ETC group
action group on Erosion, Technology and Concentration

COMMUNIQUE

November/December 2001 **Issue #73**

New Enclosures:

Alternative Mechanisms to Enhance Corporate Monopoly and BioSerfdom in the 21st Century

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Summary:

Issue: Confronted with the practical, technical and political uncertainties of intellectual property, industry is developing alternative mechanisms -- "New Enclosures" -- to secure monopoly control of biotechnology and other emerging technologies. New Enclosures that offer built-in exclusivity and long-range (remote) control will be used to supplement (or eventually replace) intellectual property as a means of strengthening corporate dominance over products and processes. In this report the ETC Group identifies three categories of New Enclosures: 1) biological monopolies; 2) remote sensing and biodetectors; 3) legal contracts.

Impact: New Enclosure mechanisms encourage bioserfdom, facilitate corporate consolidation and undermine national sovereignty. Evolving technologies are being used to identify and control germplasm, territory and labour. Poorly-understood but powerful new technologies may be used to ensure regulatory compliance, or to circumvent regulations and patent laws. *Perhaps most disturbing is that the start-up companies developing the new control technologies are developing alliances with – or are controlled by – the companies their tools are intended to monitor. This new technocracy is positioned to dictate regulatory standards to governments that have lost their capacity to assess and evaluate control mechanisms.* New Enclosures will facilitate external, long-distance control of industrial (farm and manufacturing) systems. Ultimately, New Enclosures threaten to erode the rights of farmers, workers, and small enterprises and their role in management and decision-making.

Players: New Enclosures span a diverse array of technologies – from biotech to microelectronics, remote sensing to robotics, geospatial information technologies, and more. Corporate giants from Cargill to Deere, Motorola to Monsanto are teaming up with entrepreneurial start-ups such as CropVerifeye.com, GeneScan, Icon Genetics, Neogen and many more. Governments are also using New Enclosure tools to monitor and enforce regulations.

Policy: In the New Enclosures era, it is not enough for civil society to monitor corporate consolidation and to campaign against the patenting of biological products and processes. Intergovernmental bodies and civil society organizations must move beyond IP to examine how new economic configurations coupled with a confluence of new technologies are becoming strategic alternatives for strengthening corporate control. Governments have shown little interest in –or capacity for – cross-sectoral technology analysis. New Enclosures and related technologies are moving far faster than anti-trust agencies and other regulatory bodies. National anti-trust laws are limited in their approaches to curbing abuses of monopoly market power in global markets. Intergovernmental bodies must step in to fill the gap. In this report, the ETC Group proposes specific recommendations for monitoring, analyzing and independently regulating New Enclosures at the national and international level.

Part One: Old Enclosures

The Context: Intellectual Property is Becoming Unreliable, Unpredictable and Untrustworthy

Over the past two decades intellectual property (IP) has become a powerful, though imperfect, legal tool to enhance corporate monopoly and gain market exclusivity. IP has been a major factor in the growth and consolidation of the biotechnology industry. In the 1980s the US government took giant steps to accommodate the corporate desire to patent life by re-defining laws to allow for exclusive monopoly patents on *all* biological products and processes. At the World Trade Organization and through bilateral trade agreements the biotech industry has lobbied vigorously to impose an US-style IP regime on the rest of the world.

Despite the push to harmonize, expand and enforce stronger IP laws worldwide, patents are often a giant headache for the corporations who stand to benefit the most from them. IP laws, especially as they apply to biological products and processes, are characterized by confusion and uncertainty. The application of patent law to living materials has resulted in immense and costly legal battles between corporations that are competing for ownership of strategic genes, traits and biological processes. In order for patents to have economic value, corporations must defend their patent claims and enforce licensing requirements under civil law. As patentable subject matter grows in number and complexity so are patent applications.

Critics contend that too many patents are being granted for too long, and the subject matter being monopolized is based too often on someone else's innovation and knowledge. Instead of promoting innovation, patents are stifling research and hindering competition. The concerns are not just technical, but go further to question the morality of a legal system that is fundamentally inequitable. Twenty-year monopolies granted by state authorities in record numbers are jeopardizing basic human rights, threatening food security and marginalizing public sector research.

It is in this context that industry is seeking new and additional mechanisms – technological and regulatory – to secure control of biotechnology in the 21st century. Industry's discomfiture with the present intellectual property system can be summarized as follows:

1. Practically unreliable – The science and the IP process are too unpredictable to allow enterprises to count on IP as a means of controlling markets and technology.
2. Politically unpredictable – In the wake of "Post-Seattle Syndrome," negative patent PR in South Africa, and mounting opposition from United Nations' agencies, the biotech industry does not trust governments to "stay the course" on IP monopolies.
3. Technologically untrustworthy – Some new technological advances could dis-assemble or circumvent biotech patents. This points the way to what could become a profitable move toward lawful patent piracies that (in the current political environment) governments would be reluctant to confront.

