

Redesigning Academia to Support Organic Farming

E. Ann Clark, Plant Agriculture, University of Guelph, Guelph, ON (eaclark@uoguelph.ca) ©2005 E. Ann Clark

Presented to the First Annual UBC Farm Research and Education Symposium, Vancouver, BC 1 Apr 05

The argument that academia needs to be *redesigned* presumes first that something is wrong now, and second, that there is a better way to do it. Focusing primarily on agriculture, evidence will be presented to support the following:

- a) that academia has *already* been redesigned, right before our eyes, by government's intentional insertion of industry funding, agendas, and ethics into academia, with disastrous outcomes not simply for academia but for society as a whole.
- b) that academia is uniquely qualified to inform, advise, and ultimately, convince government that forcible academic/industrial linkages are a net negative - to Canada and to Canadians,
- c) that the component-based, symptom oriented legacy of the 'industrial paradigm' permeates both the farming and academic communities - and truthfully, society as a whole - obscuring both the real issues and potential alternative solutions, and
- d) that to truly address the really big issues facing society today, academia - and society as a whole - must be transformed to adopt system-oriented thinking focusing on causes rather than symptoms, and on designs to avoid problems rather than to create and then solve them.

Some early examples of curriculum redesign at Guelph will conclude the talk.

The Industry Paradigm

Questions to consider: how did we get here, have the outcomes warranted the costs, what is wrong with it - generally, as well as in the specific context of organic farming - and what do we do about it?

How did we get here? The ubiquitous presence of industry on contemporary Canadian campuses did not occur through the immutable laws of Nature. In fact, the collegial relationship between industry and academia in Canada today has been contrived as a result of intentional government policy. The 1994 Science and Technology Review process was critical of Canada's limited productivity gains between 1974 and 1993 - in which Canada ranked 18th of 48 surveyed countries (Runci, 2000). Weak performance was attributed in part to "inefficiencies in the development, adoption, and commercialization of technology, which have dampened real income growth and contributed to high government deficits".

Paralleling developments from Reagan in the US and Thatcher in the UK, the Canadian government proceeded to reduce public funding for research by 30-50% in all major R&D

departments between 1994 and 1997, with further reductions in subsequent years, specifically to oblige Canadian researchers to focus on questions of commercial interest to industry. And it worked. Despite declining federal support, Canadian R & D increased by 40% in the 90s, owing to a robust increase in privately funded research, which rose by 70% over that same period (Runci, 2000).

A complementary and equally intentional outcome of this approach is that government no longer **leads** but **partners** with other institutions and industry. Government intentionally limits access to public research funding to those who are able to attract matching - usually industrial - funding. Government literature is replete with words like ‘partnership’ ‘cost-sharing’ and ‘innovation’, **where the leadership in research direction has been effectively ceded largely to industry.**

Examples of this repositioning to enable industry to take the lead in prioritizing the efforts of publicly funded Canadian academics may be viewed from the NSERC website:

