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The Imperative for Nuclear Responsibility: Facing the Weapons Legacy in School

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Introduction

Schools have the responsibility to see that students consider the consequences of the development of uranium mining by examining ethical issues relating to nuclear weapons production, testing, and facilities contamination. This recommendation is made within the framework of an environmental ethic which recognizes that ignorance of the consequences of nuclear weapons technology constitutes a moral problem. To advance education committed to the preservation, health, and safety of humankind, teaching must put into question the public relations hegemony of nuclear proponents through critical thinking and ethical reflection. This essay looks specifically at the issues of nuclear ideology and hegemony in the public-relations campaign in Saskatchewan schools. The nuclear industry is advocating expansion in this province, where uranium has been mined since the 1950s and production is currently 20 percent of the world's supply. Pro-nuclear curriculum supplements provided to schools omit and/or, in effect, deny that Saskatchewan uranium has been or is being used in United States weapons production, testing, and facilities contamination. Three of these supplements are presented as representing a selective tradition to the province's schools. Review of one supplement, *Uranium in Saskatchewan: Teachers Guide*, examines treatment of the relationship between uranium mining and weapons production, testing, and facilities contamination. The conclusion is that the Guide does not provide the information required to support critical or ethical considerations in these areas.

Responsibility: Foundations for Nuclear Education

Hans Jonas offers a foundation for teaching constructed upon an environmental ethic of responsibility. In *The Imperative of Responsibility*, he argues that modern technology has introduced actions and consequences which former ethical frameworks can not adequately address. He contends that, in antiquity, human use of technology left the natural world fundamentally unchanged, therefore nature was not an object of responsibility nor of ethics. Human beings could use and create technologies without ethical concern because nature's generative powers were unaffected and human life was not threatened. However, modern interventions have been so novel, on such a large scale, and with such serious consequences that they interfere with nature's ability to regenerate, while threatening human life and habitation.¹

There are many examples of how this has come about: agricultural use of herbicides and pesticides has poisoned the land and waterway; production of CFCs has damaged the ozone; while carbon dioxide and other gases from automobiles and coal-fired power plants contribute to the green-house effect. Logging in Thailand and slash-and-burn in the Amazon are contributing to desertification. The diminishing ozone layer threatens human health and growth of vegetation directly. The accumulation of greenhouse gases is changing the world's climate and is predicted to affect human patterns of habitation. Nuclear weapons and nuclear-power technologies which use uranium and its products have also become the object of widespread criticism because of the threats they pose to the environment and human life. Uranium is an internationally-traded commodity that has been the object of controversy because of its military strategic value and because its use creates long-lived, highly-toxic substances. As the only naturally occurring radioactive substance which fissions and produces great amounts of energy, it has been used to construct over 50,000 nuclear weapons and is used currently to produce electricity in over 400 nuclear reactors. Ethical questions about the use of uranium have been posed in publications and at conferences. *The World Uranium Hearing*, September 13-19, 1992, at Salzburg in Austria, for example, gave a voice to Indigenous peoples from around the world who are suffering the effects

of uranium mining, atomic-bomb testing, and nuclear-waste storage.² *Healing Global Wounds* was a conference in Nevada, in August of 1992, which brought together Aboriginal peoples and others from the United States to discuss the medical and scientific responses to radiation exposure from uranium mining and nuclear-weapons testing. Their statement included a walk to protest weapons testing, which ended at a Peace Camp constructed at the Nevada weapons test site.

Hans Jonas argues that ethics for a technological age should be grounded in the recognition of our ignorance of the consequences of technology and our commitment to the preservation, health, and safety of human life. The ability to understand and predict the consequences of new technologies falls far behind our power to develop them. Our ignorance creates a moral problem. Ethical consideration means that we must recognize this huge knowledge gap in order to govern it. As technology has become a central feature of our lives, ethical attentiveness becomes an imperative. Our first obligation has become to preserve the physical world in order to ensure the integrity, health and safety of the person and to protect nature and the environment from conditions which imperil their existence.

The use of uranium is perceived by many to constitute a threat because of the wastes produced through the nuclear fuel cycle, particularly in nuclear weapons and through the production of nuclear power. Today, Saskatchewan uranium sold to the United States and its products are found in contaminated US nuclear weapons facilities; the warheads of more than 27,000 US nuclear weapons; contaminated lakes and rivers; the storage bays of civilian nuclear reactors (some of which have been accumulating high-level waste for 30 years); the contaminated walls of these reactors, which will soon have to be decommissioned; and in the stratosphere, where radioactive contamination continues to circulate since weapons testing of the 1960s. Nuclear waste products include strontium, cesium, and krypton, intensely radioactive fission products which last for hundreds of years. Transuranic substances, including plutonium, Americium, and neptunium from fissioning are less hazardous but remain radioactive for hundreds, thousands, and billions of years. An average of thirty tonnes of irradiated nuclear fuel bundles are produced by each of America's 117 nuclear reactors in a year. Sludge from reprocessing nuclear fuel

bundles constitutes the longest lived and most intensely radioactive waste. Use of uranium has also contributed to the production of enormous quantities of "low-level" waste which includes sludges, resins, filters, and other materials used to clean reactor parts, as well as entire nuclear plants which must be securely disposed of when dismantled.

Releases of radioactive substances are associated with many adverse health effects including sterility, cancers, suppression of the immune system, and other conditions.³ Since the nuclear era began, scientists have learned much about the effects of ionizing radiation. For example, in 1989 a US National Research Council committee concluded that acute doses of radiation are four times more likely to induce leukemia and three times more likely to cause cancerous tumours than believed ten years ago.⁴ In the United States for the last forty years, nuclear weapons manufacturing at about 100 plants has led to extreme environmental pollution, which government and industry now need to address.⁵ To make possible ethical reflection that puts uranium mining into question, curricula need to acknowledge and study the consequences of its development.

