What Can Be Learned from DuPont and the Freon Ban: A Case Study

Richard P. Mullin

ABSTRACT. Between 1974 and 1988, executives of DuPont, the world's largest producer of CFCs, were confronted with emerging evidence that CFCs were destroying the stratospheric ozone layer. The difficulty that executives face in such cases is that scientific knowledge develops over time and does not necessarily proceed in a straight line toward true conclusions. At the beginning of a new field of research, there is much uncertainty and disagreement among the experts. The solution of the ozone problem required a remarkable cooperation among science, business, and international governments. After looking at the role of DuPont executives in this drama, and the difficulties facing any executive dealing with uncertain science, the paper turns to an evaluation of the field of Business Ethics to see what light it might throw on this and analogous problems. Finally, the paper offers specific suggestions in terms of principles in dealing with uncertain science, and concludes that the course of action that DuPont followed, including some mistakes, can serve as a model for analogous crises.

KEY WORDS: CFC's, DuPont, environmental ethics, international cooperation, Montreal protocol, ozone depletion, uncertain science

Richard Mullin, who earned his Ph.D. at Duquesne University, teaches philosophy at Wheeling Jesuit University, and has taught Business Ethics in the MBA program since 1977. Along with Business Ethics and Environmental Ethics, his main interest is Classical American Pragmatism, and he frequently presents papers to the Society for the Advancement of American Philosophy. He has lectured on American Pragmatism at the University of Ljubljana, in Slovenia, and the University of Trnava, in Slovakia.

A characteristic of educated people is that they do not expect more from a science than a science can deliver. This paraphrase of Aristotle's remark about ethics applies to contemporary empirical science. Yet there is a tendency to think that scientific judgments should be certain, and that otherwise they are not scientific. The problem that vexes policy makers, in industry as well as in government, is that scientific knowledge develops over time and does not necessarily proceed in a straight line toward true conclusions. In science, there are often many unknown factors that lead to uncertainty and disagreement among the experts, especially at the beginning of a new field of study. The research into the connection between human made chlorofluorocarbons (CFCs) and the stratospheric ozone depletion is a stark example of this uncertainty.

The real test of business ethics is how well it can handle issues in which the right course is not certain and in which there are not exact precedents. These problems are especially acute for those at the executive level who cannot refer the problem to a higher official. The CFC case was clearly such an issue because there were no laws in place and the question of harm was not certain.

This paper will first define the complex problems that DuPont faced in relation to the CFCs. This will be followed by a summary of the history of the scientific discourse on CFCs. Next, the paper will explore the role that the discipline of Business Ethics[1] can play in helping shape decisions, along with the difficulties that executives face in making decisions in the dim light of uncertain science. The paper will conclude with examination of the opportunities for more ethically sound decisions, especially in

Journal of Business Ethics **40**: 207–218, 2002.

terms of what can be learned from DuPont and the CFCs.

The purpose of this study is neither to condemn nor defend DuPont's course of action. Rather, it is to observe any decisions that, after the fact, appear to be good or bad and to see what insight can be derived for companies that must make analogous decisions in the future. The focus is on DuPont's policies and decisions as they reacted to the scientific evidence, the political pressure, and the conflicting economic and social pressures. These decisions should be evaluated against the standard of Business Ethics principles, given the evidence that was available at the time of the decision.

The most important ethical question concerns the extent to which DuPont can serve as a good or bad example. Did they do anything wrong that businesses in the future could learn from? What did they do well that others could emulate? Are there any feasible generalizations that could be useful for business leaders in analogous situations in the future? An appreciation of the problems that confronted DuPont requires an understanding of how the scientific, political, and economic issues developed over time.

Scientific discourse on the CFCs

The term "scientific discourse" is more appropriate than simply "the history of scientific research." Science must be expressed in language, and this involves interpretation. A key role is played by those whom Karen Litfin calls "knowledge brokers," who serve as intermediaries between the producers and consumers of knowledge, i.e., between the researchers and the policy makers. Brokers must be adept at both science and communication. "Knowledge brokers are especially influential under conditions of scientific uncertainty that characterizes most environmental problems" (Litfin, 1994, p. 4).

CFCs were first produced as beneficial products and were considered to be non-toxic, stable, and harmless in every way. By far, their most important use was in refrigeration and air-conditioning, where they had replaced the dangerous ammonia that could be harmful if it leaked. The belief that CFCs are harmless is true at ground level. If they leak or are deliberately released as a propellant in aerosol sprays, the compound holds together and does not react with any other substance. From the time they were invented in the 1930s, until 1974, the producers had no reason to suspect that they would behave differently in the stratosphere.

Endangerment to the stratospheric ozone became a concern in the 1970s during the debate over the supersonic transport (SST). The U.S. Department of Transportation commissioned a 40 million-dollar study of the environmental impact of the SST, and in the end, the United States canceled the project, although Britain and France went ahead with their joint venture in producing the Concorde. This is an important part of the CFC story because it called attention to the vulnerability of the ozone.