Program	URL	Objective
Partnerships Programs		
Collaborative Research and Development (CRD) Grants	http://www.nserc.gc.ca/professors_e.asp?nav=profnav&lbi=b3	“intended to give companies operating from a Canadian base access to the unique knowledge, expertise and educational resources available at Canadian postsecondary institutions and to offer opportunities for mutually beneficial collaborations that result in industrial or economic benefits to Canada”
Idea to Innovation (I2I) Program	http://www.nserc.gc.ca/professors_e.asp?nav=profnav&lbi=b4	“to accelerate the pre-competitive development of promising technology and promote its transfer to Canadian companies”.
Intellectual Property Mobilization Program	http://www.nserc.gc.ca/professors_e.asp?nav=profnav&lbi=b6	“to accelerate the transfer of knowledge and technology residing in Canadian universities, hospitals and colleges for the benefit of Canada. IPM grants are intended to further strengthen the ability of these institutions to manage their intellectual property”
Research Network Grants	http://www.nserc.gc.ca/professors_e.asp?nav=profnav&lbi=b2	“It is critical to havethe active involvement and financial support of non-academic organizations....
Research Partnership Agreements	http://www.nserc.gc.ca/professors_e.asp?nav=profnav&lbi=b5	“to build strong linkages between the private sector and researchers in universities and federal institutes”
Strategic Project Grants	http://www.nserc.gc.ca/professors_e.asp?nav=profnav&lbi=b1	“The participation of one or more academic researchers with one or more ofnon-governmental organizations, industries or industrial consortia, and government agencies/departments..... They should...be actively involved in all stages... and guidance relating to the exploitation and/or commercialization of the results.”
Novel Next Generation Technology ...Energy	http://www.nserc.gc.ca/professors_e.asp?nav=profnav&lbi=ghgm	Projects should have the potential to lead to new areas of research that can be taken up by research organizations and industry;
Chair and Faculty Support Programs		

Chair in Design Engineering; Chair in Environmental Design Engineering	http://www.nserc.gc.ca/professors_e.asp?nav=profnav&lbi=c3 ; etc.	“match cash contributions from sponsoring ...organizations up to a maximum of \$200,000 per year, or \$1 million over the five-year term ...partner contributions can come from industry, government, the university or any other private or public sector organizations, communities or individuals”
Fuel Cell Research	http://www.nserc.gc.ca/professors_e.asp?nav=profnav&lbi=b5_1	“creation of knowledge and expertise through industrially focused multidisciplinary research”
Chair for Women in Science and Engineering	http://www.nserc.gc.ca/programs/wise_e.htm	“ will match private-sector cash contributions of up to \$70,000 per year for each of five years....NSERC funding must be matched by cash contributions from corporate sponsors”
Industrial Research Chairs	http://www.nserc.gc.ca/professors_e.asp?nav=profnav&lbi=c1	“funded jointly by NSERC and industry.only the industrial contributions are taken into account when NSERC determines its funding...industrial supporting organizations will normally contribute at least half the cost, in cash”

The demonstrably fallacious assumption that what is good for industry is good for society appears to have been a key driver for government policy. This argument is flawed at several levels, particularly when the industry in question is transnational, with no necessary allegiance to Canada - or for that matter, to any given country.

But the key point to remember is that it didn't have to be this way. This was an intentional and overt policy decision. And what has been made by policy can be unmade by policy.

So, was it worth it? Why fix was ain't broke? Is there evidence that the economic gains from academic/industry partnerships warranted government's wholesale restructuring of academia? The two best documented partnership endeavors were between MIT and Amgen (plus 6 other sponsors), and between Syngenta and a single department at Berkeley.

- The MIT arrangement was worth \$173 million, of which \$30 million was provided by Amgen over 10 years, starting in 1994.
- The Syngenta deal was worth \$25 million, over 5 years, starting in 1998, and unlike the Amgen deal, awarded Syngenta control over IP produced by the department - even if not funded by Syngenta, as well as first rights to licensing (Lawlor, 2003).

The primary commercialization outcomes associated with these massive projects appear to have been negligible, while engendering considerable friction within academia. Amgen reportedly got a few patents, of which it is 'following up' on just one - in return for its \$30 million investment. The more restrictive \$25 million Berkeley deal does not appear to have produced any commercializable IT (Lawlor, 2003), while destroying the career of Ignacio Chapela and raising serious questions about the integrity of the University of California at Berkeley.

Canada is hardly immune from similar entanglements, and for much the same reason (Tudiver, 1999). Consider the University of **Manitoba**, which welcomed a \$10 million Monsanto crop development center on campus (<http://www.acs.ucalgary.ca/~pubconf/Media/manitoba.htm>), to which the province of Manitoba itself contributed \$1 million

<http://www.trentu.ca/arthur/archive/34/34-04/news11.html>. As happened at Berkeley, Paskey (2000) cited concern among some faculty at the University of Manitoba who reported being 'blind-sided' by the decision to welcome Monsanto onto campus. The Manitoba Organization of Faculty Associations was motivated to sponsor a conference "Food for Thought" in March of 2000 to sound the alarm about the administration's collegial relationship with Monsanto.