Nuclear Hegemony in Saskatchewan Schools

In constructing pedagogies of critical literacy for ethical reflection committed to the preservation, health, and safety of humankind, schools are not neutral political arenas but rather centres of ideological contestation. Apple argues that consciousness and practices in schools, determined through a "complex nexus of relationships", are ultimately economically rooted.⁶ This theory is useful in understanding how nuclear hegemony and ideology saturate and shape the consciousness of teachers, administrators, and students. Central to this position is the distinction between "hegemony" and "ideology". Compared to ideology, which Apple views as somewhat abstract, secondary and superstructural, hegemony constitutes the limits of common sense and permeates thought. Our educational, social, and economic points of view become "the only world". Hegemony refers to an "organized assemblage of meanings and practices, the central effective and dominant system of meanings, values, and actions which are lived".⁷ It is possible, for example, for schools to reinforce an effective and dominant

set of meanings which fails to acknowledge that Saskatchewan uranium has been used in the production of nuclear weapons and is available for military use.

Schools perpetuate the dominant economic interests through the social process of *incorporation*, the inclusion and emphasis of certain meanings and practices, through what Apple calls the *selective tradition*. Because they are relatively autonomous, in his view, this is not done "consciously". However, in the selective tradition teachers and schools pass on the effective dominant culture as the significant past. In this process, teachers "select" a particular interpretation of events, which reflects the economic interests of the dominant group, to constitute the curriculum. At the same time, they do not present information or interpret events with the same sophistication, thoroughness, or conviction which confront or contradict these forces. In *Ideology and Curriculum*, Apple quotes Raymond Williams on selective tradition:

Moreover, at a philosophical level, at the true level of theory and at the level of the history of various practices, there is a process I call the *selective tradition*: that which within the terms of the effective dominant culture, is always passed off as "the tradition," the significant past. But always the selectivity is the point; the way in which from a whole possible area of the past and the present, certain meanings and practices are chosen for emphasis, certain other meanings and practices are neglected and excluded. Even more crucially, some of these meanings are re-interpreted, diluted, or put into forms which support or at least do not contradict other elements within the effective dominant culture.⁸

At present, the nuclear industry provides selective information which schools can incorporate into their curriculum. This has been achieved through campaigns focused directly upon schools. In the late 1970s the Saskatchewan Mining and Development Corporation sought to "immunize" students against criticism of the nuclear industry by massaging various sectors of the school system.⁹ They provided bursaries for students; visits from company representatives and public relations personnel with teachers, students, and school counsellors; books for libraries; financial assistance for teacher activities; speakers and resource bureau; a summer program for students; student, teacher, and school board tours of the uranium mines; and free distribution of glossy pro-nuclear publications to students.¹⁰

The industry invited science teachers to special panels, symposia, and conferences. The Canadian Nuclear Association (CNA), made up of more than 100 companies and agencies, targeted Saskatchewan church, media, labour, government, and education leaders with a multi-million dollar public relations and education campaign as part of a broader thrust to advance nuclear development in Canada. The CNA's *Public Education and Communication Strategy for the Nuclear Industry in Canada* (August 1987), identified the public, opinion leaders, and regions as campaign targets. The *CNA Public Information Program Business Plan 1987-1988* reported a budget of \$4,260,000 to promote the industry through education, advertising, research, print materials, lobbying, movie and video production, and a speakers bureau. These materials are part of the strategy of moving people from "opposition to neutrality", "from being soft opponents to being neutral fence sitters".

In recent years, the nuclear industry has taken considerable initiative in this area. Saskatchewan's Lieutenant Governor, an outspoken nuclear advocate, officially opened a \$300,000 *Uranium Today* trailer in 1989 that visited schools with a pro-nuclear message. The industry flew vice-principals to tour the Key Lake uranium mine and has provided each elementary school with a three-ring binder of lesson plans and overheads for classroom use. Through its Futures Department, the Government funded the *Futures Caravan* which toured Saskatchewan's schools with a model of the Candu reactor as its central display. The government supported the production of a video program on uranium mining, funded by the nuclear industry, for distribution.

Consulting companies provide the industry with suggestions about how to approach the education system:

In their "Rationale for P. J. Spratt & Associates Approach to the Challenge of Effective Communicating with the Education Community," Spratt and Associates consultants for AECL (Atomic Energy of Canada Limited) point out that to penetrate the education system, outside interests need to understand that "education has established norms regarding its internal decision-making and relationships with the community." It views the education system as a market, with which the industry can set up long term cooperative arrangements. Because schools support liberal democratic norms and seek to appear neutral on debatable items, the industry is advised to present resources within the framework of traditional

values and not as alternative to them. They also identify the distribution of teaching aids and teacher training as two key elements in informing teachers. To overcome the credibility gap of distrust between education and corporation, characterized by teacher suspicion of nuclear advocacy, they suggest that the industry should develop convenient usable information aids for busy teachers. The development of these aids should result from cooperative efforts in which teacher and industry interests are mutually satisfied. Teachers and suitable provincial representatives should be involved in this production if they are not to be alienated from them.¹¹

Promotion of the nuclear interests in the 1970s and 1980s accompanied Saskatchewan becoming the world's uranium producer in the last decade. At present, its three uranium mines are among the richest in the world. Although opposition to uranium mining in the province has been vocal, broad-based, and encoded in the policy of the New Democratic Party from 1983 to 1992, all three political parties in the province now support the industry's development. The recent increase in public relations initiatives in the schools is associated with proposals to open five new sites currently under review. Atomic Energy of Canada Limited, a Crown Corporation, has lobbied extensively to construct a nuclear reactor, undertake research on new projects, and construct a high-level nuclear waste disposal site in the province. In the face of the declining fortunes of the nuclear industry in Canada, particularly in Ontario where uranium mines have been closed and new nuclear power plant construction stopped, Saskatchewan has been targeted for industry expansion.

