
Social responsibility for the use of genes, genomes and biotechnology in biotechnology companies: A commentary from the bioethical viewpoint

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Abstract

Corporate social responsibility (CSR) is discussed, targeting a broad range of industries. As yet, little work on CSR has focused on the specific situation of each industry. The biotechnology industry is unique in that companies use the genes and genomes of plants, animals, and humans, as well as biotechnology in their business. Public concern about genes and genomes centres on their inappropriate use or application in either research or business. This paper proposes a new CSR component for biotechnology companies: taking responsibility for the use of genes, genomes, and biotechnology (GGB) by adopting environmental ethics and bioethics. Environmental ethics is proposed as the ethical root of the environmental responsibility that companies take. The principles of environmental ethics are inductively reasoned from actual business activities, and towards the achievement of environmental responsibility. CSR for the use of GGB is deductively derived from the principles of bioethics and genetic ethics.

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VIEW REGARDING ‘THE USE OF GENES, GENOMES, AND BIOTECHNOLOGY’ (GGB) FOR THE CORPORATE SOCIAL RESPONSIBILITY (CSR) OF BIOTECHNOLOGY COMPANIES

In any industry, all kinds of companies must introduce CSR if the company is newly

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established or a new business has been launched. The concept of CSR can be divided into several elements: for example, Carroll and Buckholtz's four-part pyramid model from the viewpoint of society's expectations.¹ Recently, the following elements have been widely used, following the development of the Global Reporting Initiative as a guideline for sustainability reporting.²

Economic responsibility

The main purposes of a company include earning a profit, maintaining a solid financial basis and paying dividends. At the same time, the activities of the company as a social organisation – its eco-oriented activities – must also be considered.

Social responsibility

Companies must meet their responsibilities regarding employment and welfare, the human rights of employees and stakeholders, good relationships between the company and the community, their products, and sound partnership with their business partners.

Environmental responsibility

Companies must meet their responsibilities for the progressive development of eco-products or services for the safekeeping of chemicals and the reduction of their use, conservation of the ecosystem, prevention of global warming, the reduction, reuse and recycling of natural resources, and green purchasing, green logistics, and so on.

Companies are required to achieve the sustainable development of both the public and the companies themselves by meeting these three responsibilities in a well-balanced and effective way. This thought originates in the 'Triple Bottom Line', as established by Elkington of Sustainability Ltd.³ Today, this idea is said to represent the essential elements of CSR.

In the case of the biotechnology companies, which include all businesses that use biotechnology, such as medical laboratories, IT bioinformatics, biotechnology

venture enterprises, pharmaceutical, chemical, food, agrochemical, and seed companies, we find a specific role that GGB play in their businesses. More focus on GGB is necessary because contemporary biotechnology is inseparably related to genetic engineering. For biotechnology companies, as members of society, an important question arises: 'Do the biotechnology companies have to consider only the three responsibilities of CSR?'

The biotechnology companies involved with genes or genomes have three options: the companies use genes and genomes (including genetic information) for their business, they use genes and genomes only for non-business purposes, or they do not use genes or genomes for any purpose.

The last option must be considered inappropriate decision-making lacking any rationality or reality. The second option is also unsatisfactory, and for the same reason, that any social action should be programmed as part of the business. Proper dealing requires the use of genes and genomes to be part of the business. The biotechnology companies should use them honestly in a manner that is acceptable to both stakeholders and society.

Henriques notes the importance of diversity for sustainability,⁴ suggesting the encouragement of environmental, social, and economic diversities and the appropriate government policies as key ways in which companies can contribute to diversity. He also notes that the conservation of biodiversity has important implications for the sustainability of systems.

Biodiversity exists as a set of various phenotypes of genome. In this sense, the biotechnology companies in particular should be required to use genes and genomes in an appropriate manner, with implications for environmental diversity and sustainability that are acceptable to the stakeholders.

AWARENESS OF GENES BY THE PUBLIC, SCIENTISTS, AND COMPANIES

Genes or genomes usually contain the biological, psychological, medical, and genetic

information of individual human beings, and thanks to genes or genomes as origin of biodiversity, the balance of an ecosystem, or the existence of the ecosystem itself in the natural environment is retained. They are therefore influential not only scientifically but also socially and culturally, and not only for one individual but for all concerned, not only in a specific geographical place but also regionally, and not only reversibly but also irreversibly. Naturally, the public easily understands that the inappropriate use of GGB has a great impact on all creatures, both globally and intergenerationally. In fact, several surveys have found public anxiety about, and distrust of, research and development or industrialisation that uses GGB.⁵⁻⁷

Scientists also understand the public controversy that arises from human genome deciphering and the subsequent genetic research. Around 3–5 per cent of the annual budget of the Human Genome Project – an international undertaking to decode the entire human genome – has been devoted to the study of the ethical, legal, and social implications (ELSI).^{8,9}

The biotechnology companies have probably also been aware of the need to give special consideration to GGB, through, for example, legislation on the handling of genes, setting guidelines for genes, genomes, cloning, and embryonic stem cells, and taking into consideration the trend of public opinion on genetically modified organisms. Eaton has already addressed the importance of business ethics for the bioscience industry.¹⁰ She predicts that many fears resulting from the ethical and social issues created by GGB will prove well founded, as biotechnology products or services come onto the market.

The following is an interim summary. The biotechnology companies are interested in applying genes and genomes. The public watches the moves of the companies from both an economic and an ethical viewpoint. Hence, the investigational range of the meaning of genes and genomes in the biotechnology companies must be extended,

from genes as life-scientific materials to genes as ethical, legal, and social elements, and also to genes as an element of business administration.

POSSIBLE METHODS OF CSR STUDY FOR BIOTECHNOLOGY COMPANIES

The descriptive approach is valuable for studying the use of GGB by biotechnology companies. Exploring the prescriptive approach, however, is now more important than ever in studying the business activities or behaviour of biotechnology companies, as social entities using GGB.

As Brummer noted, several types of CSR theory have been proposed; these theories are closely related to the theory of ‘Business and Society’, a sub-field of business administration.¹¹ Contemporary CSR theory, however, was inevitably spotlighted and requested after the scandals that involved large firms in the 1980s. The nature of CSR was thus revealed as not only a reactive response but also a proactive and normative consideration based on corporate philosophy. Epstein’s theory of the Corporate Social Process also insisted that responsibility for the process is essential to fulfilling CSR, as well as one of its consequences.¹² Hence, for companies, a normative background of decision making is needed to implement CSR. In this sense, prescriptive approaches can be useful in the study of contemporary CSR theory. In fact, ‘social demandingness theory’ and ‘social activist theory’ in Brummer’s classification are still significant today. Stakeholder theory is also derived from CSR theory. The research targets of stakeholder theory are the counterparts of the responsibility takers or the companies. This means that stakeholder theory is a normative theory.¹³

Genes have also been treated as a subject of human and social sciences research because of specific characteristics such as the origin of biodiversity, irreversibility, and the bilateral

character between individuality and commonality. Therefore, normative theories combined with a prescriptive approach are indispensable elements of CSR research on genes, and for descriptive empirical theories in the field of business administration.