While some lucrative, blockbuster patents have evolved from academic or academic/industry IP, most go nowhere and often embroil the university IP sector in contentious and debilitating litigation. Press and Washburn (2000) cited evidence that dozens of major US universities have spent as much in litigation with each other, and with their own faculty members, as they earned in all licensing and patenting activity.

The Guelph Director of Business Development advised in 2002 that despite the very high level of industry and public sector investment in genetic modification in a range of departments at the University of Guelph, **not a single GM product had yet been commercialized through her office**. The quasi-independent GUARD (Guelph University Alumni Research and Development) office raised \$14 million in capital from the University of Guelph and various others - specifically to capitalize on Guelph's IP. As of January 2003, GUARD retained several patents, but as yet, none had been commercialized. And despite having fully expended the whole \$14 million (40% of the shares are owned by the University of Guelph) over 7 years of operation, GUARD has yet to return a penny on the investment made by the University of Guelph and other investors.

Guelph is not unique in this regard. Press and Washburn (2000) provide an in-depth analysis of **just how pervasive - and how unprofitable** - university involvement in proprietary research has been for most schools.

Thus, the degree to which forcibly linking Canadian university researchers with industry has materially improved Canada's national productivity gains - the ostensible reason for government restructuring of academia in the industrial model - should be subjected to rigorous review and scrutiny before proceeding further down this divisive path.

Industry threatens academia What is clear, however, is the range of the deleterious effects caused by adopting the industry paradigm into academia. One of the more troubling is the perceived loss of objectivity in what Press and Washburn (2000) indelicately called the 'kept' university. Academia is rapidly approaching what could be called a 'credibility cliff'. Indeed, some schools have already thrown caution to the wind and openly embraced industry agendas in order to access research funding. In so doing, the distinction between 'inside' and 'outside' campus has itself been physically and functionally eliminated on campuses such as Berkeley, MIT, and Manitoba. Safeguarding academics from outside interference was a key justification for tenure and an essential prerequisite for 'academic freedom'.

The objectivity of industry-funded research is increasingly in doubt, as may be judged from analyses reported in both the scientific literature [Baker et al. (2003), Bekelman et al. (2003);

Burton and Rowell (2003); Levinsky, 2002); Lexchin et al. (2003); Melander et al. 2003); and Yaphe et al. 2001] and in popular academic texts and publications [Angell, 2004; Bruneau and Turk, 2004; Healy, 2004; Press and Washburn, 2000; Turk, 2000].

Biomedical research has been most heavily scrutinized. Based on surveys spanning 1140 biomedical studies ranging from calcium channel blockers to non steroidal anti-inflammatory drugs, Bekelman et al. (2003) concluded that industry-sponsored studies yield pro-industry conclusions. Examples included 'publication bias', or publishing results that were positive but not those that were negative for product efficacy, and 'multiple reporting' of studies with positive outcomes, to inflate favorable perceptions. Based on a review of 30 studies, Lexchin et al. (2003) found evidence of systematic bias in experimental design favoring outcomes advantageous to the industry sponsor, whether due to inappropriate comparator or publication bias. For further evidence of this disturbing trend, see the above referenced papers.

In sum, industry encroachment threatens the objectivity and credibility - and potentially, the very existence of - academia in modern society. This transformation is recent, intentional, and reversible.