Each of these concerns is discussed in more detail below:

1. Practically unreliable - It is extraordinarily difficult to monitor and monopolize a technology that is advancing so quickly. The volume of life sciences data is doubling every six months.[1] As patentable subject matter grows in quantity and complexity, applications are growing in size. IBM wins 10 new patents every working day.[2] Last year, the US Patent & Trademark Office received its largest ever biotech patent application – the equivalent of 400,000 pages![3]

Complexity has led to a massive leap in transaction costs. The legal costs alone of obtaining a patent approach $10,000, and it typically costs $1.5 million (per side) to litigate a patent.[4]

Not surprisingly, the number of intellectual property lawyers in the United States is growing faster than the amount of research.[5] As one legal expert puts it, the scope of monopoly patent rights depends not so much on the inventors' work, as it does on the imagination and skills of the lawyers who draw up the patent applications.[6]

Since 1995 in the USA, the number of intellectual property lawsuits reaching federal courts has risen ten times faster than other legal actions. There were 8,200 cases in 1999 alone.[7] Because patents are civil law, these costs fall on the industry. Were it only a matter of cost, the larger companies would probably see the expense as a useful barrier to deny entry for smaller enterprises. Indeed, the costs are a barrier. Start-up biotech "boutiques" are reported to be budgeting as much for patent litigation as they are for research expenditures.[8] But even the largest enterprises cannot be assured that the courts will be on their side. Twelve of every one hundred biotech patents end up in court. Forty-six per cent of all US biotech patents that are challenged in court are overturned and some legal experts suggest that a still larger percentage would be rejected if they were challenged.

The outcome of patent litigation can literally make or break a biotech business. CellPro Inc. lost 50% of its stock market value in a single day after a federal court ruled the company infringed a competitor's patent.[9] When Visx lost a patent dispute its stock plunged 40% within one hour.[10] Even the larger patent-holders are vulnerable, however. If an enterprise surfaces with a "submarine" patent, for example, it could hold competitors ransom at the point of commercialization.[11] For the biotech industry, these uncertainties are becoming more and more unacceptable.

2. Politically unpredictable - Compounding the functional uncertainties and costs associated with IP, industry is now discovering that the "patenting of life" is politically contentious. Efforts to enforce patents are not only expensive, but also controversial. The industry and its investors are worried that mounting political opposition to patents could lead to legislative changes that threaten their IP and the market premises based upon their IP. Media reports now appear daily in Europe and elsewhere debating the merits and morality of intellectual property in biotechnology. Consider the following examples:

- When former US president Bill Clinton and UK Prime Minister Tony Blair jointly expressed concerns about privatization of the human genome in March 2000, biotech stocks plummeted. Human Genome Sciences, Inc. lost 25% of its stock value the day or the announcement; Incyte Pharmaceuticals fell 30%. (The stock prices recovered after the US Patent & Trademark Office issued a press release re-affirming that the Clinton/Blair announcement would not affect gene patenting).

- The 1999 United Nations' Human Development Report states that, "the relentless march of intellectual property rights needs to be stopped and questioned."[12]

- In August 2000 the United Nations Sub-Commission for the Protection of Human Rights recognized that the World Trade Organizations' Trade-Related Intellectual Property Agreement could infringe on the rights of poor people and their access to both seeds and pharmaceuticals.[13]

- In December 2000 the Swedish Ministers of Trade, Justice and the Environment announced their alarm over the scope of gene patenting. "Commercial forces believe they have the right to claim ownership of the discoveries of the inner building blocks of life. Such an attitude is totally unacceptable to us. It is absolute[ly] vital that this information is freely accessible to society as a whole."[14]

"There was a feeling that if a country deliberately went against TRIPs, there would be a castle-of-cards effect. Without patents, the industry ceases to exist." - Jean-Pierre Garnier, CEO of GlaxoSmithKline, after the drug industry was forced to drop its lawsuit to prevent South Africa from importing cheaper anti-AIDS drugs.[15]

- In April 2001, eager to escape the glare of negative publicity, the pharmaceutical industry dropped its lawsuit to defend its patents by preventing South Africa from importing cheaper anti-AIDS drugs and other medicines.[16] In a related international campaign waged by civil society organizations, the WTO is under attack for using trade sanctions against poor countries that fail to enforce 20-year monopolies on drugs.[17]

- In April 2001 the UN Human Rights Commission passed a resolution on the "right to development" which recognizes the gap between developed and developing countries in the full realization of such rights. Intellectual property regimes are cited as one example of obstacles to the right to development.[18]