Since biotechnology companies conduct business using both genes themselves and genetic information, normative theories with a prescriptive approach are a necessary part of the CSR research that targets biotechnology companies. The integration of the prescriptive and the descriptive approaches has long been attempted. The prescriptive approach usually considers what companies should do and how, by adopting philosophical and ethical principles. The descriptive approach examines a variety of phenomena, activities, and facts, to reach the common concept, the principle, the rule, or the cause.^{14,15} The fruits of such integration will make empirical theories more significant, as Singer points out.¹⁶ He also suggests two future directions for a normative-empirical dialogue: applying the normative framework to the evaluation of the 'goodness' of business practices, and virtue and ethics as the foundation of business conduct.

To make progress, the study of CSR will have to propose many theoretical models that are based on normative theories. The proposed models will stimulate debate between the supporters of normative theory and those of descriptive theory.

CSR STUDY OF BIOTECHNOLOGY COMPANIES FROM A BIOETHICAL APPROACH

Many normative studies of biotechnology companies could involve business ethics.¹⁷⁻²⁵ In fact, no business activity fails to take into account the principles of bioethics and genetic ethics in biotechnology companies, which builds in a specific attribute of GGB. The need for, and the expectation of, the normative bioethical approach is suggested here in the study of biotechnology companies.

A more positive reason for supporting the bioethical approach lies in one purpose of bioethics itself. This purpose may be to seek a sustainable society that is in harmony with the problems derived from life sciences, genes, and genomes, by considering a genome-conscious way of life, adopting and implementing the appropriate public welfare policies, and pursuing better solutions in conventional bioethics, as seen in medical ethics.²⁶ A similarity exists between the bioethical problems discussed above and the bioethical points of issues that must be dealt with in the conduct of CSR on genes and genomes. Consequently, the thought processes of bioethical challenges will serve as a useful reference to discussion of the CSR of biotechnology companies.

NECESSITY OF RESPONSIBILITY FOR THE USE OF GGB

Two important points emerge from the above context for the investigation of CSR in biotechnology companies: the necessity to consider the social responsibility for the use of GGB and the scholarly hopes of a deductive approach using a normative concept that conjugates CSR theory and bioethics.

ISO26000 (a guidance for social responsibility) is expected to be launched in 2009.²⁷ The target of this guidance will be not only commercial entities but also all organisations and groups in society. Society as a whole will enter a new phase of fulfilling each social responsibility. Those biotechnology companies that make use of GGB in several ways will have to make a public commitment in the near future to implement their social responsibility for the use of GGB.

The biotechnology companies' efforts to embody so-called 'genome-conscious management', however, are inadequate. To complement such efforts, a consistent system of laws and sophisticated social systems will be

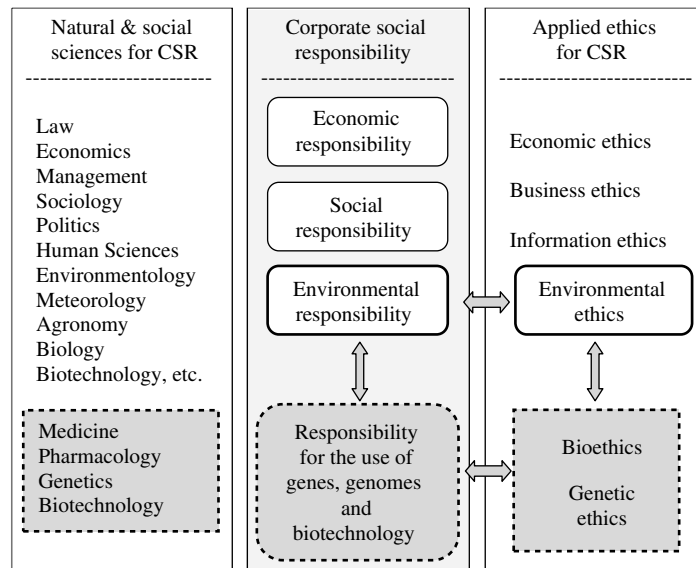


Figure 1: Interrelation between CSR and applied ethics

introduced into society. The basis for establishing such a system is grounded in the fundamental, institutional, and operational research on the use of GGB.

IMPORTANCE OF RESPONSIBILITY FOR THE USE OF GGB

Siep, a German philosopher, has stated that enlargement of knowledge, possibility, and potentiality requires an increase in responsibility, both for the positive use of genetic engineering and for the avoidance of its use.²⁸ If this statement is applied to biotechnology companies, the following situation becomes feasible. The start-up of a biotechnology business using gene-modifying techniques results in the enhancement of genetic information and related knowledge, and the possibility of gene alteration for customers and their families. The companies can no longer remain in a relationship with their customers in which the companies entrust the customers with decisions regarding the use or non-use of the genome-related products, services, or biotechnologies. Given that the companies can now offer their customers genome-related products or

services, and the possibility of genetic modification, the companies should take responsibility for the abandonment of genome-related businesses in the case of unpredictable safety or seriously uncertain social impact. For genome-related businesses, in particular, the companies, as the introducers of that possibility, ought to take social responsibility, regardless of the customers’ needs and choice. This is why discussion of the philosophical and ethical considerations involved in genome-related new businesses is needed, and why the importance of the responsibility for using GGB must be emphasised.

PROPOSAL OF A HYPOTHETICAL CSR MODEL FOR BIOTECHNOLOGY COMPANIES

We now propose a hypothetical CSR model for biotechnology companies, from the viewpoint of applied ethics. This model has two characteristics: the bioethical normative feature of genes and genomes as a social factor serves as a useful reference to the CSR theory proposed in this paper, and a deductive

Table 1: Tactics of environment-conscious management and related business activities