The case needs to be made - and who better than universities themselves - that forcibly channeling academic research to the service of industry has resulted in limited, if any, commercializable outcomes at most schools, while simultaneously threatening the very place of academia as a societal institution in Canada. Surely this is one of the unique roles intended for academia by society - to see big picture issues, and to inform and alert societal decisionmakers, for the betterment of the society which pays our salaries. Indeed, it could be argued that if we fail to perform this service, and allow the industrial paradigm to continue unchallenged in academia (above) and in agriculture in general (below), that we are not doing the job we are paid to do.

Industry threatens farming, society, the environment and academia. Less obvious but more pernicious is the intellectual legacy of the components-based, symptom-oriented, product-focused thinking which drives modern corporations. By not simply permitting but actively encouraging 'how to sell product' thinking to dominate societal decisionmaking, government and academia have contributed centrally to the big problems now facing us today (see below).

According to McDonough and Braungart (2002), "design is the first sign of intention". The intention, and literally the only purpose, of business is to make money. Thus it is plausible and perhaps even inevitable that industry would design products which are profitable for them, regardless of costs to everyone else.

RR Wheat Case Study. Consider the example of RR wheat - an application developed collaboratively by Monsanto and the Canadian government with little or no consultation with the affected farm community. At the Univ of Saskatchewan, Furtan et al. (2003) concluded that introducing RR wheat in Canada would **cause:**

- **losses of \$45.8 and \$32.3 million annually to the adopters and non-adopters of the technology, respectively, and**
- **gains of \$156.6 million annually to Monsanto.**

Farmers lose because most importers of Canadian wheat say they won't accept GM wheat, and it is not feasible to segregate them. Everybody loses except Monsanto because the price of GM-contaminated wheat would be devalued in the marketplace.

RR wheat was conceptualized in the industrial model - as a way to sell product, without regard to what either farmers or consumers wanted or needed. It is therefore not surprising that the only beneficiary would be Monsanto. This case encapsulates elements of what needs to change if academia is going to be prepared to deal with the really big issues facing society today and tomorrow.

As a result of this and other factors, realized net farm income in Canada as a whole has trended downwards for decades, and is now below zero (NFU,2004). In the last census of agriculture (2001), net farm income per operator ranged from \$7,800 to \$14,500 among Ontario's five agricultural regions. The reasons are not the vagaries of the weather or the extraordinary impact of mad cow border closing, but rather, are an inescapable and predictable outcome of the industrial domination of agriculture, and of agricultural research and technology development.

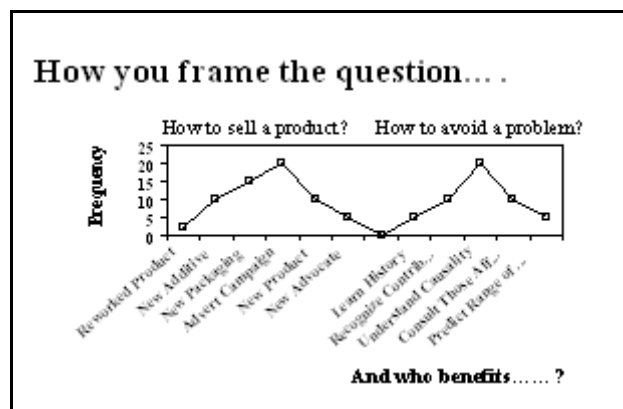
The industrial paradigm has engendered parallel, catastrophic outcomes to the environment. According to Gelinias (2001), the federal Commissioner of the Environment and Sustainable Development, "Current farming practices are not sustainable. In spite of conservation efforts, close to half of Ontario's agricultural soil is at risk of washing away faster than new soil can form. Livestock operations in Ontario and Quebec – often "factory farms" – generate manure equal to the sewage of 100 million people....Ottawa is not working effectively with the provinces to manage the problem, nor has it any formal plan in place...".