Nuclear-industry materials are not the only ones on the subject available to teachers and students in schools. Schools, school libraries, and division libraries have resources and access to technical information, as well as social, political, and moral debate on uranium-mining related issues. One excellent source, "Uranium: A Discussion Guide", published by the National Film Board of Canada (NFB), designed as a supplement to the NFB film "Uranium", on the consequences of uranium mining in Canada, has received considerable circulation. Other materials are available to schools from environmental and anti-nuclear organizations such as the Inter-Church Uranium Committee Education Cooperative, the Saskatchewan Environmental Society, and the International Uranium Congress. However,

unlike the nuclear industry, these groups do not have strategic campaigns aimed at supplying curriculum supplements to all schools, and they have minimal financial resources with which to produce materials.

Responsible Education: Critical Thinking for Ethical Reflection

Education for nuclear responsibility that responds to the hegemony of nuclear public relations could draw upon critical-thinking pedagogies that lead to ethical reflection and challenge normative assumptions within which societal ignorance about the relationship between mining and nuclear weapons is embedded. In *The Moral and Spiritual Crisis in Education*, David Purpel argues it is necessary for educators to affirm moral and educational commitments at a time when educational reform tends to be trivial and when educators reflect the larger society's difficulty addressing moral problems. He presents the Socratic and prophetic traditions as frameworks for confronting the problematics of avoiding moral affirmation. Socrates grounded teaching in a commitment to intellectual pursuit as sacred. He engaged in critical thinking through emphasis on clarity, examination of statements, scepticism, and logical analysis. Rather than teach "critical thinking" or "cognitive development" as a skill, like a debate coach, he taught virtue through critical examination of conventional thinking, within a social and sacred vision. Such an environmentally-responsible pedagogy could examine the conventional thinking presented to schools through public-relations materials and speakers today.

To carry his commitment further, Purpel, who draws from Abraham Joshua Heschel's *The Prophets*, offers a notion of critical pedagogy for ethical reflection within a prophetic understanding of nuclear responsibility. Purpel identifies the biblical prophets as educators who increased "public awareness and insight into the ultimate significance of... events."¹² They were social critics who spoke loudly and vividly from a deep devotion to sacred ideals. They called upon society to return to its highest aspirations and made it aware of the consequences if it did not. Impatient of excuse and contemptuous of pretence and self-pity, the prophets were concerned with "wrenching

one's consciousness from a state of suspended animation".¹³ They energized and encouraged the demoralized to action. Industry public-relations campaigns can shape knowledge and values in society and schools through the force of ideology and hegemony. Teachers and students who intend critical and ethical analysis which portends the possibility of resistance and opposition may need such "en-courage-ment".

Much analysis has already been undertaken in educational journals on these matters. However, the importance of critical thinking, particularly in the form of technological literacy, has become accepted as part of curriculum in many jurisdictions. With the introduction of the Core Curriculum to Saskatchewan schools, teachers were called upon to ensure that Critical Thinking and Technological Literacy were Common Essential Learnings in their school systems. Critical Thinking intends students reflect upon and examine their own thinking and to scrutinize propositions or claims by others.¹⁴ Through Technological Literacy students develop a critical understanding of how technological developments relate to human culture and values.¹⁵ It covers the notions of technology as hardware, know how, and sociotechnical systems of manufacture and use to understanding the value-laden political and cultural dimensions.¹⁶ Both these approaches allow students to examine information and apparently rational ideology, indoctrination, and public-relations rhetoric.

Many ethical issues are associated with the use of uranium for weapons production, testing, and contamination of facilities and environment. The most obvious and immediate issue, debated in schools, churches, and union halls, is whether uranium should be made available for weapons of mass destruction which directly threaten the existence of the planet. Various ethical frameworks and critical approaches allow versions of this question to be formulated and reformulated. Should uranium be sold for civilian use when the by-product of uranium fuel becomes available to the military for weapons use? How should uranium suppliers to weapons producers understand their ethical responsibility within a society where government and citizenry are impoverished through participation in the arms race? Even though nuclear weapons may not be used, how does one assume responsibility for radioactive contamination and threats to human life created in the process of

producing those weapons? Critical questions reflect society's interests. In Saskatchewan, such questions have been posed on several occasions, as the industry has expanded, through public inquiries, hearings, and political debate.

Identifying the Selective Tradition

In analyzing how the *selective tradition* presents the relationship between uranium mining, and nuclear weapons production, testing, and facilities contamination three curriculum supplements available to Saskatchewan schools were chosen for review: URANIUM Today, a mobile information unit; "Uranium in Saskatchewan: Teachers Guide", a three-ring binder of teacher information, plans, and resources; and "Uranium", a video on uranium mining in Saskatchewan. Other materials, both anti- and pro-nuclear, are not universally available and are not designed for ready use in the classroom, to complement one another, nor to be curriculum-specific. They are either too technical or written for the general public; are not supported by other services, lobbying or external resource materials; are poor quality (photocopy, newspaper, or "shoestring" publishing); or do not have external legitimating agencies in government or industry. The three were selected because of their universal availability, design for easy use by busy teachers, complementary to one another, integration into the curriculum, industry support in the school system, high-quality production values, and external social legitimation. These characteristics increase the likelihood that they will be used more extensively and effectively than other materials, while representing the selective tradition:

1. They are distributed or available to all schools in the province with students in Grades 8 and 9. The URANIUM Today trailer has toured most schools in the province with its display and can be booked for return visits. "Uranium in Saskatchewan: Teachers Guide" was distributed free to all schools. The video, "Uranium", is made available through Media House through a dubbing service at minimal cost.
2. They are designed for easy use. The trailer comes to the schools. Teachers do not have to arrange trips, seek parental permission, provide information to parents, or spend time commuting. Because the organization of schools, particularly rural schools, makes it difficult to undertake field trips,

its arrival is anticipated by the whole school. Material in the trailer is attractively displayed and presented in three-dimensional, action, and interactive formats. The Teachers Guide has lesson plans, overheads, information, and hand-outs prepared for minimum teacher preparation and organization. Student material is easily interpreted and written in usable language. The video can be used in any VCR, which all schools have.