Tactics of environment-conscious management	Types of business activity
<p><i>Green procurement</i> The companies purchase eco-friendly materials, products, or services from the suppliers. The companies also request the suppliers to improve insufficient systems or rules.</p>	<p><i>Corporate-related topics</i> To reduce, reuse, and recycle natural resources To preserve and conserve the natural environment To prevent environmental pollution and destruction To prevent global warming (and to reduce carbon dioxide emissions) To introduce a mind-set that emphasises the prevention or minimisation of adverse effects on the natural environment, natural resources, humans, plants, and animals To use high-precision or highly reliable scientific data, and the outcomes of qualitative research in human and social sciences in business decision making and business activities To procure materials, products, or services, taking into consideration the rights of the environment as a basic human right, and to purchase them based on the evaluation of suppliers' business philosophy To prevent human rights violations in return for the procurement of environmentally high-value-added materials, products, or services</p>
<p><i>Green innovation</i> The companies develop environment-conscious products, services, and eco-friendly techniques and know-how.</p>	<p>To reduce, reuse, and recycle natural resources To preserve and conserve the natural environment To prevent environmental pollution and destruction To prevent global warming (and to reduce carbon dioxide emissions) To develop and release products and services, and to expand sales of them with high security, great value, and high energy efficiency To deal with new concerns about environment-conscious management To solve the existing North–South problem by employing environment-conscious management To deal with new North–South problem by employing environment-conscious management To avoid the maltreatment of human and animals, restore human and animal dignity, and avoid the excessive pain caused by defective and immature products, services, equipment, and systems</p>
<p><i>Green marketing</i> The companies adopt eco-friendly marketing strategies and tactics to meet the customers' and the public's requirements, and to implement sustainable development.</p>	<p>To reduce, reuse, and recycle natural resources To preserve or conserve the natural environment To prevent environmental pollution or destruction To prevent global warming (and to reduce carbon dioxide emissions) To introduce a mind-set that insists on the prevention or minimisation of adverse effects on the natural environment, natural resources, humans, plants, and animals To avoid the maltreatment of humans and animals, to restore human and animal dignity, and to avoid the excessive pain caused by defective or inadequate products, services, equipment, and systems To operate businesses that are based on consideration for the rights of the environment, as a basic human right To develop, release, and expand sales of products or services that offer high security, great value, and high energy efficiency To deal with new concerns about environment-conscious management To solve the existing North–South problem by employing environment-conscious management To deal with the new North–South problem by employing environment-conscious management To use high-precision or highly reliable scientific data, and the outcomes of qualitative research in human and social sciences, in business decision making and business activities To enhance a company's reputation with its stakeholders and the public To develop a fair system for sharing the benefits from research, and from businesses utilising biodiversity To respect the cultural, religious, racial, and other values of every community To prevent environmental racism To decide to entry, progress, or exit the market on the basis of not only the current situation but also from a long-term perspective To act in harmony with universal, international and national hard laws, soft laws, and policies regarding environmental problems</p>

Table 1: Continued

Tactics of environment-conscious management	Types of business activity
<i>Green designing</i>	To prevent the shrinking of biodiversity due to genetically modified organisms and other biotechnology To provide an intra-industry system for the maintenance of biodiversity not only for its industrial utility but also as rich biota To reduce, reuse, and recycle natural resources To preserve and conserve the natural environment To prevent environmental pollution and destruction To prevent global warming (and to reduce carbon dioxide emissions) To develop, release, and expand sales of products or services with high security, great value, and high energy efficiency
<i>Green accounting</i>	To digitalise and visualise the process of environmental activities, and measures regarding business, and to make them comparable in order to report to the stakeholders and the public To refine numerical data continuously, by improving the methods of gathering raw data To seek to evaluate continuously and update the green accounting system To disclose objective data to facilitate stakeholder engagement and external communication To evaluate the effects of economic North and South problems on their own companies and those of their competitors, and the effect of their own companies and those of their competitors on economic North and South problems
<i>Environmental report (or CSR report)</i>	To release the company's stance on environmental problems To create opportunities for useful information services intended to promote socially responsible investment To enhance the company's reputation with its stakeholders and the public
<i>Green philanthropy</i> (e.g., tree planting, cleanup activities and support of environmental education)	To preserve and conserve the natural environment To prevent environmental pollution and destruction To contribute directly and indirectly to the realisation of a recycling-oriented society To enhance the company's reputation with its stakeholders and the public To reinforce the employees' education in current environmental problems, and the employees' consciousness of the environment To contribute directly and indirectly to the solution of environmental North–South problems To prevent environmental racism
<i>Investor relations</i> (e.g., socially responsible investment, eco-funding and environmental credit-rating)	To release the company's stance on environmental problems To actualise sustainable environment-conscious companies by funding them
<i>ISO 14000s</i>	To exercise continuous control of high-quality environmental management To enhance the company's reputation with its stakeholders and the public To reinforce the employees' education in current environmental problems, and the employees' consciousness of the environment
<i>Socially responsible investment</i>	<i>Investor-related topics</i> To promote investment in the businesses of environment-conscious companies To enhance the company's reputation with its stakeholders and the public
<i>Environmental credit-rating</i>	To enhance the company's reputation with its stakeholders and the public
<i>Green purchasing</i>	<i>Consumer-related topics</i> To promote the purchase of products and services from environment-conscious companies To promote the reduction, reuse, and recycling of natural resources, by increasing the purchase and use of environment-conscious products and services To preserve and conserve the natural environment To prevent environmental pollution and destruction To prevent global warming (and to reduce carbon dioxide emissions)

Table 1: Continued

Tactics of environment-conscious management	Types of business activity
<i>Green economics</i>	<p><i>Academia-related topics</i></p> <p>To support research in economics and business administration by collecting and compiling a variety of business cases on environment-conscious management</p> <p>To support the development of new environment-conscious management models</p> <p>To actualise advanced environment-conscious management by introducing new management models</p> <p>To develop a fair benefit-sharing system for sharing the benefits from research, and from businesses utilising biodiversity</p> <p>To refine numerical data continuously, by improving the methods of gathering raw data</p> <p>To seek to establish, and to evaluate continuously, an up-to-date green accounting system</p>

process is introduced to verify that CSR theory. In consequence, genes and genomes as business administrative subjects are factored in the conventional CSR models.

The set-up of the model has two stages: environmental ethics is positioned as an ethical standard of the environmental responsibility of CSR. The principles of environmental ethics are inductively reasoned from the actual business activities used to achieve the environmental responsibility, and the social responsibility of CSR for the use of GGB is deductively derived from the principles of bioethics and genetic ethics (Figure 1). The procedure is divided into eight steps:

Step 1: Extraction of types of business activity from the tactics of environment-conscious management

The tactics of environment-conscious management are known as the corporate activities that carry out the environmental responsibility (Table 1). They are categorised into four groups by topic: the corporate-related topic that contains internal operations, the investor-related topic that contains the investor-intended external activities, the consumer-related topic that contains the consumer-intended external activities, and the academia-related topic that contains the mutually cooperative research between industry and academia. Several types of corporate activity can be seen in each group (Table 2).

Step 2: Assumption of motives from types of business activity

The types of business activity are the kinds of phenotypes. The motives of environmental ethics are assumed from those types (Table 2).

Step 3: Reasoning of the principles of environmental ethics from types of motive

In reasoning about the principles of environmental ethics, the target terms are qualified as the well-established phrases that are featured in standard textbooks or dictionaries on environmental ethics.^{29–33}

The following five reference words are set for the consistent selection of the targeting terms. The reference words represent the idea of ‘sustainable development’. A target term is selected if it meshes with the contexts of more than one reference word. The selected terms are categorised into three groups: principles of environmental ethics, attributes of environmental ethics, and environmental ethics-related topics (Table 3). The definition of ‘sustainable development’ in the report *Our Common Future*, from the World Commission on Environment and Development,³⁴ and its background theory – Daly’s operational principles of sustainable development³⁵ – were consulted in the selection of the reference words.