Court interpretations of IP law also threaten to compromise the scope and value of patents. If the US Supreme Court upholds a November 2000 court decision on the so-called Festo decision, industry observers warn, "biotechnology company patent estates could turn out to be built on sand."[19] If upheld, the decision would narrow the ability of the patent holder to claim infringement based on the "doctrine of equivalents." The doctrine of equivalents acts as a safeguard for patent holders because it discourages the development of copycat products that represent only insubstantial or small differences. If the Festo decision is upheld, it could create "a field day for biotech copycats to develop technologies that are similar but do not literally infringe a patent" reports *Nature Biotechnology*.[20] A decision is not expected until early 2002.[21]

3. Technologically untrustworthy - Compounding practical and political constraints, the biotech industry is discovering some significant technological problems as well.

At one level, the industry appears to have overreached itself in patenting "too much too often." Not long after the US government granted its six millionth patent in December 1999, three human genomics enterprises allowed that they had collectively applied for patents covering 3 million human gene sequences – enough gene patents "to cover the human genome many times over."[22]When the "Book of Life" was unveiled in February 2001 human genome researchers concluded that there might only be 30,000 to 40,000 human genes. The revelation immediately called into question the scientific credibility and capability of the patent applications – as well as the competence of patent examiners.[23]

At another level, the cost and uncertainty of IP – and the potential for patents to thwart innovation – has encouraged some companies to "invent around" the patent system altogether. The following are two recent examples:

- Bristol-Myers Squibb is working with a small biotech company, Athersys Inc., to develop a new protein discovery technology that seeks to circumvent gene patents held by its competitors. The chief scientific officer at Bristol-Myers points out that there are over 50 cancer-related proteins that his company cannot investigate because the patent holders refuse access or demand unreasonable royalties. Athersys, based in Cleveland (USA), has developed a technique for randomly turning on genes inside a cell. Using a genetic switch the company instructs the gene to produce an associated protein. The company maintains that since it is producing proteins without isolating the gene involved, the protein can be used without infringing existing patents on the gene.[24] The claims have not yet been tested in court.

- Large Scale Biology Corporation (USA) and Icon Genetics (Germany) have developed a different technique that they claim will give them "freedom to operate" in otherwise patent-restricted areas of soybean and maize transformation. The companies will use a proprietary genomics technology that makes it possible to determine the function of completely uncharacterized gene sequences via high-throughput robotic cloning and transfection of mature plants.[25]

Part Two

New Enclosures: Emerging Mechanisms

In the following sections ETC Group examines three categories of "New Enclosures" that are evolving rapidly and will offer alternative mechanisms for the biotech industry to gain technological control over biological products and processes.

- Biological Monopolies on Germplasm
- Remote Sensing and Biodetectors
- Legal Contracts

Biological Monopolies on Germplasm

Terminator and Traitor Technologies: The best known examples of New Enclosure mechanisms are the controversial genetic use restriction technologies (GURTs), better known as Terminator and Traitor technologies, that offer the potential for a biological monopoly on germplasm. GURTs involve the use of genetic switches, triggered by the application of external chemicals, to control a plant's genetic traits. Terminator refers to plants that are genetically modified to switch on or off the trait for fertility. Seeds harvested from Terminator crops will not germinate if re-planted the following season. The technology aims to prevent farmers from saving seed from their harvest, thus forcing them to return to the commercial seed market every year.

Please refer to our web site, www.rafi.org, for in-depth background information on Terminator and Traitor technologies. (See, for example, the *RAFI Communiqué*, "Suicide Seeds: Not Dead Yet!" January-February 2001.)

Terminator and Traitor technologies go far beyond intellectual property as an appropriation mechanism for corporate Gene Giants. Unlike patents or plant breeders' rights, GURTs are not time-limited, they are bio-imperative, and there are no "exemptions" for farmers:

While technical hurdles remain to be overcome, Terminator and other genetic trait-control technologies could either supplement or replace IP as the "vehicle of choice" in establishing technological supremacy in specific seed markets.

Beyond Intellectual Property

- **Biological-imperative:** Terminator seeds are single-use seeds; this technology makes it impossible for farmers to re-use seed from their harvest. Traitor technology could require a farmer to treat her crop with a proprietary chemical in order to activate a genetic trait. Patents become unnecessary when biological controls dictate market dependency. ETC Group calls it "bioserdom" because farmers are caught in a vice with no choice but to buy inputs from the same company.
- **No time limit:** Patents and plant breeders' rights are time-limited, legal monopolies, usually 17-20 years. Terminator is a biological monopoly with no expiration date.
- **No exemptions:** IP laws enable governments to make legal exemptions for farmers which allow them to use proprietary materials under certain circumstances. But Terminator seeds do not discriminate between end users or make allowances for national laws or societal concerns. As tools for *biological* monopolies, Terminator and Traitor offer the potential for total, built-in exclusivity.