We are living beyond our means, according to the just released Millennium Ecosystem Assessment (<http://www.maweb.org/en/Article.aspx?id=58>), which called upon the efforts of 1360 global experts over 4 years. "Human activity is putting such a strain on the natural functions of the Earth that the ability the planet's ecosystems to sustain future generations can no longer be taken for granted." The pervasiveness of profound ecological problems globally - and in much more than simply agriculture - suggests root or foundational flaws in how we've chosen to build contemporary society, not localized or transitory issues.

To illustrate the thesis that industrial, product-based thinking is one of the root causes for this

conundrum, consider that **how a question is framed predetermines the range of possible answers.**

If the research question is ‘how to sell a product within the context of a particular problem’ - e.g. a private sector good), you will evolve one population of possible answers. But if the question is ‘how to avoid the same problem in the first place (and hence, to reduce dependence on purchased inputs, improve farmer profitability, rural community sustainability, and environmental integrity - e.g. a ‘public good’), you will certainly evolve a different, and likely, not overlapping population of possible approaches.



Problem Solving v. Problem Avoidance. To illustrate with a practical example, when faced with a weed problem, a conventional farmer - under the guidance of publicly funded research and extension agents channeled to the service of industry - would likely use an herbicide to kill the weed. To the farmer, the weed is the problem, and the spray is the solution. End of story.

But recognize that weeds are really symptoms of a larger system problem - not the problem themselves - such that spraying an herbicide is really just addressing a **symptom**, not a problem. Because they act at the level of a symptom, herbicides do not actually resolve the problem.

In contrast, organic farmers are necessarily ‘system-thinkers’, acknowledging that every issue has multiple causes, and every intervention has multiple impacts. An organic farmer faced with the same weed problem would start at the **causal** end. They would analyze what has happened to their production system to open or widen a niche, allowing the weed to proliferate to pestiferous proportions. They would then seek to modify whatever factors favored the pest, narrow the niche, and reduce the problem to acceptable proportions. The goal is not simply to kill the weed, but to narrow the niche which favored the weed in the first place, so that it exists below the threshold of economic impact.

Industry Promulgates Symptom-Based ‘Solutions’. Indeed, an herbicide **MUST** work at the symptom end and the weed which necessitated the herbicide **MUST** persist in order to sustain benefit to the purveyor. If Monsanto’s Roundup (herbicide) worked at the causal end, then Monsanto would be out of business in a year. It could be hypothesized that many contemporary inputs to agricultural production are necessarily designed to work at the symptom end, specifically to ensure that the problem itself persists, assuring sustained product sales.

The same symptom-based reasoning seems to apply not simply to industry-funded research today, and more alarmingly, to how we literally think about issues. Manure - and especially

phosphorous - overloading around megafarms is a significant externality forced on society and the environment. But rather than seeing the **manure as the symptom** and **factory farming as the problem**, academia-in-the-industrial-model chooses to genetically engineer a proprietary pig that excretes marginally less phosphorous, and then has the audacity to name it 'enviro-pig'. Or, government subsidizes ever-larger manure holding tanks on megafarms. Or obliges all farmers to comply with 'nutrient management' regulations which are so cumbersome and expensive as to force smaller operations out of business.

Thus, imposing the industrial paradigm into academia has produced limited economic spin-offs for society at large, compromised the perceived integrity of academia in general, and furthermore, left a legacy of symptom-focused thinking that obscures both the problem(s) itself and possible alternative solutions.

New Academia

We now know both how we got here, and the harm that has resulted from uncritically welcoming industry into academia - and in a broader sense, in allowing industrial thinking to override government 'in the public good'. The question now is twofold: how are we going to get out the current mess, and what are we going to do instead?

Question 1. The answer to the first question is straightforward if daunting: academia must inform government of the dubious benefits and palpable harm that has been generated by intentional, if misguided, government policy, and help them to rethink how best to address the really big issues of the future. Government must come to see that what is good for industry has not only been 'not good' for society, but has actually been deleterious, for the reasons discussed above. This is an uncomfortable even disquieting prospect, because this is not a role that academia has traditionally acknowledged. Nonetheless, the magnitude of the crises facing society today - global warming, unsustainable farming, fishing, and logging, pollution of air, soil, and water, peak oil, etc. - warrant extraordinary efforts if we are to survive, both as academia and as society as a whole.