The reference words are

- sustainable development
- conservation

Table 2: Motives of environment-conscious business activities in companies

Types of the business activity	Motives of the business activities
<p>To reduce, reuse, and recycle natural resources To promote the reduction, reuse, and recycling of natural resources by increasing the purchase and use of environment-conscious products and services To develop and release products and services that offer high security, great value and high energy efficiency, and increase sales of them</p>	<p>Natural resources are limited.</p>
<p>To preserve and conserve the natural environment To reduce, reuse, and recycle natural resources To prevent global warming (and to reduce carbon dioxide emissions) To prevent environmental pollution and destruction To develop and release products and services that offer high security, great value and high energy efficiency, and to increase their sales To deal with new concerns about environment-conscious management To contribute directly and indirectly to the realisation of a recycling-oriented society To reinforce employees' education on current environmental problems, and their awareness of the environment</p>	<p>The natural environment in the land, the sea, and the air has both instrumental and intrinsic values for human beings and for nature itself</p>
<p>To maintain biodiversity To prevent the shrinking of biodiversity resulting from genetically modified organisms or other biotechnology To provide an intra-industry system for the maintenance of biodiversity not only as an industrial utility but also as rich biota To reinforce employees' education on current environmental problems, and their awareness of the environment</p>	<p>Biodiversity gives human beings ecological, genetic, social, economic, scientific, educational, cultural, recreational, and artistic value</p>
<p>To prevent human rights violations in return for the procurement of environmentally high-value-added materials, products, and services To contribute directly and indirectly to the solution of environmental North–South problems To develop a fair system to share the benefits from research and businesses that utilise biodiversity To respect the various cultural, religious, and racial values of every community</p>	<p>Humans should not discriminate, and should not be discriminated against, socially, economically, culturally, or religiously, in any way caused by disclosure of genetic information</p>
<p>To use high-precision or highly reliable scientific data and the outcomes of qualitative research in the human and social sciences in business decision-making and business activities To disclose objective data that facilitate stakeholder engagement and external communication To release the company's stance on environmental problems To enhance the company's reputation with stakeholders and the public To create opportunities for useful information services that seek to promote socially responsible investment To digitalise and visualise the process of environmental activities or measures on business, and to make them comparable in order to report them to stakeholders and the public To reinforce employees' education on current environmental problems and their consciousness of the environment</p>	<p>Information about environmental considerations should be disclosed and shared</p>
<p>To avoid maltreatment of humans and animals, restore the dignity of humans and animals, and avoid the excessive pain caused by defective and immature products, services, equipment, and systems</p>	<p>Humans and animals should be respected and released from any suffering</p>
<p>To reduce, reuse, and recycle natural resources To preserve and conserve the natural environment To prevent environmental pollution and destruction To prevent global warming (and to reduce carbon dioxide emissions)</p>	<p>Problems regarding the natural environment, natural resources and any subsequent human-related problems should be considered on the basis of both the current situation and a long-term perspective</p>

Table 2: Continued

Types of the business activity	Motives of the business activities
<p>To introduce a mind-set that insists on the prevention or minimisation of adverse effects on the natural environment, natural resources, humans, plants and animals</p> <p>To contribute directly and indirectly to the realisation of a recycling-oriented society</p> <p>To enter, continue or exit the market not only on the basis of the current situation, but also on that of a long-term perspective</p>	
<p>To reduce, reuse, and recycle natural resources</p> <p>To preserve and conserve the natural environment</p> <p>To prevent environmental pollution and destruction</p> <p>To prevent global warming (and to reduce carbon dioxide emissions)</p> <p>To develop and release products or services that offer high security, great value and high energy efficiency, and expand their sales</p>	<p>Every possible innovation that helps maintain the natural environment is indispensable for sustainable development.</p>
<p>To introduce a mind-set that insists on the prevention or minimisation of adverse effects on the natural environment, natural resources, humans, plants, and animals</p>	<p>The precautionary principle is necessary for sustainable development</p>
<p>To solve the existing North–South problem by using environment-conscious management</p> <p>To deal with new North–South problems by using environment-conscious management</p> <p>To evaluate the economic effect of North–South problems on their own companies and their competitors, and the effect of their own companies and their competitors on North–South problems</p>	<p>North–South problems are included in environmental problems</p>
<p>To act in harmony with universal, international and national hard laws, soft laws, and policies on environmental problems</p>	<p>Universal, international, and national policies on environmental problems should be respected</p>
<p>To procure materials, products, or services that take into consideration the right of environment as a basic human right, and to purchase them based on the evaluation of business philosophy</p> <p>To operate business assuming that the right of environment is a basic human right</p>	<p>Humans should consider the right of the environment as a basic human right</p>
<p>To use high-precision or highly reliable scientific data, and the consequences of qualitative research in the human and social sciences, in business decision making, and business activities</p> <p>To avoid the maltreatment of human and animals, restore human and animal dignity, and avoid the excessive pain caused by defective and immature products, services, equipment, and systems</p>	<p>The ethics of science, technology, and research should be respected</p>
<p>To actualise sustainable environment-conscious companies through funding</p> <p>To control continuously high-quality environmental management</p> <p>To promote investment in the business of environment-conscious companies</p> <p>To promote the purchase of products or services from environment-conscious companies</p> <p>To enhance the company’s reputation with stakeholders and the public</p>	<p>Efforts to solve environmental problems should be continued</p>

- regeneration
- generation
- anthropocentrism.

Step 4: Proposition of a hypothesis

The standard of environmental ethics for the actual activities that will fulfil environmental

responsibility has been confirmed. In the next stage, the items of environment-conscious management are presupposed to be applicable, by replacing ‘environment’ with ‘gene’ for biotechnology companies. These are the items of genome-conscious management. Based on this presumption, a hypothesis can be

Table 3: Principles of environmental ethics for environment-conscious management

<i>Principles of environmental ethics</i>
Anthropocentrism
Sentientism (Animal liberation)
Biocentrism
Deep ecology, land ethics
Ecocentrism
Precautionary principle
<i>Attributes of environmental ethics</i>
Limits of the earth
Intergenerational ethics
Rights of nature
<i>Environmental ethics-related topics</i>
Sustainable development
Plaintiff qualification of nature
North–South problems
Environmental racism
Rights of environment as basic human rights
Natural sciences, medical science, engineering, social sciences, and human sciences affecting environmental ethics

generated: the interrelation between environmental responsibility and environmental ethics is applicable to the interrelation between the responsibility for the use of genes and genomes and bioethics.

To establish the hypothesis, the responsibility for the use of GGB in biotechnology companies is elicited from the principles of bioethics and genetic ethics, through the reverse process based on the reasoning of the principles of environmental ethics.