Science textbooks often claim that the first step in the scientific method is observation. But in reality, scientists do not just look around. Most breakthroughs occur when scientists become aware of a practical or theoretical problem. The SST controversy called attention to the stability of the stratospheric ozone and elicited a need to investigate factors that could disturb it.

The first major study that indicated a connection between CFCs and ozone depletion was done by Sherwood Rowland and Mario Molina at the University of California – Irvine. This study was not based on evidence of actual depletion; no convincing evidence would be found until twelve years later. Rather, their hypothesis was based on a complex chain of conditions regarding the reactions of chlorine with ozone. If CFCs find their way to the stratosphere, and if the ultraviolet rays break them down into their component parts, and if the rate of breakdown overwhelms the stratosphere's ability to renew the ozone, then there is a major and potentially catastrophic problem.

The National Academy of Science (NAS) responded with a major study, from April 1975 to September 1976, of the impact of CFCs on stratospheric ozone. The outcome of the study was a prediction that the ozone would be depleted in the range of 2 to 20%, with the most likely depletion between 6 to 7.5%. The NAS

did not recommend a ban of CFCs but warned that some regulation would be necessary at some time in the future. Congress responded in May 1977 by banning all non-essential aerosols by 1978 Rowlands, 1995).

A brief review of the science involved in the ozone study will be helpful in understanding the problem that DuPont faced. Chemists know from theory and laboratory confirmation that chlorine destroys ozone. (The controversial issue was whether the chlorine in CFCs destroys ozone in the stratosphere.) Ozone (O_3) composed of three oxygen atoms is formed in the stratosphere when ultra-violet light breaks down a molecule of oxygen (O_2) into two oxygen atoms. The free atoms bond with molecules of oxygen to form new molecules of ozone. The ozone absorbs ultra-violet light, which breaks it into its component parts of an oxygen molecule and a free oxygen atom (O_2 and O). The free oxygen atom then combines with another oxygen molecule to reform as ozone. The process is continuously repeated. The net result, under stable conditions, is that the amount of ozone remains stable over time. Chlorine atoms upset the balance. When a chlorine atom collides with a molecule of ozone, it takes one of the oxygen atoms, resulting in a molecule of oxygen and a molecule of chlorine monoxide (ClO), which is a free radical containing an odd number of electrons and therefore reactive. When the chlorine monoxide molecule meets a free oxygen atom, the two atoms of oxygen unite to form an oxygen molecule, and the abandoned chlorine atom is free to destroy another molecule of ozone (Stolarski, 1988).

The chlorine atoms in CFCs were considered safe because they were bound in a stable molecule that did not react with other molecules. The danger arises if the CFC molecules rise to the stratosphere where ultra-violet light breaks them down into their constituents including free chlorine atoms. This is precisely what Rowland and Molina argued would happen. The questions challenging this theory were whether the CFCs would rise to the stratosphere, whether they would break down, and if so, whether they would destroy ozone faster than the natural ozone cycle could replenish itself. Critics argued that there have always been natural ozone depleters, such as volcanic eruptions, that the ebb and flow of the ozone goes on constantly, and that the amount of human-made chlorine is insignificant.

During the first decade of study, the connection between CFCs and ozone depletion was based on theory and computer models rather than on observation and empirical data. The critics dismissed this as "speculation." The changes in the predictions that occurred during that time were not based on any known change in the ozone, but on a combination of changes in the amount of CFCs being released and on the development of better scientific models.

In 1976 Molina and Rowland announced good news, that the depletion of ozone would be slowed down. Chlorine and nitric oxide could combine in the stratosphere to form chlorine nitrate ($ClNO_3$). This would serve as a reservoir that would absorb the chlorine atoms and prevent them from destroying ozone. The NAS report was delayed several months by the new consideration. When it was released, it predicted that ozone depletion would be 7% rather than the 14% prediction of an earlier draft.

This relief was short lived. Rowland testified before the Senate in 1977 that nitrogen oxides and hydroxides would react forty times faster than had been believed. This meant that there would be less nitrogen available to form the reservoirs of chlorine nitrate. Ozone would be depleted faster than the 1976 report indicated (Litfin, 1994). In 1979 the NAS predicted that the loss in ozone would be 16.5%. However, this was revised downward to 5.9% in 1982, and in 1984 lowered to a range of 2 to 4%. Actual monitoring showed no evidence of depletion. The critics were vindicated, and those who had sounded the alarm for the "crisis that wasn't" were discredited.