Still out-of-breath from the breakneck pace of seed industry merger & acquisition trends, national anti-trust bodies have not begun to think about the implications of biological monopolies in the seed/livestock sector.

Genetic Encryption for Livestock: AviGenics, a US biotech company, plans to commercialize transgenic chickens that will act as living bioreactors for the production of biopharmaceuticals. The company says it will develop genetically modified chickens that are faster growing and disease resistant. AviGenics will control its proprietary breeding stock by inserting a DNA copyright tag among the chicken's genes. "Unique DNA sequences can be engineered and introduced into the poultry

genome to indelibly mark valuable transgenic and breeder lines, effectively acting as genetic encryption devices," explains AviGenics.[26]

"Gene Barriers" for Crops: Teosinte, a wild relative of domesticated maize, has a built-in "genetic barrier" that prevents it from cross-pollinating with domestic maize varieties. Using traditional plant breeding techniques, Jerry Kermicle of the University of Wisconsin has developed conventional maize varieties incorporating teosinte's gene barrier that are capable of locking out foreign genes, including those from genetically modified corn. Kermicle hopes that his method will be developed as a means of protecting the genetic integrity of a farmer's non-GM maize crop. The discovery could ensure that traditional hybrid maize, or maize grown by organic farmers, is not contaminated by cross pollination from genetically modified crops. The gene barrier technology is presented as a positive protection for farmers who risk losing markets and/or livelihoods because of genetic contamination from neighboring GM crops. However, widespread adoption of this technology also threatens food security, because if plants cannot cross-pollinate, it prevents continuous evolution/breeding and the maintenance of wide genetic bases in agriculture. According to Kermicle, there are parallel "gene barrier" systems in other cross-pollinated crops that have yet to be discovered. Once "gene barrier" genes are characterized at the molecular level, the concept could theoretically be used to protect the genetic integrity of a wide range of germplasm. In the future, could genetic barriers be appropriated by the Gene Giants for "protecting" GM crops? Could government regulators someday require that all non-GM crops adopt genetic barrier technologies to limit industry liability from GM gene escape? While gene barrier technology is still in the experimental stages, it demonstrates that Terminator technology is not the only option for preventing gene flow in crops.

Remote Sensing & Biodetectors

"Remote sensing" refers to the acquisition and measurement of data or information about an object by a device that is not in physical contact with the object under surveillance. One of the most powerful examples of remote sensing is satellite technology. Earth observation satellites – operating beyond the limits of national sovereignty - are already being used by governments, civil society and industry to collect images and related geospatial information on human activities and the natural environment. The first satellites were government-owned and used strictly for military purposes. In 1972, the US government launched the first civilian remote sensing satellite, which collected digital color images at about 80-meter resolution. The world's first commercial earth-observation satellite, launched in September 1999, provides images with better than 1-meter resolution. Today, a new constellation of smaller, cheaper and more agile commercial satellites are being financed, built and operated by private firms that hope to profit from satellite imagery, geospatial information products and related services. The remote-sensing marketplace, hand-in-hand with geospatial information technologies, is expanding rapidly, and potential applications are virtually limitless. A new study by the RAND Corporation emphasizes the potential for satellite imagery to promote global transparency and international security.[27] Civil society organizations, governments and the media routinely benefit from space-based imagery and remote sensing data to track oil spills, deforestation and nuclear facilities, for example. A new generation of satellite technologies based on synthetic aperture radar and hyper-spectral imaging is on the horizon.[28]

While remote sensing and geospatial information technologies have potential to benefit agriculture and civil society, they also threaten to diminish the rights of farmers and farm communities, sometimes in unexpected and unforeseen ways. In the following section ETC Group examines specific cases where remote sensing and biodetectors are being used by corporations and governments to:

- Enforce proprietary rights and regulatory or contract compliance.
- Identify, monitor and control germplasm, territory and labour.