Step 5: Analogy of the principles of bioethics and genetic ethics from the principles of environmental ethics

The principles of environmental ethics are categorised into three groups: principles of environmental ethics, attributes of environmental ethics, and environmental ethics-related topics, in Step 3. The bioethical principles are also categorised into three groups by analogy with environmental ethics: principles of bioethics and genetic ethics, attributes of bioethics and genetic ethics, and bioethics-related and genetic-ethics-related topics. The target terms are qualified as well-

Table 4: Principles of bioethics and genetic ethics for genome-conscious management

<i>Principles of bioethics</i>
Autonomy
Non-maleficence
Beneficence
Justice
<i>Attributes of bioethics</i>
Medical ethics
Genetic ethics
Science, technology and research ethics
Bioethics of life and death
Bioethics of gender
Bioethics of animals
Intergenerational ethics
<i>Bioethics-related topics</i>
<i>Human</i>
Three action principles on medical ethics (informed consent, institutional review board, and personal information protection)
Right of health (as a basic human right)
North–South problems
Religions and bioethics (e.g., rejection of blood transfusion by the Jehovah's Witnesses)
Genetic counselling
Genetic testing and screening
Genetics and the environment in human health
Genetics and racial minorities
Genetics and human behaviour
Genetics and human self-understanding
Human genetic engineering
Genetic discrimination
Personal information about the human body
<i>Plants</i>
Genetically modified plants
Plant diversity
North–South problems
<i>Animals</i>
Genetically modified animals and cloned animals
Animal welfare/Animal liberation
Animal diversity and the vulnerability of the gene pool
Bioethical and religious problems regarding the use of the organs, tissues, or cells of genetically modified animals
<i>Marine life</i>
Genetically modified marine organisms
<i>Micro-organisms</i>
Continuous safety assessment of bio-pesticides using genetically engineered bacteria or viruses

established biotechnology-related phrases that are featured in the *Encyclopedia of Bioethics* or other standard textbooks (Table 4).^{36,37}

Step 6: Analogical application to motives of business activities regarding the principles of bioethics and genetic ethics

In the inductive process of identifying the principle of environmental ethics from the environmental responsibility, the principle of environmental ethics is reasoned directly from the types of motive. The motives of business activities are analogised from the principles of bioethics and genetic ethics, by reverse reasoning (Table 5).

Step 7: Analogical application to types of business activity from motives

In the process of reasoning on the principles of environmental ethics from the environmental responsibility, the motives of the business activity are induced from the type of business activity. The types of business activity in biotechnology companies using GGB are induced in a similar way (Table 5).

Step 8: Analogical application to the tactics of bioethics-conscious management from types of business activity

In the process of reasoning on the principles of environmental ethics from the environmental responsibility, the types of business activity of general companies are induced from the tactics of environment-conscious management. The tactics of genome-conscious management are induced through the reverse process in the case of environment-conscious management. The induced tactics are categorised in Table 6.

SOCIAL RESPONSIBILITY FOR THE USE OF GGB DERIVED FROM THE PRINCIPLES OF BIOETHICS AND GENETIC ETHICS

The positive influence of the principles of environmental ethics on environment-conscious management is clarified by reviewing the interrelationship between the environmental responsibility and

environmental ethics in general companies. By analogy, bioethics as an ethical standard is applicable to genome-conscious management, on the assumption that the tactics of environment-conscious management are applicable to the tactics of genome-conscious management. As a result, the proposed hypothesis is confirmed: that is, the interrelationship between environmental responsibility and environmental ethics is applicable to the interrelationship between the responsibility for the use of GGB and bioethics (Figure 1). Here, we make a recommendation about the necessity of responsibility in using GGB.

In addition, the activities that are responsible for the use of GGB must be associated with four principles of bioethics: autonomy, justice, non-maleficence, and beneficence. More importantly, biotechnology companies are not allowed to engage in bioethically inappropriate activities or behaviours, even if those activities fit current management theories, such as competitive strategy theory. Hence, the activities or behaviours that fulfil the responsibility for using GGB must be judged by the following guidance for the bioethical attitude of biotechnology companies, which consists of one major premise and four principles:

Major premise:

Biotechnology companies must not impair the human dignity of customers or the public, deliberately or accidentally, by using GGB. Biotechnology companies must not undervalue either the instrumental or the intrinsic values of the natural environment, plants, and animals. Those two criteria are the minimal but fundamental norms to embody the following four principles:

- *Autonomy:* Biotechnology companies must not limit customers' decision branch of autonomy, deliberately or accidentally, in the absence of any fair contracts or agreements between the companies and the customers.

Table 5: Types of genome-conscious business activity in biotechnology companies

Motives of the business activities	Types of the business activity
Genetic information is the common heritage of human beings	To avoid unfair control of access to genetic information by using the patents on genes or biotechnologies for the wrong purpose To avoid any confusion derived from the property rights to the gene itself and to genetic information
Genes are primary elements that dominate the genetic and characteristic identity of humans	To provide an appropriate ethical judging system that makes rational distinctions between disease treatment and genetic enhancement To prohibit acts such as the genetic modification of germ lines and the dissolution of personality or identity through the use of biotechnology
Personal genetic and medical information is extremely important private information	To prohibit the inappropriate use or leakage of genetic information or medical information, both inside and outside the company
Biodiversity gives human beings ecological, genetic, social, economic, scientific, educational, cultural, recreational, and artistic value	To maintain the richness of the gene pool of all creatures, including humans To prevent biodiversity shrinking as a result of genetically modified organisms or other biotechnology To provide an intra-industry system for the maintenance of biodiversity, not only as an industrial utility but also as rich biota
Humans should not discriminate, and should not be discriminated against, socially, economically, culturally, or religiously, in any way caused by disclosure of genetic information	To avoid the emergence of a new eugenics underpinned by molecular genetics To prevent any widening in the gap between the rich and the poor in the public as a result of the unfairness of opportunities to make use of genetic engineering or cutting-edge biotechnologies To prevent genetic discrimination in employment, marriage, and life insurance
Humans and animals should be respected and not required to undergo any suffering	To avoid the maltreatment of human and animals, restore human and animal dignity, and avoid excessive pain
Patients, test subjects, customers, and their relevant associates should be considered to have rights in bioethics	To prevent any personal health hazards to those who operate genetic engineering or biotechnology for patients or customers To set business ethical rules on gene-related business for biotechnology companies, considering the rights to health as basic human rights To realise the differences between the bioethical principles of different ethnicities, regions, and creeds
Information about the commercial use of genes or biotechnology should be disclosed and shared	To clarify and release the company stance on the use of genes and biotechnology for the promotion of socially responsible investment To accelerate innovation to improve the quality of genetic analysis and genetic testing, and to prevent unmerited discrimination resulting from imprecise genetic data
Comprehensive legal, social, cultural, philosophical, and ethical consideration must be given to the usage of both genes and biotechnologies	To implement the legal, social, intergenerational, and ethical evaluation of genome-related businesses or gene enhancement businesses throughout the entire process from R&D to post-market
Continuous assessment of the safety of genetic engineering techniques and biotechnology, and their quality and maturity should be implemented	To prevent all personal health hazards to those who operate genetic engineering or biotechnology for patients or customers To set business ethical rules on gene-related business for biotechnology companies, considering the rights to health as basic human rights To implement the legal, social, intergenerational, and ethical evaluation of genome-related businesses or gene enhancement businesses throughout the entire process from R&D to post-market
Progress in the commercialisation of the human body, organs, tissues, and cells should be recognised	To implement ethical assessment and to build a public consensus for the appropriate and just commercialisation of biotechnology using embryonic stem cells (ES cells)