The crisis in fact was not over. In 1985, British scientists discovered a dramatic loss of ozone in the Antarctic spring. This came to be called the "hole in the ozone layer" and changed forever the attitude of government and industry toward CFCs. The terms "layer" and "hole" are metaphors. The stratosphere is the part of the atmosphere from 10 to 50 kilometers from the

surface of the earth. The "ozone layer" refers to the space from 12 to 35 kilometers in which the ozone is normally concentrated at a few parts per million. The "hole" refers to the depletion of the ozone over an area of the Antarctic. Some of the critics were not convinced, and argued that the conditions that occur in the extreme cold of the Antarctic would have no ill effect on humans or on the environment, and would not be repeated in temperate climates. However, the prevailing view of scientists was that the ozone poor air of the Antarctic would circulate and cause a thinning of ozone that would be disastrous. This had become the policy of the United States and nearly all of the industrialized nations by the time the Montreal Protocol was accepted in September 1987. The Protocol called for the regulation and phasing out of all CFCs.

The story of the end to CFC production involves the interlocking processes of science, government, and industry. If scientists are not always unanimous, and if their progress is not always even and one-directional, what can be said for government and business? Government and business leaders must pay attention to the changing picture of science as best they can, while also fulfilling the changing needs of their respective constituencies. But science, government, and business do not operate in isolation from each other. The government ban on CFCs not only made the development of substitutes necessary; they also made them possible. While it is obvious that banning an essential product makes the development of a substitute a necessity, we can show that the ban also makes development a possibility. If reductions in CFCs were merely suggested, some companies would continue to make and market CFCs. Since substitutes are necessarily more expensive, at least initially, they could not compete. Creating a substitute involves a heavy investment in time and resources with no guarantee of success. In a competitive business environment, no company would undertake the risk and expense without reasonable expectation of gain. This argument is based on the assumption that the substitutes are physically possible. So, the international ban makes them economically possible.

The scientific discourse took place mainly between 1974 and 1985. In the years immediately preceding the hypotheses by Rowland and Molina, there was a skeptical attitude toward science within the Nixon administration. John Ehrlichmann, Nixon's chief of staff, was reported to have said in 1971 ". . . if scientists could not agree with each other, the White House would not pay attention to any of them" (Rowlands, 1995, p. 45). Nevertheless, when Rowland and Molina hypothesized that chlorine from the CFCs could destroy stratospheric ozone, the National Academy of Science (NAS) undertook a major study from April 1975 to September 1976. In May 1977, Congress passed legislation banning all non-essential aerosols.

DuPont, the number one producer of CFCs, argued that the evidence did not indicate a need to abandon a much-needed product with no available substitutes. However in 1974, the Chairman of DuPont, Irving Shapiro, stated that if science ever shows that CFC's cannot be produced without harm to human health, DuPont would stop production. This declaration bolstered DuPont's reputation and image of being "science driven," but it was also a public pledge which they would later be called to fulfill. In terms of the scientific discourse, it framed the debate around the issue of skin cancer and other human ailments, rather than in the broader environmental context such as climate change or harm to aquatic life (Litfin, 1994, p. 64).

By 1984, it appeared that the high water mark of the ozone crisis had already been reached back in 1979 when the NAS predicted a 16% depletion. DuPont responded to the 1979 report by pointing out that:

> No ozone depletion has been detected despite the most sophisticated analysis. . . . All ozone depletion figures to date are computer projections based on a series of uncertain assumptions (Rowlands, 1995, p. 50).

Rowland and Molina answered that it was impossible to detect depletion until after it happened. By the time it could be detected, the damage might be irreversible. They argued that their ozone depletion hypothesis did not require the actual detection of depletion to be validated. All

that was needed was the detection of chlorine radicals in the stratosphere.

During the next five years, as the predictions were adjusted downward, the concern about ozone depletion faded. The 1977 aerosol ban by the United States Congress had been unilateral and did not have much international support. British scientists did not see a need for action. One of Britain's leading atmospheric scientists, John Gribben, said in February 1979:

> On balance, the evidence that is now available suggests that nothing mankind is now doing will have a disastrous effect on the ozone layer (Gribben, 1979, p. 474).

As the picture looked less frightening and the need for action less urgent, the Reagan Administration affirmed a reluctance to regulate business. In 1980, during the last year of the Carter Administration, the EPA had outlined a plan for future regulation of CFCs. DuPont countered by establishing an industry wide Alliance for Responsible CFC Policy. Its stated purpose was "to ensure that government did not regulate based on an unproven and unverified theory." But Reagan's EPA chief, Anne Gorsuch Burford, made it clear that she did not take the ozone threat seriously and considered it a scare (Rowlands, 1995, p. 54). The Reagan Executive order 12291 mandated that all major new regulations required cost-benefit analyses. Critics pointed out that this would curtail any administrative regulation of alleged ozone depleting substances, since there is no readily available data to show the future cost of action not-taken.

DuPont, the only company that invested heavily in developing an alternative to CFCs, had spent 15 million dollars for that purpose, and ended the project in 1981. Joe Steed of DuPont, who would later become an advocate of regulation, described the industry's point of view as it looked in 1981:

> There wasn't scientific or economic justification to proceed. How do you trade a possible [environmental] risk for a [business] risk that is real? (Litfin, 1994, p. 70).