3. They are complementary to one another. The trailer and Teachers Guide have been designed to complement one another with pre- and post-tour lessons. Material on uranium and nuclear weapons are virtually identical. The video reinforces the same position by excluding reference to the use of uranium exclusively for weapons production and by focusing on the use of uranium for peaceful purposes.
4. They are prepared to relate to the curriculum. The trailer and Guide are specifically constructed to supplement the provincial Grades 8 and 9 science curriculum.
5. They are supported by other services, lobbying, and resource materials external to the supplements. The industry has flown Saskatchewan vice-principals to a northern uranium mine, made presentations in schools, and displayed materials at meetings of social studies and science teachers and professional groups like the Saskatchewan Council of Educational Administrators.
6. They are well-funded resources, which use quality production materials. "Uranium" is funded and produced by a radio and television station, the nuclear industry in Saskatchewan, and Saskatchewan Education. The URANIUM Today trailer is funded by the uranium-mining industry at the cost of \$300,000. "Uranium in Saskatchewan: Teachers Guide" is paid for by Uranium Saskatchewan.
7. They are credited by significant external legitimating social organizations. The Lieutenant Governor opened the URANIUM Today trailer in a high-profile ceremony in Saskatoon that was reported in the provincial media. The Canadian Nuclear Association, The Canadian Nuclear Society, uranium mining companies, Atomic Energy of Canada Limited, and Uranium Saskatchewan fund community and provincial organizations and events, invite teachers to their conferences and meetings, and undertake media initiatives and public relations programs.

Review of the three supplementary materials shows that they consistently omit and, in effect, deny the view that Saskatchewan uranium is used in nuclear weapons.

Uranium Today: Uranium Saskatchewan's Mobile Information Unit. The URANIUM Today unit is a trailer that has toured schools throughout Saskatchewan for Uranium Saskatchewan, the uranium section of the Saskatchewan Mining Association. It supplements the Grades 8 and 9 science curriculum for students throughout the province. Students from other grades explore the trailer, as well. It offers information about uranium mining through several displays. One picture depicts a mushroom cloud encircled and crossed through with a NOT sign. The message is that uranium is not sold for weapons production.

Uranium in Saskatchewan: Teachers Guide. Uranium Saskatchewan also provides a three-ring binder of materials called *Uranium in Saskatchewan: Teachers Guide*,¹⁷ with lessons suitable for use before and after touring the URANIUM Today trailer. This kit, designed to assist teachers in discussions of "the uranium-mining industry" in class, complements the Grade 8 science curriculum theme *The Geology of Saskatchewan* and *Man's Utilization of Earth's Resources* and complements the Grade 9 science curriculum theme *Energy* and *Energy and Civilization*. At hand for efficient and effective use by the teacher who may have little time to search for, think through, and prepare for lessons in the area, the kit presents teacher information, six suggested lesson plans, student handouts, answers, overheads for display in class, a glossary, and a resource list. The material is attractively and effectively displayed in sections coded through coloured plastic tabs.

"*Uranium*".¹⁸ This program, produced by a television station and financed by the nuclear industry with assistance from the provincial government, does not inform students that uranium mining began in Saskatchewan in 1953 for the sole explicit purpose of supplying all its uranium for weapons production in the United States until 1965.¹⁹ Reference to this period is conspicuously absent following the pre-war discovery of pitchblende in northern Saskatchewan and the war impetus to develop uranium mining. Subsequent references relate to the progress in technology of nuclear power for peaceful

purposes. This clearly pro-nuclear video discusses the dollar value, amount, abundance, location, and richness of Canadian and Saskatchewan uranium. It presents information on uranium mining and milling processes, the destination of yellow cake, and the fly-in arrangement for mine workers. It reports that there is extensive radiation monitoring (a study which shows little effect of radiation on a lake) and that monitoring is effective and responsive.

Review of these materials shows that they do not inform students that Saskatchewan uranium was sold exclusively for military purposes between 1953 and 1963. Although they provide chronologies of events, references to that period are absent—conspicuously so to anyone familiar with the history. Contrary to fact, one is given the impression that Saskatchewan uranium has been sold and used only for peaceful purposes, primarily nuclear power. Reference to recent sales of uranium indicates that it has not been used or available for use in weapons and armaments production.

“Uranium in Saskatchewan”: A Textual Analysis

Four of six lessons in *Uranium in Saskatchewan: Teachers Guide* make reference to uranium mining and nuclear weapons and offer selected chronologies. It is important to determine if they provide relevant information for the study of uranium use in nuclear weapons production, testing, and contamination of facilities. This is necessary if students are critically to consider the associated ethical issues. This section describes and comments on the Teacher Information, Lesson Plans, and Student Handouts.

1. Grade 8 - Lesson 1

The “Suggested Lesson Plan” for Lesson 1, under “Topic 1: What is Uranium?” offers six statements from which teachers construct a lesson. Four examples are 1. Uranium was extracted from pitchblende two centuries ago by Martin Klarpoth; 2. Uranium is a mineral; 3. Uranium is the tenth most common element in the world; and 4. The teacher can hand out the information sheet provided. There is no material in the Teacher Information section for the lessons on pitchblende,

Martin Klarpoth, what a mineral is, or why the fact that uranium is the tenth most common element in the world is important to know. The provision of these statements is completely arbitrary.