Table 5: Continued

Motives of the business activities	Types of the business activity
	To provide sufficient measures based on discussion of the dignity of life before permitting the commercialisation of biotechnology using genes or genetic information To re-evaluate the commercialisation of the human body that results in autonomy or self-determination in dealing with one's own body, mainly in the United States
Bioethical and human-related problems should be considered not only on the basis of the current situation, but also from a long-term perspective	To enter, continue or exit the market not only on the basis of the current situation, but also on that of a long-term perspective
Every possible innovation in treating genes and genomes is indispensable for sustainable development	To accelerate innovation to improve the quality of genetic analysis and genetic testing, and to prevent unmerited discrimination as a result of imprecise genetic data
The precautionary principle is necessary for sustainable development	To introduce a mind-set that emphasises the prevention or the minimisation of the adverse effects of the use of genes, genomes, and biotechnology
North–South problems are included within the problems of genes and biotechnology	To prevent the economic North–South problems caused by the genome-related business
Universal, international, and national policies on bioethical and genetic problems should be respected	To act in harmony with universal, international and national hard laws, soft laws, and policies on bioethical and genetic ethical problems for biotechnology companies To realise the differences between the bioethical principles of different ethnicities, regions, and creeds
The ethics of science, technology, and research should be respected	To use high-precision or highly reliable scientific data and the outcomes of qualitative research in human and social sciences in business decision making and business activities

Biotechnology companies must not interrupt customers' independent process of self-determination.

- *Justice*: Biotechnology companies must not interrupt the following: customers' legal right to opportunities for the prevention of disease, for health promotion, and for the treatment of disease, based on public order and morals, just as the right to health is derived from fundamental human rights.
- *Non-maleficence*: Biotechnology companies themselves must not harm their customers through defective products or services. Biotechnology companies must not harm their customers' bodies or their health conditions by unduly limiting the customers' right of access to products and services.
- *Beneficence*: Biotechnology companies must not limit direct or indirect beneficence from products and services to customers,

or access to information about the products and services.

FURTHER RESEARCH

Biotechnology companies using GGB require so-called 'genome-conscious management' because GGBs have a wide-ranging and serious impact on humans, the natural environment, plants, and animals. Such management should be placed in the same position as 'environment-conscious management'. We have provided a concept of responsibility for the use of GGB as an ethical background to management. The genome-specific responsibility remains only a hypothesis, however, because in this paper this concept has been generated through a bioethical approach. The following two complementary studies are ongoing by the authors.

Table 6: Tactics of genome-conscious management and related business activities

Types of business activity	Tactics of genome-conscious management
<p><i>Corporate-related topics</i></p> <p>To avoid unfair control of access to genetic information by using patents for genes or biotechnology for the wrong purpose</p> <p>To avoid confusion arising from the property rights of the gene itself and genetic information</p> <p>To provide an appropriate ethical judging system that makes rational distinctions between disease treatment and genetic enhancement</p> <p>To prohibit acts such as the genetic modification of germ lines and the dissolution of personality or identity through the use of biotechnology</p> <p>To maintain the richness of the gene pool of all creatures, including humans</p> <p>To prevent the shrinking of biodiversity as a result of the use of genetically modified organisms or other biotechnology</p> <p>To provide an intra-industry system for the maintenance of biodiversity, not only as an industrial utility but also as rich biota</p> <p>To avoid the emergence of a new eugenics underpinned by molecular genetics</p> <p>To prevent any widening in the gap between the rich and the poor in the public as a result of the unfairness of opportunities to make use of genetic engineering or cutting-edge biotechnology</p> <p>To prevent genetic discrimination in employment, marriage and life insurance</p> <p>To prevent any personal health hazard to those who operate genetic engineering or biotechnology equipment for a patient or a customer</p> <p>To set business ethical rules on gene-related business for the biotechnology companies, considering the rights to health as basic human rights</p> <p>To prohibit the inappropriate use or leakage of genetic information or medical information, both inside and outside the company</p> <p>To clarify and release the company's stance on the use of genes and biotechnology for the promotion of socially responsible investment</p> <p>To implement ethical assessment, and to build a public consensus for the appropriate and just commercialisation of biotechnology using embryonic Stem cells (ES cells)</p> <p>To take sufficient measures based on discussion on the dignity of life before allowing the commercialisation of biotechnology using genes or genetic information</p> <p>To avoid the maltreatment of human and animals, restore human and animal dignity, and avoid excessive pain</p> <p>To implement legal, social, intergenerational, and ethical evaluation of genome-related business or gene enhancement business, throughout the entire process from R&D to post-market</p> <p>To enter, continue or exit the market not only on the basis of the current situation but also from a long-term perspective</p> <p>To accelerate innovation to improve the quality of genetic analysis and genetic testing, and to prevent unmerited discrimination as a result of imprecise genetic data</p> <p>To introduce a mind-set that emphasises the prevention or the minimisation of the adverse effects of the use of genes, genomes, and biotechnology</p> <p>To prevent the economic North–South problems caused by the genome-related business</p> <p>To act in harmony with universal, international and national hard laws, soft laws, and policies on bioethical and genetic ethical problems for biotechnology companies</p> <p>To realise the differences between the bioethical principles of different ethnicities, regions, and creeds</p>	<p><i>Biolet procurement</i></p> <p>The companies should purchase DNA samples, cells, tissues, and other products or services from suppliers that have appropriate internal rules, codes and systems regarding the treatment of genes and biotechnology, and that have a socially acceptable business philosophy or vision of bioethical and genetic ethical business operations. The companies should also request the suppliers to improve any inadequate systems or rules</p>