The picture changed suddenly and decisively after the surprising discovery of the ozone hole in 1985. The cost benefit of regulation vs. non-regulation changed. To continue production would make the companies vulnerable to future lawsuits if it were determined that skin cancers were the result of ozone depletion. This would be accompanied by bad publicity and the destruction of DuPont's image as a responsible and scientific driven corporate citizen (Rowlands, 1995, p. 110). Science which DuPont had underwritten developed the first two-dimensional model which measured latitude as well as altitude. These more sophisticated models provided strong evidence that CFCs would deplete the ozone.

DuPont's response

DuPont assigned two Ph.D. chemists to focus on the study of the CFC-ozone connection. One was Mack McFarland, whose job was to appraise and develop ozone research. The other was Joe Steed who headed the team responsible for scientific, government relations, and public affairs policies. The two attended the Ozone Trends Panel Press Conference on March 15, 1988. McFarland was the only business representative on the Panel and had read the full report before the press conference. After the Conference, McFarland and Steed phoned Joe Glas head of DuPont's Freon division and informed him that the assessment was accurate. There was a scientifically supported link between CFCs and ozone depletion. Scientific research had caught up with the pledges made by DuPont Chairman Shapiro in 1974, and repeated by CEO Richard Heckert only three weeks before the March 15 Press Conference, namely, that they would stop production when and if the evidence warranted it. Joe Glas took the report into consideration and ordered the end of DuPont's CFC production (Goodpaster and Nash, 1998, p. 191).

DuPont had already changed its position on regulation, and in 1986 supported controls of CFCs. However, it insisted that the controls be international. This made sense both from a scientific and business point of view. If the prohibition from producing CFCs were limited to

American industries, as was the case with the 1977 ban of the non-essential aerosols, then the foreign production would continue to deplete the ozone, and DuPont and other American manufacturers would suffer an economic set-back with no environmental benefits. But if an international ban were imposed, then the environmental goal of ozone conservation could be achieved, and DuPont stood to be a leader in the development of a substitute. In supporting the international treaty, DuPont announced that a substitute could be available within five years. This announcement was a boost for the negotiations, which would have been considerably more difficult if there were no substitutes in sight (Litfin, 1994, p. 93).

There was some suspicion, especially among British and European manufacturers, that DuPont already had a substitute and that the American sponsored international ban would give DuPont complete dominance of the new market. However, DuPont had stopped working on the substitute in 1980. At that time, the head of the Freon Division, Joe Glas, had said that alternatives were seven to ten years away. When they resumed research, the projected time was reduced to five years. The difference was that the agreement itself provided an incentive. Without regulation, there would be no market for alternatives, and industry is reluctant to invest heavily in an uncertain product. With the empirical verification of depletion, and the acceptance of the Montreal Protocol, the uncertainty was over.

Some of the decisions and actions of DuPont appear to be good by any standard of ethics. They pledged to stop production of CFCs if compelling scientific evidence showed that they could not be produced without harm to human life and health. When the time came, with the evidence from the Panel on Ozone Trends in 1987, DuPont lived up to that pledge. Further, they placed two scientists, Joe Steed and Mack McFarland in high level positions from which they recommended the cessation of Freon production. Also, DuPont funded some of the research that helped show the connection between CFCs and ozone depletion. Finally, DuPont took the lead in developing substitutes.

On the other hand, some of DuPont's actions were questionable. They set up the Alliance for Responsible CFC Policy to discredit the ozone theory and attempted to discredit the leading researchers, Rowlands and Molina. And while DuPont took the lead in searching for substitutes, they discontinued the search when the political and public relations factors were no longer pressing. To call these questionable is not to judge that they involved wrongdoing, only to point out they need to be questioned.

First, the Alliance for Responsible CFC Policy could be interpreted, as its name implies, as a structure to make sure that policy is based on sound science, and not on hasty generalizations, ideologies, and false assumptions. Industry was concerned with winning the battle for public opinion. The effort on the part of government to regulate products that are useful and profitable requires not only good science, but also effective and well-informed public opinion. As Richard Benedick, the chief American negotiator for the Montreal Protocol stated:

> First and foremost was the indispensable role of science in the ozone negotiations. . . . Second, *the power of knowledge and of public opinion* was a formidable factor in the achievement at Montreal. A well-informed public was the prerequisite to mobilizing the political will of governments to weakening industry's resolve to defend chemicals. The findings of scientists had to be made accessible and disseminated. Legislative hearings helped in airing scientific opinion and policy alternatives (Benedick, 1991, p. 4).

Benedick points out that the United States Government took the lead, both at home and internationally, to educate the various publics on ozone and CFCs.

Industry, for the most part, took the opposing view. While it is important that all sides are heard, and that opposing views be brought together, there is a blurry line between legitimate advocacy and propaganda. This applies to environmental advocacy groups as well as industry, but the subject at hand is industry's actions. The moral difference between legitimate and illegitimate advocacy is respect for truth. This involves, among other things, respect for the researchers themselves, avoiding ad-hominem arguments, allowing the dialogue to take place in

a mutually respectful manner, and refraining from suppressing evidence that does not support a favored conclusion. Ultimately, DuPont made their decision based on what appeared to the overwhelming consensus of the scientific community to be good policy, and the Alliance for Responsible Ozone Policy supported the Montreal Protocol.