The lesson plan also states that "Uranium was first extracted in Saskatchewan in 1953. The mine was located at Beaver Lodge in the Uranium City area." Further, "It is a highly concentrated form of energy which is used in nuclear power reactors." What is not offered is that the mine near Beaver Lodge was opened in 1953 to provide the United States government with uranium for weapons production and that virtually all uranium mined from this area until 1963 was for that purpose. Statements make it appear that uranium was only used for power generation. The use of uranium for weapons has been excluded.

The Student Handout, "Uranium Quick Facts", repeats the same information: "Uranium mining in Saskatchewan began in 1953", and "Uranium is the fuel for all current nuclear powered electrical generating stations". In addition, "Canada's production... is not sold for use in nuclear weapons." Although this statement is true today, the Handout does not reveal past sales for nuclear weapons purposes. It also fails to discuss the fact that "[f]or every seven units of uranium that enters an enrichment plant, regardless of source, less than one unit ends up in the finished product: reactor fuel. The other six units, called depleted uranium are discarded as waste...Depleted uranium has been used regularly by the US military in the manufacture of weapons."²⁰

2. Grade 8 - Lesson 3

The third and final Grade 8 Lesson Plan recommends that students debate the statement "Be it resolved that a uranium mine may be started near our community", and that they write a letter to the editor to outline their position on this topic. While the kit provides the occasion for what might otherwise be a critical discussion, it furnishes an arbitrary list of "points to be considered".

The kit lists the following *pro* points:

1. Job creation and economic benefits.
2. Diversification of the economy.

3. Steps taken to ensure minimal impact on the environment.
4. Worker's health and safety is [sic] monitored.
5. The mined uranium would not be sold for nuclear weapons in keeping with Canada's Non-Proliferation Treaty.

The kit lists the following *con* points:

1. Environmental concerns.
2. Concern's about worker's health and safety.
3. Nuclear weapons concerns.
4. Concerns about changes in community lifestyle.

The economic *pro* points are specifically divided into job creation, benefits, and diversification. No general or specific economic *con* "points for consideration" are offered.

The *con* side is presented in more abstract terms than the *pro* side. The kit writers used the general term "concerns" in every *con* point and never used equivalent broad concepts like "benefits" to state *pro* points. More specific language makes it easier for students to formulate and present *pro* arguments. Positions contrary to uranium mining would have to be constructed out of their own basic concepts. The conceptual work already undertaken for the *pro* side gives it considerable advantage. A similar imbalance is evident in the considerations about nuclear weapons.

The kit writers constructed a *pro* point about uranium and nuclear weapons which students could use to support an argument in favour of uranium mining, but they did not provide an equivalent *con* point. The phrase "Nuclear weapons concerns" cannot be used as a reason for opposing uranium mining in the same way as the Non-Proliferation Treaty might be used as a reason to support it. To construct an argument, students would have to research the area.

3. Grade 9 - Lesson 1

In the Teacher Information section of Grade 9 - Lesson 1, the kit makers ask, "Does Canada's nuclear industry contribute to nuclear weapons production?" It provides the answer:

Uranium produced in Canada is sold for peaceful purposes. The International Atomic Energy Agency (IAEA) acts as a watchdog and enforces agreements between member countries on nuclear issues. The IAEA installs devices to monitor the operation of nuclear power stations. IAEA inspectors make unscheduled visits to ensure

accurate inventory control of fuels. This is one method used to ensure that Canadian uranium is used only for peaceful purposes.²¹

The Lesson Plan poses the question, "Does uranium mining contribute to nuclear weapons proliferation?" for the teacher to raise in class. The Student Handout states only, "All uranium mined in Canada is sold for peaceful uses and may not be used to manufacture nuclear weapons." However:

- a) Neither the Teacher Information nor the Student Handout material include information about the use of Saskatchewan uranium in nuclear weapons production.
- b) Both student and teacher could be left with the view that there are no arguments against uranium mining based upon its connections to weapons production.
- c) Criticisms of the Non-Proliferation Treaty and the work of the IAEA which show their limitations and weaknesses are not considered or mentioned here. While the authors have identified safeguards, they have not criticized them.
- d) While writers included the comment that uranium is "sold for peaceful purposes", and "may not be used to manufacture nuclear weapons", they fail to note that uranium has been sold for military purposes in the past, and that depleted uranium from US utilities becomes available for military purposes.

4. Grade 9 - Lesson 2

Without indicating its purpose, the "Canada and the Nuclear Age" Teacher Information section states that Canada exports nuclear technology to various countries, has designed cobalt 60 therapy units, that cobalt and other radiation is used for various purposes, and that the Canadian government endorses irradiation of some food substances. In the Lesson Plan and Student Handout, the writers provide a chronology of uranium mining and other nuclear developments. If, as the title suggests, this section is to list contributions Canada has provided in the nuclear age, especially those specific to Saskatchewan, it should have listed uranium for power generation and weapons production. The Handout and Lesson Plan conspicuously exclude reference to weapons production.

Overall, the information provided would not make it possible for students to consider critically or reflect ethically upon

the use of uranium in weapons production, testing, or facilities contamination. Beyond the statement that "This Teachers Guide was developed to assist teachers with integrating *URANIUM Today* into their curriculum", the kit contains no goals, objectives, or rationale to guide its use. It presents selected fragments of information on uranium (radiation, exploration, underground and open-pit mining, and milling) without any stated theoretical or conceptual framework for advancing or judging the validity of the contents. The supplement provides selected facts and limited information, within a technical context that does not recognize meaning or develop critical issues.

Curriculum for Critical Literacy and Ethical Reflection

Students need the information in their curriculum that would allow them to move toward an ethic of responsibility on matters regarding uranium mining and nuclear weapons production, testing, and facilities contamination. This could be a starting point for pedagogies which challenge, resist, contest, and oppose the dominant ideology and hegemony of nuclear public-relations initiatives. Within the framework that Hans Jonas offers, ethical considerations in a technological society involve understanding humanity's inability to predict the consequences of its own technologies. Several frameworks and models for constructing pedagogies to bring about critical thinking and ethical reflection are available for addressing uranium mining-related issues. Critical, hermeneutic, feminist, and post-modern theorists, including Paulo Freire, Henry Giroux, David Purpel, Kathleen Wheeler, and T. S. Bell, offer the foundations for these approaches. They range from problem-posing, as opposed to problem-solving and banking methods of education, to methods of deconstruction. Development of such models will help us fashion the ethical questions that need to be raised.