Question 2. The answer to the second question requires even more aggressive change. Specifically, 'new' academia will need to think, conduct research, and teach:

- holistically, in **systems** rather than in **components** or products,
- emphasizing **causes** rather than **symptoms** of issues,
- using designs geared to **avoiding** rather than **solving** problems with resource-intensive inputs

In this effort, academia can learn from, and indeed - should model on - the sort of holistic, system thinking which has to date guided the evolution of organic agriculture. But organics as it exists today is an incomplete guide to sustainable farming and living, specifically because it is founded on the same flawed premises as conventional agriculture.

Is Organic Sustainable? To illustrate, Nature is the best and only standard of true ecological sustainability, as we simply don't live long enough to know whether conservation tillage, corn for ethanol, or precision farming so in fact represent ecologically 'sustainable' farming. Using the principles which we know sustain Nature to assess the sustainability of organic farming reveals some disconcerting flaws.

1. Most of global nutrition comes from barely a dozen crops, with **large-seeded annuals** like corn, rice, and wheat accounting for the lion's share. But what kind of environment selects for large-seeded annuals as the predominant growth form? The protracted summer drought of the Mediterranean climate appears to have evolved a disproportionate fraction of the progenitors of large-seeded annuals which have become our modern day grain crops (cited in Diamond's Guns, Germs, and Steel).

But annual crops pose insurmountable ecological challenges when grown in a humid, temperate environment - like here.

A. Annual crops introduce a **periodicity into nutrient sinkness**, leaving gaps in time during the year which little or no active nutrient uptake occurs. Labile nutrients like N and K, are vulnerable to leaching when precipitation exceeds potential evapotranspiration - which is in the fall and spring, coincident with planting and harvesting of annual crops. Conversely, a perennial groundcover, whether forest, hay, or golfcourse, maintains nutrient sinkness year-around - or at least for the part of the year when the ground is not frozen.

B. Annual crops require **bare soil** - a sight which is virtually unknown in Nature apart from shortly after a forest fire or landslide or hurricane. Nature has evolved various strategies for keeping the ground fully covered at all times, at least in the humid zones. So, channeling light energy and soil resources to annual crops obliges us to wage perpetual war with Nature, striving to keep the soil bare - whether through tillage or herbicides - against Nature's best efforts to cover it over.

C. Except for traditional intercropping, modern agriculture has evolved to monocropping, where only a single plant type is permitted to grow in a given field at a given time. Greatly reducing plant **biodiversity** - as compared to Nature or a perennial sward - reduces every other kind of biodiversity - yet biodiversity is essential both to control pestiferous populations and to maintain soil structure, nutrient cycling, and water infiltration.

D. Annually re-setting a field back to the pioneer stage loses the advantages of **succession**, which include accumulation of above- and below-ground organic matter and nutrients, above- and below-ground stratification/differentiation into different layers (e.g. the O, A, B, and C soil horizons), and increasing biodiversity. Withholding land from cultivation, as under a perennial hay or pasture field, allows succession to proceed and captures the ecological benefits of succession.

E. Resources cycle in Nature, but the modern agriculture and food system extracts nutrients from one place and deposits them to excess in another. Linearizing cyclical flows generates both scarcity and excess, and shortens the effective lifespan of civilization. Cycling nutrients - all nutrients - back to the land was the single defining feature for the sustainability of far eastern agriculture, as noted in King's Farmers of Forty Centuries. Marketing livestock products rather than grain or whole plant crops from the land exports a small fraction of the nutrients, leaving most to recycle in place, as in Nature. Yet who is pushing hardest for a single national organic standard - prairie grain growers, so they can continue to export their soil to Europe, in the form of grain.