The role of business ethics

The main issue in this investigation is what Business Ethics can learn from the CFC case and how it can help executives to face problems analogous to the CFC crisis. Some critics argue that the study of Business Ethics is of no help in making actual decisions. They cite material in the literature such as irrelevant intellectual disputes, menus of ethical theories, and catalogues of ethical wrongdoing. The first of these, irrelevant intellectual disputes, derives from the fact that many ethicists are academics who must publish in professional journals. The desire for intellectual respectability entices ethicists to write for each other in an idiom that is not easily accessible to business leaders, who simply do not have the time to search through the literature looking for insights that are of use (Stark, 1999).

But Business Ethics is still developing and can provide the insights that lead to ever better decisions. The study of Business Ethics involves principles and virtues, which go hand in hand. Virtue ethics refers to the development of character by cultivating habits that will lead to good behavior. This is often contrasted to principle-centered ethics, which puts the emphasis on moral reasoning. However, the two approaches are compatible and interdependent because to develop virtue means to concentrate on living by principles until they become second nature. On the environmental issue, for example, an ethical executive would habitually make environmental protection a factor in every decision, by resolutely answering the question: "How can we improve the environment or at least, how can we minimize harm?" But as beneficial as a virtuous attitude can be, it does not throw enough light on situations in which science is uncertain. Virtue is necessary, but not sufficient for making environmentally sound decisions. This will continue to be the situation in the foreseeable future, as technological developments outrun the scientific understanding of their total impact.

Environmental Ethics, which is a relatively new field, overlaps Business Ethics on issues of industrial impact on the environment (Botzler and Armstrong, 1998, p. 2). The field takes into account the whole range of human treatment of the natural environment, including such things as ethical, religious, political, aesthetic, economic, and social considerations. Environmental Ethics also includes a wide range of philosophical outlooks, and therefore, of differing and conflicting ethical values.

At one extreme, there are ethicists who oppose technological development.[2] The opponents of technology do not have any credibility with industry. This is not the place to evaluate the merit of this position, except to point out that it is not relevant to the present issue. The issue is not whether we will have business, industry, and technology, but whether we can practice them in an ethical manner.

Opposite the thinkers who oppose all technological progress in the name of environmentalism, there are those advocates of business who dismiss the entire notion of environmentalism. The anti-environmentalists see environmentalism as a cover for leftists who want government to control business. They contend that environmentalism is opposed to "sound science." This position might have some appeal to business leaders. But it poses a problem since it underestimates the harm that human activity can do to the environment. Worse yet, it poisons the wells of discourse.[3]

Among environmental ethicists who are willing to engage in a productive dialogue, there is still a wide spectrum of opinion. Some oppose regulation and believe that the market is sufficient to motivate business to act rightly toward the environment. This was the position of the Reagan Administration in the early years, and is still held by some political conservatives. An example of this is the religious based "Cornwall Declaration" published by the Acton Institute and the Interfaith Council for Environmental

Stewardship. Its immediate purpose is to counter the trend of the churches to adopt environmental positions that the signers of the Declaration consider to be based on ". . . certain misconceptions about nature and science, coupled with erroneous theological and anthropological positions" (Barkley, 2000). The charter signers include many respected Catholic, Protestant, and Jewish thinkers, including former Secretary of the Interior, Donald Hodel, who led the fight against CFC controls in the early 1980's. Since there is no shortage of environmental ideas based on misconceptions, the Declaration can serve the purpose of weeding out bad ideas.

However, in the context of the CFC issue, the Declaration makes some statements that are problematic and potentially harmful. It makes a distinction between environmental concerns that are well founded and those that are unfounded or greatly exaggerated. Two of the five contrasting characteristics are: "The former are *proven and well understood*, while the latter tend to be speculative," and "The former are often localized, while the latter are said to be *global and cataclysmic* in scope" (Barkley, 2000).

Unfortunately, science is not always certain, and damage can occur whether human beings are certain of it or not. In the case of CFCs, government and industry leaders had to make decisions without the comfort of certitude. The evidence was strong that CFCs could lead to "global and cataclysmic" damage. The only way to be certain would have been to do nothing and see whether such damage would occur. When warnings of danger are heeded, the reality of the danger is seldom established with certainty.