1. Nuclear Weapons Production

To make it possible for students to reflect on the ethical implications of selling uranium that is used in weapons production, it is important to establish that it has been used, in fact, for such purposes and that this use has consequences. If it appears that uranium is not implicated in weapons production, testing, and contamination of facilities, then the relevance

and meaning of raising questions about its use are diminished. However, if this conventional "wisdom" is sustained through public relations initiatives then one must question why. The educational task is not just one of recovering lost history but rather one of deconstructing a prevailing system which excludes and, in effect, denies the past.

Yes, Saskatchewan uranium has been sold for weapons production! By knowing that uranium has been and is used in weapons production, students can begin to determine if they have inherited an issue through historical commitments that involves them. Basic information is needed to reveal linkages between uranium mining in Saskatchewan and the nuclear industry in Canada and nuclear weapons production in the US. This information will fill in voids and absences evident in the *selected tradition* and, in doing so, challenge the conventional wisdom. First, as full an account as possible of how Saskatchewan uranium was mined to provide for the first generation of US nuclear weapons needs to be presented. Second, full disclosure is needed as to how uranium mined in Saskatchewan becomes available to the US military for weapons purposes, even though it is not sold for those purposes and despite international safeguards and bilateral agreements. Third, students need to deconstruct and analyze industry materials.

The US military demand to construct its first nuclear weapons as part of the Manhattan project in the 1940s stimulated exploration for uranium in Saskatchewan and other parts of Canada. Between 1953 and 1963 virtually "all" of Saskatchewan's uranium was sold to the Atomic Energy Agency to be used eventually in the construction of 27,000 nuclear weapons.²² Dr. Robert Bothwell, in his book *Eldorado: Canada's National Uranium Company 1926-1960*, reports that a billion-and-a-half-dollars worth of Canadian uranium went for weapons production during this time.²³ Tom Cochran of the Washington-based Natural Resources Defence Fund estimates that about one-third of all the uranium imported by the US for these weapons was from Canada.²⁴ Instead of excluding reference to this period, study could show how uranium mining in Saskatchewan has been linked to a vast nuclear scientific-military-industrial complex in the United States to enrich uranium, fuel reactors to produce plutonium, reprocess spent fuel, and fabricate weapons.

Students also need to understand that Saskatchewan is connected to nuclear-weapons production through work done to develop plutonium. On August 14, 1945, just after the first atomic bombs were dropped on Nagasaki and Hiroshima, the *Saskatoon StarPhoenix* captioned a set of eight pictures with the headline "University of Saskatchewan Men Worked on Atomic Bomb". The paper reported that Dr. C. J. McKenzie, a former Dean of Engineering at the University of Saskatchewan in Saskatoon and President of the National Research Council, directed Canadian aspects of the study which led to the bomb development. J. W. T. Spinks, who would later become President of the University of Saskatchewan, "had an active part in experiments". The project focused on designing a nuclear reactor to produce plutonium, which it continued to do until 1963 for the US nuclear-weapons program. Although the *selective tradition* often includes discussion of contributions made to the field of medicine at the University of Saskatchewan, connections to nuclear weapons production, particularly the Manhattan project, are neglected. To make it possible for students to discuss the ethics of Canada's involvement in this project, it is necessary for them to be informed.

Further study could follow uranium to the warheads of 27,000 US land-, sea-, and air-based nuclear missiles. It would lead to the unsettling realization that North Dakota, just south of Saskatchewan, is the location of 150 Minutemen III missiles dispersed over 8,000 square miles.²⁵ Each missile contains three MK-12A warheads with the force of 72 Hiroshima bombs. Most missiles are located within 100 miles and some are as close as six miles of the Canadian border.²⁶ United States Airforce B-52 bombers of the 5th Bombardment Wing, which used to leave the Minot base in North Dakota daily, could draw upon a store of 150 atomic bombs and 60 SCRAM missiles before heading north over the Canadian prairies toward the Soviet Union.²⁷ North Dakota has been referred to as a "nuclear battlefield" in Saskatchewan's backyard. With 1,510 deployed nuclear warheads, it has ranked as the state with the third largest number of warheads. It possesses the equivalent of 56,000 Hiroshima bombs. If North Dakota were to break away from the United States, it would be one of the largest nuclear-weapons powers in the world.

To heighten awareness of the weapons connections, teachers could have students review the controversy surrounding

weapons testing in Saskatchewan. Saskatchewan became even more tied into the nuclear-weapons cycle when the federal government permitted testing by the United States Air Force of Cruise Missiles, designed to carry nuclear warheads, and authorized low-level B-1, B-52, and F-11 bomber practice at the Primrose Weapons Range in northern Saskatchewan and Alberta in 1989. From basic information about the use of Saskatchewan uranium in nuclear weapons, teachers can move to a wide range of questions and analysis. They can begin with the history of uranium mining in Saskatchewan and Canada and analyze Canadian uranium development policy in relation to the United States Atoms for Peace ideology which gave rise to massive expansion in nuclear weapons production.

Uranium that is sold for electricity is available for weapons! A full consideration of the uranium-weapons connection would move beyond the historical period of the 1950s and 1960s. Since 1965, when the sale of uranium from Canada explicitly for weapons purposes was prohibited by law, uranium was sold to electrical utilities in the United States to generate power in civilian reactors. Uranium used in these reactors is enriched in American plants. Through this process, five of every six pounds of the original uranium that enters the plant, depleted uranium (U-238), became available to the United States military to produce plutonium, component parts of nuclear weapons, and high-density materials for military armour and shells. One of the most obvious questions is, "Should Saskatchewan uranium be sold to American utilities when it is known that depleted uranium can be drawn for military purposes?"