In each of these respects, agriculture confronts and opposes Nature, and this is equally true in organic as in conventional agriculture. While numerous other issues bear on the question of why agriculture has proven to be so unsustainable through most of human history, suffice it to say that these are foundational issues - not just modern issues. If agricultural sustainability is to be attained, then we need to grapple with what it will take to transform agriculture to more closely emulate the lessons Nature is trying to teach us.

It should not be a surprise that contemporary agriculture - and probably organic agriculture - are not sustainable. Bill McDonough and Michael Braungart (Cradle to Cradle; 2002) say that **'design is the first sign of intention'**. By that criterion, it would be a coincidence of miraculous proportions if farming was, in fact, sustainable - simply because it wasn't designed to be sustainable.

Canadian agriculture was largely designed to export raw, bulk commodities to the home country - and that was it. That is what it was intended to do. More recently, Cargill, ADM, Tyson, and IBP have replaced the home country, but the net ecological, economic, and social effect is the same. Conventional production systems were not *designed* to be regenerative or to fully account for costs of production or to internalize costs or to pay a decent wage. As a result, farming (like everything else) could and did evolve practices which were heedless of ecological sustainability. Likewise, because social equity/rural community integrity and farmer profitability were not the intent, farming is neither socially just nor economically viable.

So, what is the intention(s) of agriculture? What are we asking agriculture to do for us? What would agriculture look like if it were, in fact, ecologically sustainable? Socially just? Economically viable? The same questions could be asked of other aspects of society, from mining, logging, and fishing, to housing, transportation, and health care.

Or academia. What is the intention of academia? Are we content simply to generate and disseminate knowledge, knowing that the type, intent, and end use of the knowledge is increasingly channeled to the needs of industry? Or do we envision - and act on - a broader mandate, to serve the interests of the society which pays our salaries? The choice is ours.

Initiatives at Guelph

Just to conclude, let me profile a few of the changes underway at Guelph which will hopefully contribute to the growth of New Academia.

As of Fall 2004, a new Major in Organic Agriculture within the B.Sc.(Agr) degree was approved by Senate. This may be the first academic major in organic agriculture in North America, and is certainly the first - hopefully of many - in Canada. We've now taught an introductory organic agriculture course for the fourth consecutive year, to an average of 25 students a year, and will be starting the remaining four new organic courses in Fall 2005. Details of the teaching and research underway in organics at Guelph can be viewed at our new website: www.organicag.uoguelph.ca

Alfred College, which is one of the 2-year diploma granting colleges affiliated with the University of Guelph, is now in the process of transitioning their entire 40-cow dairy herd to certified organic. Alfred, which is an hour east of Ottawa, is French-speaking, offers specializations in organics, and will serve as a nucleus for both teaching and research in ecologically sound farming in eastern Ontario.

At the 650 ac Ignatius Jesuit Centre, just north of Guelph, Christie Young is developing an Incubator Farm program, analogous to that at Intervale in Vermont (<http://www.vermontagriculture.com/new%20farmers/intervale.htm>). The Ignatius program is still under development, but it is hoped that Ignatius Incubator Farm program will provide graduates of the apprentice CRAFT experience with key learning and managerial skills to start their own enterprises.

Alexandra English, who is finishing an M.Sc. degree in Agroecology from a Norwegian university, has taken up as her M.Sc. Project the design of a 2-year certificate in practical organic farming, to be offered at Guelph. If approved, this will offer a combination of academic background and practical experience, culminating in a business plan for aspiring farmers.

So, a number of people have taken up the challenge of redesigning curriculum to meet the changing needs of those aspiring to a career in organics. Research funding remains very limited, but some movement may be underway. At least, we can always hope!

Angel, M. 2004. The Truth About the Drug Companies. How they deceive us and what to do about it. Random House, NY, 305 pp

Baker, C.B., M.T. Johnsrud, M.L. Crismon, R. Rosencheck, and S.W. Woods. Quantitative analysis of sponsorship bias in economic studies of antidepressants. *British J. Psychiatry* 183:498-506.