Not-So-Remote Possibilities: Remote sensing technology for agriculture, though mostly in the research stage, has the potential to provide absentee farm managers with detailed, site-

specific information about their farm fields anywhere on the planet.[29] Proponents claim that these technologies will lower input costs and raise crop yields. However, they will also facilitate long-distance control of intensive farming operations, reduce farm labor and/or eliminate management and decision-making of independent farm operators. Consider the following examples:

- **Remote Control E-Farming:** Thanks to researchers at the US Department of Agriculture (USDA), cotton plants in Oklahoma and peanut plants in Texas are emailing vital signs to absentee farmers via the Internet, signaling when the crops are "stressed" and need irrigation.[30] The patented device is called BIOTIC – Biologically Identified Optimal Temperature Interactive Console. The device involves wireless, pencil-size infrared thermometers that relay information via a midnight cell phone call to the Internet. The farmer, orchard grower or turf operator can decide when to irrigate by checking his/her email. BIOTIC can also be programmed to trigger automated irrigation based on the crop's temperature readings – without human intervention. USDA developed BIOTIC as a tool to conserve water and increase efficiency by minimizing trips to the field.

- **Agricultural Eavesdropping:** The integration of remote sensing devices to telecommunications is known as "telemetry." According to *Top Producer* magazine it means that "a vineyard manager in Long Island, New York can dial up a computer that shows real-time temperature, relative humidity, wind speed and leaf wetness in Napa Valley, California, vineyards and order a fungicide spray to head off [a fungal disease] a continent away."[31] By connecting remote sensors to an antenna or telephone line, data can be transmitted straight to a manager's computer every 15 minutes.

- **Crop Intelligence:** A 6,600-acre San Joaquin Valley cotton farm is the site of a large-scale research project dubbed Ag 20/20, funded by the Cotton Foundation, Cotton Incorporated and the US government's National Aeronautic and Space Administration. The project is using advanced hyperspectral remote sensing from the air for early detection of crop damage. The project is using a NASA satellite, not a commercial satellite, to gather information. Hyperspectral imaging sensors measure a detailed color spectrum, showing up to 256 distinct colors of reflected light. The spectrum of a crop is determined by its chemistry, and since environmental stresses such as lack of water and insect damage change the chemistry of the crop, the imaging allows researchers to measure changes to a plant's condition and health.[32] For example, entomologists are using hyperspectral imaging to measure plant vigor. They have established a correlation between the infrared-perceived degree of plant vigor and likely insect infestation.[33]

- **Not-So-Remote Sensing:** High-flying airplanes or satellites equipped with multispectral imaging sensors are already being used to monitor plant health. But ground-based remote sensing is also being developed by University of Tennessee (US) engineers to detect plant stress related to nitrogen deficiency.[34] The sensing technique looks at infrared bands -- spectral signatures reflected from the plant. The sensor is first "trained" by engineers in the field who show the sensor healthy plants and unhealthy plants. Once the sensor is programmed, it will spray plants that need nitrogen (fertilizer), and avoid those that don't. Ground-based sensors, designed to ride on the front of a tractor, are expected to be commercialized within 2 years.

- **Virtual Fencing:** USDA scientists have also been developing tools for long-distance, fence-free ranching. US Patent No. 6,232,880 issued on 15 May 2001 describes a new device to control free-ranging livestock and their location using global positioning systems (GPS) and an "uncomfortable or stress-inducing stimulus" (such as electrical shock, high-frequency sound, pricking or pinching devices).[35] GPS refers to a network of satellites controlled by the US Dept. of Defense that allows ground-based units to determine precisely where an object is located (on or above the surface of the earth) in longitude and latitude coordinates. The patented animal control system can be used to change the location and movement of livestock over virtually any landscape or topography. How does it work? "Virtual boundary lines" are pre-determined. The animal is fitted with an external apparatus which includes a

microprocessor, GPS receiver and stimulus unit – parts of which may be inserted into the animal's ear canal. The microprocessor includes hardware and software that determines the direction of the animal's movement, and activates averse stimuli when the animal penetrates a pre-determined boundary.[36] The system is designed to function autonomously, apart from human intervention.

Eye in the Sky: The use of earth observation imagery to enforce laws or regulations is not new, and there are many possible applications in industrial farming. The following examples illustrate how remote sensing tools and geospatial information technologies are already being used for governmental regulatory compliance in agriculture:

- In Andalucía, Spain some 1.4 million hectares of farmland are involved in the European Community's program for agricultural subsidies. To qualify for payment, a farmer is required to set aside a certain percentage of his or her fields as a means of preventing overproduction. In the mid-1990s, over 57,000 growers in Andalucía applied for subsidies exceeding $500 million. As a means of preventing subsidy fraud, authorities in Andalucía are now using satellite remote sensing to conduct field audits and to verify production on any given farm in the region.[37]

- In Tasmania a Global Positioning Satellite System (GPS) is being used to assign special identification numbers to 600 agricultural fields. The pilot program has been so successful in "identity preservation" that the Tasmanian government is hoping to have a comprehensive mapping and numbering system for all Tasmanian farms by 2005. The Tasmanian-wide system began as a way to regulate legally-licensed opium poppy fields produced by Tasmanian Alkaloids. Officials in Tasmania are expanding the concept to include all Tasmanian farmland, calling it a "a welcome step toward providing verifiable information on foodstuffs." The idea is that seed, fertilizer and spray regimes could be recorded for future reference, and the downstream buyer would be able to scrutinize detailed history of their suppliers. There are obvious benefits for buyers to verify and track production practices from seedling to supermarket. The same technology offers unprecedented opportunity to allow industrial food processors and retailers to determine who will farm, how they farm, and under what conditions.