Table 6: Continued

Types of business activity	Tactics of genome-conscious management
<p>To use high-precision or highly reliable scientific data and the outcomes of qualitative research in human and social sciences in business decision making and business activities</p>	
<p>To develop and release products or services that offer high security, great value, and legal and ethical acceptance continuously To deal with new concerns about the use of genes and biotechnology To solve the existing North–South problems arising from the use of genes and biotechnology To deal with the new North–South problems arising from the use of genes and biotechnology</p>	<p><i>Biolet innovation</i> The companies should continuously accelerate the innovation of genome-conscious products, services, bio-oriented techniques, and know-how</p>
<p>To avoid any personal health hazard to those who operate genetic engineering or biotechnology for a patient or a customer To prevent the shrinking of biodiversity as a result of the use of genetically modified organisms or other biotechnology To prohibit the inappropriate use or leakage of genetic information or medical information, both inside and outside the company</p>	<p><i>Biolet marketing</i> The companies should adopt genome-conscious marketing strategies and tactics to meet the requirements of customers and the public</p>
<p>To introduce a mind-set that emphasises the prevention or the minimisation of the adverse effects of the use of genes, genomes and biotechnology To develop and release the products or services that offer high security, great value and legal and ethical acceptance, and expand their sales To deal with new concerns about the use of genes and biotechnology To solve the existing North–South problems arising from the use of genes and biotechnology To deal with the new North–South problems arising from the use of genes and biotechnology To use high-precision or highly reliable scientific data and the consequences of qualitative research on human and social sciences for business decision making or business activities To enhance the company’s reputation with stakeholders and the public</p>	
<p>To develop and release the products or services that offer high security, great value and legal and ethical acceptance, and expand their sales To avoid any personal health hazards to those who operate genetic engineering or biotechnology for a patient or a customer To prevent any shrinking of biodiversity as a result of genetically modified organisms or other biotechnology To prohibit the inappropriate use or leakage of genetic information or medical information, both inside and outside the company</p>	<p><i>Biolet designing</i> The companies should develop high-security and high-quality equipment or systems for the treatment of genes and genomes, as well as biotechnology that protect individual genetic information, to obtain precise data and to avoid endangering the dignity of life by human or machine error</p>
<p>To digitalise and visualise activities or measures on the use of genes and biotechnology, and to make them comparable in order to report them to stakeholders and the public To refine numerical data continuously by improving the methods of gathering raw data To seek an up-to-date accounting system suitable for a biotechnology business that uses genes and genomes</p>	<p><i>Biolet accounting</i></p>
<p>To disclose objective data for stakeholder engagement and external communication To evaluate the economic effect of North–South problems on their own companies and their competitors, and the effect of their own companies and their competitors on North–South problems</p>	
<p>To release the company stance on the use of genes and biotechnology To create opportunities for useful information services that seek to promote socially responsible investment</p>	<p><i>CSR report</i></p>

Table 6: Continued

Types of business activity	Tactics of genome-conscious management
To create opportunities to enhance the company's reputation with stakeholders and the public	
To contribute directly and indirectly to the realisation of a genome-conscious society To create opportunities to enhance the company's reputation with stakeholders and the public	<i>Biolet philanthropy</i> The companies can establish or contribute to social actions or philanthropy that focus on, for example, the theme of the genome and our society and the future of our health, as well as genome education
To reinforce the employees' grasp of the current status of gene-related problems, and the employees' awareness of genes To contribute, directly and indirectly, to the solution of North–South problems regarding genes, genomes, and biotechnology	
To release the company stance on the use of genes and biotechnology To actualise sustainable gene-conscious companies through funding	<i>Investor relations</i> (e.g., socially responsible investment, Biolet fund, Biolet credit rating)
To release the company stance on the use of genes and biotechnology To continuously control the genome-conscious management using high-quality review and assessment To enhance the company's reputation to the stakeholders and the public To reinforce the employees' grasp of the current status of gene-related problems and the employees' awareness of genes	<i>ISO26000</i>
<i>Investor-related topics</i> To release the company stance on the use of genes and biotechnology To actualise sustainable gene-conscious companies through funding	<i>Socially responsible investment, Biolet fund, Biolet credit rating, and others</i>
<i>Consumer-related topics</i> To actualise sustainable gene-conscious companies through the increase of sales To avoid the personal health hazard caused by the use of genome-conscious products or services to a patient or a customer To grasp consumers' awareness of basic human rights, such as the right to health	<i>Biolet purchasing</i> The companies should forge and maintain a good relationship with the Biolet consumers
<i>Academic-related topics</i> To support research in economics and business administration by collecting a variety of business cases on genome-conscious management To support the development of new genome-conscious management models	<i>Biolet economics</i>
To support research in bioethics and business ethics by accumulating a variety of business cases on genome-conscious management To support the development of new business ethics models by the genome-conscious companies	<i>Biolet ethics</i>
<i>Biolet: BIOindustrial Law & Ethics Targeted</i> (The word 'Biolet' was created by the authors and is associated with Violet, which is in contrast to Green.)	

One approach uses stakeholder theory, an academic field of business administration. Recognition of genes as a stakeholder (who may be a secondary, silent stakeholder) is indispensable in requiring biotechnology companies to accept responsibility for the use of GGB. This is because the companies provide budgets, organisation, and manpower only to

the stakeholders of the companies. Conventional studies show that the natural environment is regarded as a stakeholder in the companies. Whether genes and genomes that define the specific characteristics of plants and animals are stakeholders is now being discussed.

One predictable objection is that the responsibility for the use of GGB is included

in the responsibility of consideration for the use of the natural environment, given that genes are components of the natural environment. Therefore, the responsibility specific to GGB does not need to be provided. Gene-related problems can be dealt with in the environmental responsibility. The purpose of this paper is not to identify the style of the responsibility for using GGB, but to elicit the responsibility, in a deductive manner, out of the vague consensus that genes are something special.

The other approach uses integrative social contract theory, an academic field of business ethics. Under discussion is a business ethics theory that covers economic, social, and environmental responsibilities, and is consistent with bioethical responsibility. Such a theory is needed to ensure that the ethical standard of corporate activities acts with responsibility for the use of GGB by biotechnology companies. This involves some adaptability of the responsibility for the use of GGB by biotechnology companies, by taking up the integrative social contract theory as a fit theory for solving, simultaneously, business ethical, environmental ethical, and bioethical responsibilities.

