dozen problems needs to be solved if our society is to avoid collapse. He identifies eight of these problems (Collapse p. 6) from a consideration of the difficulties and the downfall of societies in the past. They are "deforestation and habitat destruction, soil problems (erosion, salinization and soil fertility losses), water management problems, over-hunting, over-fishing, effects of introduced species on native species, human population growth, and increased per capita impact of people." Four (Collapse p. 7) he identifies as threatening current societies - "human caused climate change, buildup of toxic chemicals in the environment, energy shortages, and full human utilization of the earth's photosynthetic capacity." But is the total twelve in fact, or is it eleven? Isn't over-fishing just another form of over-hunting? Actually, it's likely to be only one big problem – the problem of human population growth and greed – or is that two?

But I'm nit-picking, and will take the number to be twelve for the sake of argument. Diamond certainly recognizes that all twelve are interconnected. Leave any one unsolved and we could go the way of the Easter Islanders he says (Collapse p. 79-119). This is the favourite cautionary example of several scholars, amongst whom Joseph Tainter (1988) should be singled out perhaps, as the author of the classic Collapse of Complex Societies, an influence acknowledged by both authors under review.

When they first arrived, the Easter Islanders found a cornucopia of easily exploited, low entropy resources – especially large trees, large marine mammals which they hunted from wooden boats, and fertile volcanic soils. They used up the trees completely, stopped singing their equivalent of "I'se the bye that builds the boats", couldn't catch the big marine meals anymore, and watched as the island's good soils were gradually flushed or blown into the sea. The basis of the complex society they had developed was gradually dissipated. At its most abstract, they were defeated by increasing entropy, as we all shall be in the fullness of time.

Why didn't the Viking settlers of Iceland meet the same fate? They had nothing like Easter's natural advantage of a relatively warm climate. Just below the Arctic Circle it's cold, dark and wet for much of the year. Volcanoes erupt under glaciers, causing gigantic floods that make the island a fearsomely dangerous place for human colonization. Like their Polynesian counterparts, the Vikings chopped down trees, although not quite all. The settlers' sheep and goats ate the seedlings and prevented

regeneration. Wind erosion carried exposed topsoil into the Atlantic Ocean. (Collapse 197-205).

In spite of everything, Icelandic society has survived for over a thousand years. It had three big advantages not enjoyed by the Easter Islanders. First, the Icelanders, with the usual ups and downs of any human population, have developed a deep sense of community – an all for one and one for all attitude which appears to be quite common in human groups living close to the edge of survival. Second, the religion they espoused was relatively benign in its material demands. Not for them the mad and ruinous expenditure of resources in a futile competition to impress their gods with bigger and better stone statues. However, the most important advantage was that they were not isolated from their roots – help was available when the going got tough (which inevitably it did). They could extend their ecological footprint back to Europe. Significantly, the Norse settlement in Greenland did not survive after it lost support from Europe.

But to return to Diamond's twelve problems: every one is technical and it is easy for him to suggest technical solutions. Take soil erosion for example: we can control it in a number of ways, among which are ridging and furrowing along contours as in East Africa, contour ploughing and leaving stubble in the fields over winter as the corn farmers of Eastern Canada do, converting arable land to pasture as the Azoreans have done, reforesting as the Icelanders are doing, or, most elaborately of all, constructing terraces as the Incas did. In part 4 of Collapse, Diamond shows that we can glean many practical clues on how to deal with such problems by studying the trials and tribulations of ancient and modern societies. He states once more (Collapse p. 438) that he is not an environmental determinist, and to underline the point stresses the importance of "courage" amongst peoples and leaders, in the survival of societies. Relegated to the notes at the back of the book (Collapse p. 521-525), he gives a prescription of practical measures that the ordinary citizen can take to lessen the environmental dangers we face. On the whole, although he admits that the subject of Collapse is a pessimistic one, the lessons he learned leave him "cautiously optimistic".

An earlier review concluded that Collapse is "probably the most important book you will ever read" (Flannery, 2005). That judgment is way over the top. There is no doubt that the book is an interesting and instructive roundup of the problems that beset human societies, but it doesn't probe deeply enough, and in addition it is rather prolix. Diamond's well-meant prescriptions, for example, will make you feel good, but they will not come anywhere near to touching the hard men who have the real power. They are little more than a set of band-aids for a system that actually needs radical surgery. Consider a few of Diamond's recommendations: boycott businesses you do not like, praise those that you do, talk to the people at your church, synagogue or mosque (would it be politically incorrect to include your favourite pub), make a donation to Ducks Unlimited (but why give money to people who eliminate the ducks' predators so that human hunters will have more ducks to kill). Still, band-aids are not a negligible addition to the social medicine chest, and they sometimes enable us to win small victories, especially in local arenas. The overall effect however, is transient and disappears like tears in rain. Even exercising our vote may turn out to be no more than palliative in a democracy continually subverted by the power of money. If anything, all of this makes me more of a cautious pessimist than cautious optimist.

We need to delve below the symptoms and find the disease, and at the technical level, part of the disease lies in the nature of agriculture, the unique geological process of the Holocene (Chesworth, 1996, 2002). Angus Martin (1975) asks the crucial question: "how many millennia of deforestation, dust storms and soil erosion has it taken for us to realize that our agricultural methodology has had serious flaws in it from the start." Wes Jackson believes that the critical mistake was to base our agriculture on annual species requiring a yearly cultivation (Jackson, 2004). This leads to exposure of the soil-surface in preparation for planting, the oxidation of organic matter, the break down of crumb-structure, the development of no more than a meagre root system (especially in the case of corn and soybeans). All of the foregoing increase the tendency of wind and water to carry the soil away. Jackson's answer is to start all over and to base our agriculture on the perennial plants of the Tall Grass Prairie. Not only that, he advocates the perennialization of existing annuals by embryo rescue which he describes in the following way. "We make a wide cross. The embryo forms but the endosperm does not or if it does is inadequate to keep the embryo going until it can take care of itself. That is biotech of sorts but not high biotech. When our geneticists rescue that embryo they, place it in a test tube with nutrient agar to keep it going until the young plant can collect sunlight on its own" (Jackson, pers. com. Feb. 10, 2005). This is not the contentious can of worms we refer to as genetic engineering (the "high biotech" of his comment). I do not have the space to go into that, but anyone interested will find an intelligent airing of the issue on Ann Clark's website at http://www.plant.uoguelph.ca/research/homepages/eclark/.