- In early 2001 the Argentine government announced that it would use satellite imagery to monitor farmers' crops in an effort to halt tax evasion.[38] "Through the satellite pictures, we will know how many hectares each farmer has sown, and be able to check to see if his declared crop yields are consistent with the average for the region," said Guillermo Farias of the State Public Revenue Office.

- The National Seed Institute (INASE) of Argentina proposed last year to use satellite surveillance to stop illegal seed commerce. "The current law permits a producer to save seed for his own use, but in no way is he authorized to sell the seed, or trade it for other inputs or machinery and he can't even give it away to other producers, because that act of delivery is prohibited and, in the end, will be prosecuted," warned INASE officials.[39]

Biodetectors for Genetic Identity: Controversy over GM food, and growing concern about the unintended escape of transgenes from GM plants, is prompting increased demand for tests to detect whether or not a plant genome or processed food product contains an artificially inserted sequence of DNA, and how much is present. GM test kits, utilizing a variety of technologies, have many potential users. Gene Giants like Monsanto are using GM test kits to verify whether or not farmers or competitors are using (or re-using) GM seeds and infringing the company's patents. Civil society organizations, government regulators and food processors are testing crops and food products to determine the amount and presence of GM ingredients. Farmers use tests to verify that their crop is free of GM contamination, especially for buyers who demand GM-free crops.

While the uncontrolled spread of Aventis's illegal StarLink genes in the food supply has been a colossal blunder for the biotech industry, it has been a boon to the crop genetic testing business. (The US-Environmental Protection Agency approved the use of StarLink maize for livestock feed or non-food use only because of

concerns that the Bt toxin (Cry9c) could trigger allergies in people.) Today, the crop DNA detection business is advancing rapidly. Aventis alone reportedly paid for millions of GM test kits used by farmers, food processors and grain handlers to identify traces of StarLink.[40] According to the *New York Times*, seed companies, food processors, and farmers spent more than $1 billion over a six month period trying to eradicate StarLink contamination.[41] Before the StarLink debacle, the total market for GM crop testing was approximately $10 million. Less than one year later, the annual market is estimated at $38 million, and Strategic Consulting Inc. predicts that actual testing volume will increase eight-fold in the next five years.[42]

There are no internationally accepted protocols or performance standards for testing GM crops and genetic traits; regulations are in a state of flux internationally. The biotech industry is advocating for relaxed tolerance standards, especially because widespread pollen flow and commingled seeds have spread GM crop material far and wide.[43]

Genetic ID (Iowa, US) provided the first commercial diagnostic tests for GM crops in 1996. The following year, DuPont formed its own subsidiary, DuPont Qaulicon, to market biotech test kits to food processors to "ensure the authenticity of ingredients in the supply chain." The two most common methods to detect GMOs are polymerase chain reaction (PCR) and enzyme linked immunosorbent assay (ELISA).[44] PCR is the most common method used internationally to detect GMOs, particularly in processed foods. Initially, GM crop testing (PCR-based) required expensive, laboratory tests that took 3-10 days and cost anywhere from $400 to $700 per sample.[45] A new generation of tests that use antibodies to detect specific proteins produced by genetically modified DNA is promoted as being faster and cheaper, though they are less sensitive than PCR tests, and cannot screen for all commercially available GMOs. The following are examples of GM testing capabilities:

- State-of-the-art laboratory tests (performed by companies such as GeneScan, Genetic ID, EnviroLogix, Strategic Diagnostics, DuPont Qualicon) can identify one genetically modified DNA molecule co-mingled with 10,000 conventional DNA molecules.[46]

- One company boasts that its GM detection technology, the immunochromatographic strip test, can be performed on-site, take 5-10 minutes, and cost less than $10 per test.