References and Notes

- Carroll, A. B. & Buckholtz, A. K. (2003). *Business & Society: Ethics and Stakeholder Management*, 5th edn, South-Western, Mason, Ohio, pp. 35–42.
- Global Reporting Initiative G3 Guidelines, [http://www.globalreporting.org/ReportingFramework/G3Guidelines/Global Reporting Initiative](http://www.globalreporting.org/ReportingFramework/G3Guidelines/Global%20Reporting%20Initiative), accessed 6th October, 2007.
- Elkington, J. (1997). *Cannibals With Forks: The Triple Bottom Line of 21st Century Business*, New Society, Gabriola Island, BC, pp. 69–96.
- Henriques, A. (2004). CSR, sustainability and the triple bottom line, in Henriques, A. & Richardson, J. (eds.), *The Triple Bottom Line, Does It All Add Up?*, Earthscan, London and Sterling, VA, pp. 26–33.
- Gaskell, G., Allum, N., Bauer, M., Durant, J., Allansdottir, A., Bonfadelli, H., Boy, D., de Cheveigne, S., Fjaestad, B., Gutteling, J. M., Hampel, J., Jelsoe, E., Jesuino, J. C., Kohring, M., Kronberger, N., Midden, C., Nielsen, T. H., Przystalski, A., Rusanen, T., Sakellaris, G., Torgersen, H., Twardowski, T. & Wagner, W. (2000). Biotechnology and the European public. *Nat. Biotechnol.* **18**(9), 935–938.
- Priest, S. H. (2000). Us public opinion divided over biotechnology. *Nat. Biotechnol.* **18**(9), 939–942.
- Savadori, L., Savio, S., Nicotra, E., Rumiati, R., Finucane, M. & Slovic, P. (2004). Expert and public perception of risk from biotechnology. *Risk Anal.* **24**(5), 1289–1299.
- The Ethical, Legal and Social Implications (ELSI) Research Program, [http://www.genome.gov/10001618National Human Genome Research Institute](http://www.genome.gov/10001618National%20Human%20Genome%20Research%20Institute), accessed 21st September, 2007.
- Collins, F. S., Green, E. D., Guttmacher, A. E. & Guyer, M. S. (2003). A vision for the future of genomics research: A blueprint for the genomic era. *Nature* **422**, 1–13.
- Eaton, M. L. (2004). *Ethics and the Business of Bioscience*, Stanford University Press, Stanford, CA, pp. 5–13.
- Brummer, J. J. (1991). *Corporate Responsibility and Legitimacy: An Interdisciplinary Analysis*, Greenwood, Oxford, pp. 19–31.
- Epstein, E. M. (1989). Business ethics, corporate citizenship and the corporate social policy process: A view from the United States. *J. Bus. Ethics* **8**, 583–595.
- Mitchell, R. K. (1997). Toward a theory of stakeholder identification and salience: Defining the principle of who and what really counts. *Acad. Manage. Rev.* **22**(4), 853–886.
- Rosenthal, S. B. & Buchholz, R. A. (2000). The empirical-normative split in business ethics: A pragmatic alternative. *Bus. Ethics Quart.* **10**(2), 399–408.
- Victor, B. & Stephens, C. U. (1994). Business ethics: A synthesis of normative philosophy and empirical social science. *Bus. Ethics Quart.* **4**(2), 145–155.
- Singer, M. S. (1998). Paradigms linked: A normative-empirical dialogue about business ethics. *Bus. Ethics Quart.* **8**(3), 481–496.
- Calkins, M. (2002). How casuistry and virtue ethics might break the ideological stalemate troubling agricultural biotechnology. *Bus. Ethics Quart.* **12**(3), 305–330.
- Sandler, R. (2005). A response to Martin Calkins's "How casuistry and virtue ethics might break the ideological stalemate troubling agricultural biotechnology". *Bus. Ethics Quart.* **15**(2), 319–327.
- Ryan, M. P. (2005). Introduction: Ethical responsibilities regarding drugs, patents, and health. *Bus. Ethics Quart.* **15**(4), 543–547.
- Leisinger, K. M. (2005). The corporate social responsibility of the pharmaceutical industry:

- Idealism without illusion and realism without resignation. *Bus. Ethics Quart.* **15**(4), 577–595.
21. Werhane, P. H. & Gorman, M. (2005). Intellectual property rights, moral imagination, and access to life-enhancing drugs. *Bus. Ethics Quart.* **15**(4), 595–613.
 22. Flowers, E. B. (1998). The ethical and economics of patenting the human genome. *J. Bus. Ethics* **17**(15), 1737–1745.
 23. McMillan, S., Duska, R., Hamilton, R. & Casey, D. (2006). The ethical dilemma of research and development openness versus secrecy. *J. Bus. Ethics* **65**(3), 279–285.
 24. MacDonald, C. & Whellams, M. (2007). Corporate decisions about labeling genetically modified foods. *J. Bus. Ethics* **75**(2), 181–189.
 25. Eaton, M. L. (2007). Managing the risks associated with using biomedical ethics advice. *J. Bus. Ethics*, online, 22 February.
 26. Callahan, D. (1995). Bioethics, Epps, P.G. Genetic discrimination, Juengst, E.T. DNA identification, Lee, S.S.-J. Genetics and racial minorities, Murray, R.F. Jr (1995). Genetic counseling, ethical issues, in Omenn, G.S. & Motulsky, A.G. (1995), revised by Sharp, R.R. Genetics and environment in human health, Press, N., Ariail, K., Clayton, E.W., Juengst, E.T., Hodge, Jr, J.G., Quaid, K.A., Marsick, R. & Kodish, E.D. Genetic testing and screening, Resnik, D.B. Genetic engineering, human, Shweder, R.A. (1995). revised by Fleck, L.M. Genetics and human behaviour, Zoloth, L. (2004). Genetics and human self-understanding, in Post, S.G. (ed.), *Encyclopedia of Bioethics*, 3rd edn, Macmillan Reference USA, New York, NY.
 27. Social Responsibility, <http://isotc.iso.org/livelink/livelink/fetch/2000/2122/830949/3934883/3935096/home.html?nodeid=4451259&cvernum=0>International Organization for Standardization, accessed 7th October, 2007.
 28. Siep, L. (1996). Ethische probleme der gentechnologie, in Beckmann, J.P. (ed.), *Fragen und Probleme einer medizinischen Ethik*, Walter de Gruyter, Berlin/New York, NY, pp. 309–331.
 29. Des Jardins, J. R. (2000). *Environmental Ethics: An Introduction to Environmental Philosophy*, 3rd edn, Wadsworth, Belmont, CA.
 30. Pojman, L. P. (2001). *Environmental Ethics: Readings in Theory and Application*, 3rd edn, Wadsworth, Belmont, CA.
 31. Benson, J. (2000). *Environmental Ethics: An Introduction with Readings*, Routledge, London.
 32. Elliot, R. (ed.) (1995). *Environmental Ethics*, Oxford University Press, Oxford.
 33. Stenmark, M. (2002). *Environmental Ethics and Policy-Making*, Ashgate, Aldershot.
 34. World Commission on Environment and Development (1987). *Our Common Future*, Oxford University Press, Oxford.
 35. Daly, H. E. (1990). Toward some operational principles of sustainable development. *Ecol. Econ.* **2**(1), 1–6.
 36. Post, S. G. (ed.) (2004). *Encyclopedia of Bioethics*, 3rd edn, Macmillan Reference USA, New York, NY.
 37. Rollin, B. E. (2005). Biotechnology and animals: ethical issues in genetic engineering and cloning, in Burley, J. & Harris, J. (eds.), *A Companion to Genethics*, Blackwell Publishing, Malden, MA/Oxford/Victoria.