Jackson believes that his reforms could buy us another 10,000 years, and technically speaking he may be correct, but he's proposing radical surgery, and radical ideas get a frosty reception amongst the agricultural establishment. Tell the faculty of your friendly neighbourhood school of agriculture that farming needs a drastic makeover and you will quickly come to appreciate that such reform has profound behavioural aspects that overwhelm the technical problems. The farmer is the cynosure of all eyes and ranks right up there with the noble savage. The apologists for modern industrial agriculture and agribusiness have their wagons form a circle at virtually any sign of criticism.

A Short History of Progress is the text of the five Massey Lectures for 2004 given by archeologist and novelist Ronald Wright. Amongst his books is the novel A Scientific Romance, which won the David Higham Prize in 1997. Progress is short but by no means slight. Each lecture is a marvel of concise narrative, graphically expressed. The author takes his objective from the title of a painting by Gauguin: "Where do we come from? What are we? Where are we going?" The first two questions are easily answered: "There is no room for rational doubt that we are apes, and that regardless of our exact route through

time, we came ultimately from Africa" (Progress p. 27). The third question is the most interesting one and it takes Wright into the past where he crosses some of the same ground as Diamond. He sees the ruins of once great civilizations as "fallen airliners whose black boxes can tell us what went wrong" (Progress p. 8).

Wright's particular hook is the notion of the "progress trap"; an evolutionary path that initially brings desirable improvements to a society, but that eventually leads to excess, to decline and sometimes to fall. The first trap was set in the long run-up to civilization, when we perfected our hunting techniques. Everywhere we reached after leaving Africa we encountered large mammals and birds, too ignorant of our ways to be wary of us. We considered them to be no more than big meals, and the "bad smell of extinction" (Progress p. 37) dogged our footsteps. We became "serial killers beyond reason" (Progress p. 63), with the biosphere our abattoir. Unfortunately, efficiency in hunting in the unmanaged commons of the pre-Neolithic world, leads only down the road towards Malthusian crisis. Still, the trap was sprung when we invented agriculture and civilization, though seen from the perspective of the 21st century that looks as if it may be the greatest trap so far (Progress p. 32).

For all of its brevity, Wright's book digs beneath the proximate causes of concern that Diamond emphasizes and looks for ultimate causes. His thoughts in the first lecture about our encounter with the Neanderthals provide an example. Was it our first genocide? Does it represent "Stone Age forebodings of the final solution and the slaughter on the Somme?" Are we hard-wired always to prefer the path of short-term gain, no matter how grisly? Wright seems to be pointing in that direction: "our inability to foresee – or watch out for long range consequences may be inherent to our kind, shaped by the millions of years when we lived from hand to mouth by hunting and gathering" (Progress p. 108). Let's call it "Darwin's Trap" – the impulse to out-compete and out-breed our rivals. If it exists it might explain all the destructive behaviour detailed by Jared Diamond, and underlie all the progress traps of Ronald Wright.

At an even deeper level of causality, built into the very structure of the universe, there is a thermodynamic or "Terminal Trap". Fred Hoyle (1964), who believed that we were nearing the point of no return, put it this way: "It has often been said that, if the human species fails to make a go of it here on earth, some other species will take over the running …. This is not correct. We have, or soon will have, exhausted the necessary prerequisites so far as this planet is concerned. With coal gone, oil gone, high grade metallic ores gone, no species, however competent can make the long climb from primitive conditions to high level technology. This is a one shot affair."

The fight for democracy in the Second World War, and the construction of an affluent society after it, were based on the fossil energy we exploited by scaling Hubbert's Peak (Deffeyes, 2001). We are close to the top now and set to slide down the other side. We do not have a lot of time to put things right and the next energy source will be nothing like as cheap, portable and versatile. Wright reminds us: "each time history repeats itself, the price goes up" (Progress p. 107).

We are spending our planetary capital like drunken sailors in the Last Chance Saloon. We have to use what low entropy resources we still have, to make our one kick at the can count, or increasing entropy will deny us the energy to climb that hill again. More than anything we must recognize that for all our technical and scientific expertise, we have a behavioural problem. Let's face it, we're a mess, too easily seduced by will-o'-the-wisp promises of salvation through fundamentalist religion, dogmatic political ideologies, post-modern quackery, voodoo economics, the so-called Free Market, or that 20th century contradiction in terms, sustainable development, (to name, as Gore Vidal might say, but a few). We need to change our behaviour in double quick time and Ronald Wright is surely correct in saying that we must switch "from short-term to long-term thinking. From recklessness and excess to moderation and the precautionary principle" (Progress p. 131). It's easier said than done of course, especially if Darwin's Trap really exists, but it isn't impossible if we maintain a strong social structure, financed by an equitable tax system, and "governed by laws, not men".

As the Victorians understood, we are doomed by the Second Law anyway; but let's not worry about the inevitable. The Heat Death of the Universe won't happen tomorrow, and I'll take Wes Jackson's 10,000 years for want of a longer term.

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