Public relations materials. Teachers can have students deconstruct and critically assess industry materials. In response to the public-relations question, "Is Saskatchewan uranium sold for weapons purposes?", students can be asked to consider why this question, rather than other questions, is posed in the display and materials. They might formulate alternative questions which convey messages contrary or contradictory to the overall message of the display. Questions like: "Does Saskatchewan uranium find its way into weapons production even though it is not sold for the purpose?" To analyze the industry's answer to the question, teachers can have students review criticisms of the effectiveness of bi-lateral agreements,

the non-proliferation treaty, and the work of the International Atomic Energy Agency.

2. Nuclear Weapons Testing: Fallout in the Curriculum

In the 1960s, Saskatchewan anti-nuclear activists did not know that some of the uranium used in the atmospheric tests of the 1960s came from their own province. Acknowledgement of this is important in considering the ethics of selling uranium. The *selective tradition* neglects to present the pathway from uranium to weapons testing nuclear fallout. Much fallout from US nuclear-weapons tests conducted in the 1950s and 1960s, which remains in the earth's stratosphere, is fission products from Saskatchewan uranium. When ingested, fission products can weaken the immune systems and accelerate the deaths of many people. Between 1945–1962, US atomic-bomb tests released the equivalent of 137,000 kilotons of explosive power. Prior to 1963, the United States conducted 183 atmospheric tests, “more than all other nations combined”.²⁸ The Soviet Union exploded the equivalent of 402,000 kilotons of explosive power. During this period, world populations were subjected to fallout from the equivalent of 40,000 Hiroshima bombs. The cumulative yield of radioactivity released to the stratosphere through these tests increased 13,000 fold, from 45 “kilo” tons (45,000 tons) to 587 “mega” tons (587,000,000 tons).²⁹ By 1978 the United States had set off an additional 400 underground tests in Nevada. Radiation poisons from these tests spread through the central and eastern United States.³⁰ When the enriched uranium and plutonium in these weapons explode, they produce hundreds of highly radioactive substances called fission products. Atmospheric tests continued until the public outcry, led by scientists like Linus Pauling and Andrei Sakharov, forced the US, Britain, and Russia to move testing underground.

Scientists as early as 1943 predicted that these fission products would enter the food chain, where they would be ingested, and accelerate the deaths of millions of human beings. “Radioactive chemicals can now be found in the organs, tissues and bones of every individual in the Northern Hemisphere, and the contamination from past nuclear explosions will continue to cause environmental and health problems for hundreds of thousands of years, even if all nuclear activities are stopped

today.”³¹ Andrei Sakharov, inventor of the Soviet hydrogen bomb, predicted in 1958 that 50 megatons of atmospheric bomb testing would cause one half million to one million deaths world wide.³² Linus Pauling suggested bomb tests would produce “one million seriously defective children, and about one million embryonic and neonatal deaths, and will cause many people to suffer from hereditary defects.”³³ There has been great concern about fission products, such as strontium-90, which continues to drift down to the earth where it enters grass, wheat, and corn, is ingested by cows, and enters the milk and bones of human beings where it can cause cancer.

In their book *Deadly Deceit: Low Level Radiation, High Level Cover-up*, Gould and Goldman report how concern about the effects of nuclear fallout assume much more importance as new studies reveal that low levels of radiation are more dangerous than previously thought. Dr. Abram Petkau of Atomic Energy of Canada Limited demonstrated in 1972 that radiation “can destroy cell membranes much more efficiently at low doses than high ones.”³⁴ Dr. T. Stokke discovered “that very small doses of strontium-90 were much more efficient in damaging bone marrow cells of rats than were high doses.”³⁵ Saskatchewan uranium entered nuclear weapons tests with uranium sold for nuclear weapons production. Nuclear weapons testing continues in 1993. To move toward awareness of the relationship between weapons testing and Saskatchewan uranium, curriculum should include information and analysis that fills the void.

3. Contaminated US Nuclear-Weapons Facilities

The most notorious failure of governments to control nuclear wastes has occurred at U.S. and Soviet military facilities. Weapons manufacturing over the last 50 years at roughly 100 U.S. military sites has led to extreme environmental pollution. According to the U.S. Office of Technology Assessment (OTA), there is “evidence that air, ground water, surface water, sediments, and soil, as well as vegetation and wildlife, have been contaminated at most, if not all, of the Department of Energy nuclear weapons sites.” Contamination from these sites has been found in tumbleweeds, turtles, coyotes, frogs, geese, and shellfish, among other species—and in people.³⁶

Uranium from Saskatchewan and other parts of the world is part of the contamination of weapons-production facilities in

the United States. While being processed, it is differentiated in no way from any other uranium. Americans were shocked by revelations that their government deceived them by withholding "official data" on the dangers associated with the release of radioactive substances. In the fall of 1988, the US Senate Government Operations Committee, under Senator John Glenn (former astronaut), studied accidents and safety problems at US Department of Energy nuclear plants. It discovered that government and industry withheld crucial information from the public and Congress for as long as 25 years.³⁷ These releases are associated with public concerns about cancer rates, birth deformities, infant mortality, thyroid deficiencies, premature aging, and immune deficiencies. Recent studies by the International Research Council recognize the higher risks associated with low-level radiation. The first US nuclear-weapons plants were constructed in the 1940s. These facilities, which grew in the 1950s to supply the United States' significantly-expanded nuclear weapons arsenal, included uranium refineries, enrichment plants, fuel fabrication plants, nuclear reactors to produce plutonium, plutonium reprocessing plants, weapons components construction facilities, and weapons assembly plants. These facilities have produced hazardous nuclear wastes that have entered the environment. The clean-up of facilities is expected to cost \$300 billion.³⁸ The health consequences are unknown.