Bekelman, J.E., Y. Li, C.P. Gross 2003 Scope and impact of financial conflicts of interest in biomedical research: as systematic review. *JAMA* 289:454-466

Bruneau, W. And J.L. Turk. 2004. Disciplining Dissent. The curbing of free expression in academia and the media. A CAUT Series Titls. Lorimer, Toronto. 223 pp.

Burton, B. And A. Rowell. 2003. Unhealthy spin. *BMJ* 326:1205-7

Clark, E. Ann and Jennifer Sumner (submitted). Lessons in Sustainability from Organic Farmers in Ontario, Canada. Invited book chapter in S. R. Gliessman, Martha Rosemeyer, Sean Swezey (eds) *Making the Conversion To Sustainable Agriculture: Principles, Processes, and Practices.* An edited book for the Advances in Agroecology Series, CRC Press.

Furtan, W.H., R.S. Gray, and J.J. Holzman. 2003. The optimal time to license a biotech 'lemon'.

http://www.usask.ca/agriculture/agec/research/publications/working_papers/biotech_lemon.pdf

Gelinas, J. 2001. Great Lakes and St. Lawrence River Basin. Ch. 1. A Legacy Worth Protecting. Report of the Commissioner of the Environment and Sustainable Development. Office of the Auditor-General of Canada, Ottawa
([http://www.oag-bvg.gc.ca/domino/reports.nsf/html/c101fore.html/\\$file/c101fore.pdf](http://www.oag-bvg.gc.ca/domino/reports.nsf/html/c101fore.html/$file/c101fore.pdf))

Gillam, C. 2003. Monsanto courts farmers on gene-altered wheat. Reuters 4 Mar 2003.
<http://www.cropchoice.com/leadstry11c4.html?recid=1461>

Healy, D. 2004. Let Them Eat Prozac: The Unhealthy Relationship Between the Pharmaceutical Industry and Depression. New York University Press

Lawlor, A. 2003. Last of the big-time spenders? *Science* 299:330-3333.

Levinsky, N.G. 2002. Nonfinancial conflicts of interest in research. *New Engl. J. Med.* 347:759-761.

Lexchin, J., L.A. Bero, B. Djulbegovic, and O. Clark. 2003. Pharmaceutical industry sponsorship and research outcome and quality: systematic review. *BMJ* 326:1167-1176.

Melander, H., J. Ahlqvist-Rastad, G. Meijer, B. Beermann. 2003. Evidence bi(i)ased medicine - selective reporting from studies sponsored by pharmaceutical industry: review of studies in new drug applications. *MBJ* 326:1171-1175

NFU (National Farmers Union). 2004. Black Friday for Canadian farmers.
<http://www.oneworld.ca/article/view/78794/1/983>

Paskey, J. 2000. Research Deal Drives a Wedge at University in Canada's Rural Heartland.

Chronicle of Higher Education (April 2000; p. A75)
<http://chronicle.com/free/v46/i32/32a07501.htm>

Press, E. and J. Washburn. 2000 The kept university. Atlantic Monthly 285(3)

Runci, P.J. 2000. Energy, Research and Development in Canada. PNNL-13233 Washington, D.C. March 2000

Tudiver, N. 1999. Universities for Sale: Resisting Corporate Control over Canadian Higher Education. CAUT Series. James Lorimer & Co. Ltd, Toronto.

Turk, J.L. (Ed) 2000. The Corporate Campus. Commercialization and the Dangers to Canada's Colleges and Universities. A CAUT Series Title. Lorimer, TO. 223 pp.

Yaphe, J., R. Edman, B. Knishkowsky, and J. Herman. 2001. The association between funding by commercial interests and study outcome in randomized controlled drug trials. Family Practice 18:565-568.