In contrast to the anti-regulators, many environmental ethicists favor regulation as a necessity for environmental protection. This is the position that CFC producing corporations, especially DuPont, finally adopted. While industry has an understandable and rational bias against regulation, that position is different from the ideological doctrine that regulation is always bad. Sometimes regulation is reasonable and fair. Anti-regulators may argue that the market gives business enough incentive to avoid harm, and this might be true if the harm is known quickly enough to affect the market. But for long term problems, it is not enough. Further, those industries which acknowledge a problem would be put at an unfair disadvantage if competitors could continue the harmful practice. In the case of the CFCs, regardless of what DuPont would do, there was no hope of solving the problem without international regulation. Business leaders interested in sound environmental policy would avoid activities that they consider to cause unwarranted harm to the environment, and support regulation that prevents others from doing such harm. That position promotes environmental safety and economic self-interest. The discussion has hopefully clarified a general ethical attitude for business leaders on environmental issues, but the challenge is to acknowledge the difficulties that executives face and suggest some ways of dealing with the difficulties.

Ethical executives: The difficulties and opportunities

The difficulties

At the end of the last section, the question of the ethical executive was raised. One of the main objectives of the present study is to learn to what extent the field of Business Ethics contributes to the practical ethics of business. There is some discouraging evidence that it contributes very little. Most formal Business Ethics thinking is irrelevant to the decision-makers. Business leaders from CEOs to line managers may understand and espouse moral codes, but these often yield to loyalty to the group (Jackall, 1988, pp. 110–111).

Regarding environmental issues, there are several disincentives for responsible action. Developing a sound environmental policy within a company takes resources. Well-staffed departments of environmental concern not only compete with line managers for funds, but they interfere with their work. It is the production side that generates economic value on which upper management is judged. Therefore, emphasis on the environment runs contrary to the self-interest of the executives. Managers are rewarded for their solutions to short term problems and financial gains, rather than long-

term production goals, much less environmental protection. Actions that ward off future disasters are seldom known, much less acknowledged. This is true whether it be worker safety, consumer safety, or the environment. Avoiding lawsuits might be considered a reason to act responsibly. However, it is questionable whether they are an incentive for executives to act responsibly toward the environment. Environmental damage is usually slow in coming, and even slower in being proven. Litigation moves slowly through the system and affects future generations of executives rather than the ones currently making decisions. Threat of lawsuits can motivate denial and cover-ups, which can at least defer acknowledgements that might lead to solutions of environmental problems. In this atmosphere, a forceful effort to remedy a problem can be interpreted as an admission of the problem. Thus, the award system for management does not foster environmental protection on the part of business.

There are also historical and political realities that can diminish the motivation to expend resources on environmental protection. In the early days of the Reagan administration, the threat of the EPA and governmental regulation seemed dead (as did the ozone crisis). In this atmosphere, the option of self-regulation to preempt government regulation did not loom large. Nor was there an urgency to promote acceptable regulation to stave off more harmful regulation. The possibility of minimum regulation looked like a welcome alternative.

The opportunities

While it is easy to paint a grim picture, the situation is not hopeless. There has been progress in environmental protection, and the effort to preserve the ozone is a good case in point. In spite of the resistance on the part of industry, key members of government, much of the international community, and even some scientists, the conservationists finally prevailed.

The ozone case can be seen as an instance of a long-term move toward greater environmental responsibility. Several factors are behind this. There is more awareness of the harm that can be done by human activity. Until the second half of the twentieth century, environmentalism was seen as primarily of aesthetic interest and necessary to preserve such things as picnicking and sport fishing. At worst, it was seen as a local health hazard, which should be cleaned up, but not at the price of lost jobs. As science and industry gained more power to alter the environment, the awareness dawned that environmental deterioration affected not only the leisure of the rich and the health of the poor, but also the well being of the human race and of the planet itself.

In addition to the grim awareness of threatening doom, there was another quite different reason for environmental awareness. Societies such as those in the First World, which have an abundance of goods, can turn their attention to "bads." The whole problem is one of joint production of "goods" and "bads." As economist Kenneth Boulding put it:

> If goods are very scarce, you put a very high value on them and you're ready to put up with a lot of "bads." As the old Lancashire saying has it, "Where there's muck, there's money." Its only when you get richer that you become interested in what are really superior "goods", the quality of life and so on (Chisholm, 1972, p. 32).

Business ethics in the dim light of uncertain science

But while economic development enhances environmental concern, ethics becomes more difficult as decision-makers become aware of the uncertainty of science. Technology is always experimental, and any innovation is, by definition, untested (Rosenthal and Bucholz, 1999). Inventors and industrial developers of technology make educated guesses and unexpected results are always a possibility. Some recent examples are thalidomide, DDT, and asbestos. Business leaders who initially decide to manufacture these products are performing experiments. Sometimes there are warnings about safety, but the only way to find out if the warning is justified, is to test it. In some fortunate cases, the testing can be done in a laboratory without risk to consumers

or the environment. In other cases, this is not possible. For example, some of the engineers at Morton-Thiokol warned of the danger facing the Challenger space shuttle because of the unreliability of the O rings at low temperature. If these engineers had prevailed, nobody would have known that they had saved the lives of the crew. Sometimes the warnings come before the fact, and other times the evidence of danger emerges only after the product has been launched. The evidence in such cases is seldom clear and certain. Companies are therefore tempted to keep the knowledge hidden with the hope that the danger is not real and the fear that the companies might be harmed by an unfounded scare. In the case of asbestos, which was considered a safe product because of its fireproof quality, the evidence was suppressed with disastrous results. In the case of silicon breast implants, there was some suppression of evidence, but apparently there was no real harm from the product. The suppression of evidence magnified rather than eased the scare.