- A new "GMO QuickCheck Test Kit" is capable of detecting one kernel of StarLink corn in 800 non-StarLink kernels in less than 10 minutes. It sells for approximately US $4.00 per test.[47]

- Novel DNA proteins can be detected not only in seeds and grain, but also in flours and some highly processed foods. One company claims that RoundUp Ready soybeans can be detected in products such as tofu or soymilk in concentrations as low as 0.1%.[48]

- GeneScan Europe AG and Motorola are developing a new, portable DNA detection tool. The "eSensor" relies on organic molecules to form electronic circuits that can detect numerous DNA targets simultaneously.[49] By utilizing Motorola's eSensor DNA detection system (the "scan gun"), the eSensor could lead to "on site" analyses via a hand-held device. The companies are developing a matchbook-sized biochip cartridge to detect the presence of specific genes. DNA analysis would be provided by a portable reader connected to a laptop computer.[50] Motorola expects to release the eSensor by the end of the year.

- Neogen Corporation has a licensing agreement with Monsanto to develop a new generation of GM crop detection kits. With access to proprietary Monsanto technologies, Neogen will develop tests for the detection of Monsanto's GM genes. The tests are specifically designed to enable grain distributors and processors to identify proprietary traits developed by Monsanto. Will test kits designed for Monsanto's proprietary traits be used by Monsanto to more easily and accurately identify seed-saving farmers (that is, farmers that Monsanto claims are infringing patents by re-using proprietary seed). Will the test kits be widely available, or will they become proprietary tools in service to Monsanto's "gene police"?

Will Gene Giants control the way their proprietary gene technologies can be monitored and controlled in the food chain?

ETC Group interviewed some individuals in the GM testing business who are concerned that the leading biotech firms are positioned, through broad proprietary claims on some genetic sequences, to deny access to the use of genetic material that is critical for GM testing. Small, independent companies are vulnerable to patent infringement suits and cannot risk using proprietary materials without permission. Others raise questions about joint ventures between biotech companies who sell GM crops and the companies who conduct GMO testing. Will Gene Giants control the way their proprietary gene technologies can be monitored and controlled in the food chain? Will biotech industry alliances with GM testing companies result in the marketing of test kits which are in some way favorable to the biotech industry and *less sensitive* to detecting the presence of GMOs? These are issues that should be carefully addressed by civil society and government regulators as nations scramble to resolve trade, regulatory and legal problems arising from the commercialization and the unintended spread of GM crops.

Identity Preservation Systems: The privatization of germplasm and the widespread commercialization of proprietary, GM seeds has radically changed the regulatory landscape for industrial agriculture, food processing and international trade. In order to control the value and identity of proprietary traits, and manage liability, companies will require "identity preservation" of germplasm and products. The concept of identity preservation goes far beyond individual test kits to detect the presence of GM traits. Corporate agribusiness and food processors are scrambling to implement identity preservation *systems* – tools for identifying and tracing the identity of a product at every point in the supply chain, from the farmers' field to the combine, from the grain elevator to the shipping vessel, from the food processor to point of purchase. As one industry spokesman puts it, these are tools that will give agribusiness "a chain of custody from dirt to dinner plate."[51] The concept is not limited to GM crops, but any value-added commodity.

In the future, the food industry's "chain of custody" will outpace the capacity of national regulatory systems to trace and verify the origins and integrity of food products. For food processors and retailers, the concept of "traceability" becomes a solution to the threat of product recalls, decreasing exports or the loss of brand name appeal. How long before the terms and conditions for food "biosafety" and "consumer confidence" will be dictated by industry standards – not by government regulators?

Tools that will give agribusiness "a chain of custody from dirt to dinner plate."

The following examples offer a glimpse of sophisticated new technologies for tracking, verifying and dictating the rules of the game for food, feed and fiber production in the 21st century:

- John Deere, the world's leading producer of agricultural equipment, has entered a partnership with VantagePoint Network and CropVerifeye.com, LLC to introduce a new crop identity-tracing system called "CropTracer." The new system combines John Deere's field data collection technology with VantagePoint's data warehousing capabilities and CropVerifeye's field auditing services to build an advanced crop-tracking system – from "seed to cellophane." The system is designed to trace the genetic integrity of seed, grain and vegetable crops grown under contract to food processors or agribusiness. "Through CropVerifeye, a contract buyer from a food ingredient company in Tokyo can have a verification of crop conditions at a moment's notice," explains Jim Mock of CropVerifeye.[52] "When we finalize our field-to-food auditing capabilities, we'll be able to trace the genetic integrity of main food, feed and fiber ingredients back to the farm…Imagine sleeping well at night, never worrying about what consumer organizations will find if they

perform laboratory tests on your taco shells or corn dogs," adds Mock.