Approximately 368,000 cubic meters of high-level radioactive waste have been generated from reprocessing radiated fuel for weapons production.³⁹ *Newsweek* and *Time* (October 1988) headlined the shutdown of major US nuclear weapons reactors and production facilities because of wide-spread radiation contamination. These plants released enormous quantities of radioactive substances into the air and dumped tons of cancer-producing garbage in creeks and pits. Government complacency, recklessness and secrecy, and industry disregard are blamed for the problems.⁴⁰ At the Savannah River weapons plant, the US Department of Energy admitted that as many as thirty significant mishaps were never reported to the government or made public. Between 1954 and 1982 the plant "experienced fires, equipment leaks, contaminated water floods, and a reactor coolant leak that almost caused a spontaneous nuclear reaction."⁴¹ In Hanford, Washington, the facility dumped more than 200 billion gallons of low-level, radioactive waste,

enough to create a forty-foot-deep lake the size of Manhattan Island. Beyond "death mile", an area of unusually high cancer rates near Hanford, the Center for Disease Control in Atlanta suggests that "20,000 children in Eastern Washington may have been exposed to unhealthy levels of radioactive iodine by drinking milk from cows contaminated from grazing in contaminated grasslands."⁴² In Fernald, Ohio, more than 230 tons of radioactive material has leaked into the air and water of the Great Miami River since the plant was built in the early 1950s and another 337 tons of uranium hexafluoride is simply unaccounted for at this site.⁴³

In Conclusion

To present an account of uranium mining to students, without addressing its relationship to weapons production, testing, and plant contamination, contributes to the knowledge gap between our ability to construct and use technologies, and our ability to predict consequences. This failure accommodates a pro-nuclear ideology and hegemony by allowing the dominance of a limited *selective tradition*. For teachers to create the possibility for transformative, critical thinking and ethical reflection, the relationship between uranium mining and its consequences must help shape curricula. Theoretical and practical development in this area could be advanced through a more comprehensive consideration of how Saskatchewan uranium use is approached in schools. Other work could re-examine the materials presented in this study, as well as look at the relationship between uranium mining and horizontal nuclear weapons proliferation in developing world countries, British and French nuclear weapons development and testing, the adequacy of international treaties, and uranium sales to civilian utilities in the United States and other countries. Studies could focus upon issues of employment, health, safety, and environmental protection as they relate to mining itself. The study of public-relations materials could extend to issues of high-level waste disposal, nuclear power-plant construction and operation, and the politics of radiation safety. A critical-thinking curriculum and supplements on uranium mining would assist students in questioning the claims, statements and positions that industry advocates and critics make. Students should be encouraged

to interpret the meaning of statements, uncover the assumptions upon which they are made, formulate the consequences of positions, identify contradictions, test inferences, and question the truth of what is claimed as fact. Education through ethical reflection that leads to nuclear responsibility requires this critical thinking.

Notes

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- 4 N. Lenssen, *Nuclear Waste: The Problem That Won't Go Away* (Massachusetts: Worldwatch Institute, 1991) 17.
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- 6 M. Apple, *Ideology and Curriculum* (Boston: Routledge and Kegan Paul, 1979) 4.
- 7 *Ibid.*, 5.
- 8 *Ibid.*, 6.
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- 13 *Ibid.*
- 14 S. Klensz, *Critical and Creative Thinking* (Regina: Saskatchewan Education, 1987) 24–33.
- 15 R. Fleming, *Technological Literacy: A Common Essential Learning for Saskatchewan Students* (Regina: Saskatchewan Education, 1987).
- 16 R. Fleming, "Literacy for a Technological Age", *Science Education*, Volume 73, Number 4, 1989, 391–404.
- 17 *Uranium in Saskatchewan: Teachers Guide* (Saskatoon: Uranium Saskatchewan section of the Saskatchewan Mining Association, no date given).

- 18 "Uranium", (Regina: CKCK Communications, Saskatchewan Resources Series) Video, 30 minutes.
- 19 The relevant text of the video proceeds in the following order: - "It was in 1935 on the northern shores of Lake Athabasca that uranium was discovered in Saskatchewan." - (...) - "During the Second World War, nuclear energy was developed and uranium became one of the most important metals in the world." - "The impetus for mining uranium was the program to develop an atomic bomb. In fact, two such bombs were exploded, and the horror of the consequences is something known to people around the world." - "Although the power of nuclear fission, which is the breaking apart of uranium atoms, was first developed for military purposes, the technology and science of nuclear power has progressed rapidly." - "Today nuclear power is harnessed for peaceful purposes."
- 20 G. Edwards, et.al., *Uranium: a discussion guide* (Ottawa: National Film Board, 1991) 7.
- 21 *Uranium in Saskatchewan: Teachers Guide*, 4.
- 22 Robert Bothwell, *Eldorado: Canada's National Uranium Company 1926- 1960* (Toronto: University of Toronto Press, 1984) 315-350.
- 23 *Ibid.*, 383.
- 24 T. Cochran, "Atoms for War, Atoms for Peace", *Atoms for War and Peace: The Saskatchewan Connection*, Saskatoon, February 13-15, p. 11.
- 25 M. Arkin and R. W. Fieldhouse, *Nuclear Battlefields: Global Links in the Arms Race* (Cambridge: Ballinger Publishing, no date) 203.
- 26 Nukewatch, "Missile Silos of North Dakota: Minot".
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- 28 Bertell, *No Immediate Danger?*, 55.
- 29 Gould and Goldman, *Deadly Deceit*, 98.
- 30 Bertell, *No Immediate Danger?*, 56.
- 31 *Ibid.*
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- 33 *Ibid.*, 99.
- 34 *Ibid.*, 98
- 35 *Ibid.*
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