The case of the CFCs began as a low risk experiment that would replace higher risk experiments such as ammonia refrigerants. By 1974, CFCs were no longer an experiment but simply a safe, useful, proven product. When the first warnings concerning danger to the ozone were published by Rowland and Molina, the continued manufacturing and use of CFCs once again became experimental. This is of course a retrospective view, and it is not likely that anyone at that time, including DuPont executives, were thinking in terms of this being an experiment. The CFC case is different from many others in that the data could not be hidden in company archives. It was in the stratosphere for scientists and governments to examine.

When there are reasonable doubts about the safety of a product for consumers, full disclosure of facts and an understanding of the risk would allow consumers to decide whether they want to take part in the experiment, i.e., purchase or use the product. But when the risk is environmental, individuals do not have a choice. Nevertheless, full disclosure would enable them collectively to exert political and economic pressure. Risks, whether to consumers, employees, or the environment, should be known throughout the organization, including the engineers, the whole management team, executives, and the board of directors. The information should be shared with the public before the risky product or process is put into effect. As ethicists Sandra Rosenthal and Rogene Buchholz put it:

> All those involved in a product must ask themselves whether the result of the experimental testing conducted thus far warrant a real life experiment. And should the experiment fail, would they be willing to take responsibility for the decision and show the public that it was rationally and morally justified based on the evidence available (Rosenthal and Bucholz, 1999, p. 22).

In the case of CFCs, the "experiment" was well underway before anyone was aware of the risk. If the warnings were accurate, then the results could be catastrophic. The quick ban on non-essential CFCs reflected this awareness. But a complete and immediate ban on all CFCs would have caused severe economic and health problems because of the loss of refrigeration and air-conditioning. A ban could not be implemented without a substitute, but development of a substitute was not economically feasible until there was a ban on CFCs that would make the more expensive substitute marketable. Neither the ban nor the creation of the substitute would solve the problem without international cooperation. All of this had to take place in the light of uncertain science. As described above, the investigation, dialogue, and negotiation that took place over a twelve-year period, produced a surprisingly acceptable result.

Conclusions: What went right?

Business Ethics often takes on the task of making students and business leaders aware of wrongdoing. This assures that those who make bad decisions will be held accountable for decades, even generations, after their deeds. But while the critical task of exposing and condemning wrongdoing is important, so too is the need for finding correct paths and guidelines based on decisions that were made well.

DuPont's reaction to the CFC crisis appears

overall to be an example of doing things right.[4] There were several factors that made the decision very difficult. First, CFCs were an essential product, and the whole infrastructure of existing refrigerators and air-conditioners depended on them. Secondly, while DuPont was the dominant manufacturer, they were not the sole manufacturer. CFC manufacturing was an international industry that could not be contained by one company or one nation. And thirdly, as this article hopefully explained, the scientific evidence was uncertain, controversial, and suffered some setbacks in its development.

But there were other factors that contributed beneficially to the outcome. One was that DuPont, the chief manufacturer, was a large and diversified company, which could take some risks. More importantly, they had the resources to do the research and development of a substitute for CFCs. The decision would be excruciatingly difficult for a small company who made only one thing, if evidence slowly mounted that the one thing was harmful.

But granted the uniqueness of DuPont's situation, there are some areas in which their decisions can serve as exemplars in other similar situations. First, they made a public commitment to be "science driven." This was expressed by the fact that they funded the research that helped make the case against CFCs, and they hired two Ph. D. chemists to dedicate themselves to examining the data. Further, they made a public pledge to stop manufacturing the product if scientific evidence showed that it cannot be produced without danger to human health, and they lived up to the pledge.

What can executives do when faced with critical issues in which the essential information is based on uncertain science?[5] The general model of which the DuPont case is an instance is one in which there is evidence, but not conclusive evidence, that a useful and profitable product might be causing serious damage to the environment.[6] The following principles would be a good basis for making ethical decisions in this type of case. The executives, in the name of the company, should make a public commitment to do no unnecessary harm to the environment. When there is some evidence that their products or procedures are harmful, they should openly face the possibility that the worst-case scenario may be true. In this situation, they would assess the risk and begin to look for ways to mitigate whatever harm they might be causing. In the case of Freon, this meant doing research toward developing a substitute. The second principle would be an emphasis on truth. This obviously means avoiding all deception, but also supporting scientific research and keeping all responsible parties, inside and outside of the corporation, informed. Following the guidelines formulated by Rosenthal and Bucholz, those who make the decisions should be able to give a full accounting and justification of their decisions based on what was known at the time the decisions were made. Regardless of the outcome, the executives should be able to say to any audience, whether it be a court of law, a congressional committee, or the general public," We studied the warnings, and this is what we did for these reasons."

The role of the business executive will continue to involve making tough ethical decisions without the comfort of certainty or unanimity among experts. A study of the DuPont's bumpy ride through the CFC crisis can be helpful in clarifying the issues and dealing with the uncertainty. The fact that business, science, and international governments could come together to fend off a possible disaster should be a ray of hope for future leaders, or at least liberate them from despair.

Acknowledgement

This paper was written with assistance from the West Virginia Humanities Council, a state Program for the National Endowment for the Humanities.

Notes

[1] The term "Business Ethics" with capital letters will be used to describe the academic discipline of Business Ethics, as opposed to a general description of the ethics of business. The same distinction will be made when using the term "Environmental Ethics."

[2] Examples of this attitude are not hard to find, but one example is Dave Foreman, who lists one of the principles of "Earth First" as: "A deep questioning of and even an antipathy to, 'progress' and 'technology.'" Dave Foreman, "Putting the Earth First" in Botzler and Armstrong, p. 450.

[3] A journalistic example of this is an article by syndicated columnist Mona Charen. Referring to the work of Michael Fumento, she begins the column by citing the increasing acceptance of such things as astrology and talking to the dead. Then after pointing out some of the advantages of technology, such as medicine and refrigeration, she asks: "So if the benefits of science are so apparent, why do we fret about environmental hazards like pesticides and chemical additives? . . . The bias toward environmentalists and against science is so strong that the American people have been repeatedly exposed to large doses of unnecessary panic" (Charen, 1999). The implication is that one cannot be scientific and environmentally concerned.

[4] Not everyone agrees that DuPont acted ethically. My interest in this case was whetted several years ago when I heard two conflicting interpretations of DuPont's actions. One was by the well-known business ethicist, Manuel Velasquez who, as part of a Carnegie Mellon University ethics video, used DuPont as an example of a company who continued making a product, Freon, long after they knew it was going to be harmful to us, our children, and our grandchildren. The other report was an article by Mona Charen, in which she asserted that there is no convincing evidence that CFCs are harmful to the ozone, but that DuPont manufactured the crisis to provide a market for its new substitute. I knew that it was impossible that both of these accusations were true. The arguments presented in this paper indicate that the decision making process was very complicated and that neither of the above accusations were true.

[5] Science is seldom absolutely certain, but scientific evidence is often strong enough that for practical purposes it can be considered certain. An example is the present knowledge of the harmfulness of breathing asbestos fibers. Throughout this paper I have used the term uncertain science to refer to cases in which highly qualified scientists take diametrically opposite positions.

[6] With few changes, the reasoning applied to this case could also apply to possible dangers to employees or consumers. For the sake of simplicity, the concluding remarks will be limited to environmental cases.

References

Barkley, Michael B. (ed.): 2000, 'The Cornwall Declaration on Environmental Stewardship', in *Environmental Stewardship in the Judeo-Christian Tradition* (Acton Institute, Grand Rapids, Michigan).

Benedick, Richard Elliot: 1991, *Ozone Diplomacy: New Directions in Saving the Planet* (Harvard University Press, London).

Botzler, Richard and Susan Armstrong: 1998, *Environmental Ethics: Divergence and Convergence*, second edition (McGraw-Hill, Boston).

Charen, Mona: 1999, 'Media Bias Toward Environmentalist', *Wheeling Intelligencer.*

Chisholm, Anne: 1972, *Philosophers of the Earth* (E. P. Dutton Co., New York).

Foreman, Dave: 1998, 'Putting the Earth First', in Botzler and Armstrong.

Goodpaster, Kenneth and Laura Nash: 1998, 'DuPont Freon Division', in *Instructor's Manual to Accompany Policies and Persons: A Casebook in Business Ethics*, third edition (McGraw-Hill, New York).

Gribben, John: February 1979, 'Disappearing Threat to the Ozone', *New Scientist* **81**.

Jackall, Robert: 1998, *Moral Mazes: The World of Corporate Managers* (Oxford University Press, New York).

Litfin, Karen T.: 1994, *Ozone Discourses: Science and Politics in Global Environmental Cooperation* (Columbia University Press, New York).

Rosenthal, Sandra and Rogene Buchholz: 1999, *Rethinking Business Ethics: A Pragmatic Approach* (Oxford University Press, New York).

Rowlands, Ian H.: 1995, *The Politics of Global Economic Change* (Manchester University Press, Manchester and New York).

Stark, Andrew: 1999, 'What's the Matter With business Ethics', in Jennings Marianne Moody (ed.), *Case Studies in Business Ethics* (West Publishing Co., St. Paul Minnesota).

Stolarski, R. S.: Jan 1988, 'The Antarctic Ozone Hole', *Scientific American* **258**, 30–36.

Wheeling Jesuit University,
Wheeling,
West Virginia 26003,
U.S.A.
E-mail: rmullin@wju.edu