> ***"Imagine what would happen if [a] consumer could pull a can of corn off the shelf, scan the bar code right there in the aisle, and see where the corn was grown, what was applied on it, and what its genetic traits were.***[53]***"*** **- Jim Mock, CropVerifeye.com**

- Linnet, a Canadian software company, has developed a highly sophisticated "technology regime" for identity preservation called "Croplands-The System." Linnet describes its technology as "an integrated raw material supply chain management solution." The company has licensed its GIS-based (geographic information system) platform to crop insurance firms, to Cargill, Imperial Sugar and Midwest Foods, among others. (GIS refers to an organized collection of computer hardware, software and geographic data that are designed to capture, store, analyze, and display many kinds of geographically referenced information.) Each producer field is entered into the GIS system as a geographic point or field boundary. Detailed records on the producer, field and crop history, management and agronomic data (rainfall, crop quality, yield, disease, and chemical spray regime) are tagged to each field. Over time, a "deep matrix" of data accumulates. The food processor or agribusiness company can use the data not only to evaluate each grower's performance and to fine-tune production practices, but also to target contracting efforts in regions where the conditions for growing a specific crop variety are exceptionally high.[54]

The GIS-based system, combined with on-the-ground monitoring and testing, gives each company the ability to monitor thousands of contract growers, compile detailed information about their agronomic practices, as well as the quality and identity of the farm products they produce at all points on the supply chain – from field to combine, railroad car, grain elevator, shipping vessel, industrial processing, etc.

Warburton's, the UK's third largest bakery, uses Linnet's system to monitor contracts with 800 wheat farmers growing 160,000 acres in western Canada. Imperial Sugar Corporation uses Linnet's technology to monitor 12,000 contract sugar beet growers in the US. MidWest Foods uses the technology regime to source potatoes for McDonald's in Chicago.

Legal Contracts

Contracts, like intellectual property, have dramatically changed the face of industrial agriculture.[55] In this section, ETC Group briefly examines the use of contracts to control germplasm, technology and research. We focus on the ways in which contracting arrangements go beyond intellectual property as mechanisms to appropriate technology and research.

Technology User Agreements: Increasingly, the seed industry provides commercial seed to farmers under contractual agreements that prohibit the farmer from saving or selling any of the harvested crop as seed. The contract purchasing agreement is often attached to the label of the seed bag, or on the bill of sale. With the commercialization of GM seed, contract provisions known as "technology user" or licensing agreements are commonplace – and controversial. Sometimes contract agreements are used in combination with intellectual property restrictions, other times they are used alone.[56]

Seed industry giants such as Pioneer (DuPont) and Monsanto (Pharmacia) routinely use technology user agreements when they sell patented, genetically modified seed. The contracts not only restrict the use of harvested seed, they often go beyond intellectual property by dictating conditions for using seed and related inputs, establishing limits for liability and legal recourse, and even conditions for post-harvest marketing. Consider the following examples:

Technology User Agreements Go Far Beyond Intellectual Property

- ***Privacy Rights Forfeited:*** Farmers who signed Monsanto's 1996 technology user agreement literally signed away fundamental rights to privacy, giving the company the right to monitor, inspect or test the farmer's fields for up to three years to ensure that he or she complied with the terms of the contract. In response to negative reaction, Monsanto chose to modify and make less stringent its requirements relating to the inspection and

monitoring of farmers' fields. Under the 2001 licensing agreement, the grower must consent to Monsanto's review of Farm Service Agency crop reporting information, aerial photographs and dealer/retailer invoices for seed and chemical transactions.

- ***Liability Limits:*** Growers who sign Monsanto's 2001 technology agreement must accept the company's Exclusive Limited Warranty, which severely limits Monsanto's liability for any and all losses, injury or damages that result from the use or handling of a product containing Monsanto's gene technology. The warranty also states that, "in no event shall Monsanto or any seller be liable for any incidental, consequential, special or punitive damages."[57]

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Precision Farming Update

In 1997 RAFI produced its first *RAFI Communique* on the subject of precision farming entitled, "BioSerfdom: Technology, Intellectual Property and the Erosion of Farmers' Rights in the Industrialized World." (available on ETC Group's website, www.etcgroup.org). Precision farming refers to a bundle of information technologies applied to the site specific management of commercial agriculture, including: personal computers, satellite positioning systems, geographic information systems, remote sensing devices, automated machine guidance, yield monitors and telecommunications. Various combinations of these tools enable the gathering of unprecedented levels of information about every square meter of the geographic area to be cultivated. Site-specific information is then used to identify and manage variability within a field and manage crop production according to precise, localized conditions. That's the idea.

Four years ago, we wrote that precision farming "is an industrializing technology that builds further links of dependency between the farmer, the input supply industries and off-farm information providers." Our analysis remains the same. Proponents of precision agriculture claim that it will improve efficiency, help reduce input costs and enhance the farmer's ability to protect the environment. The reality may be far different, according to a comprehensive study prepared by Francis Pierce of Michigan State University and Peter Nowak of University of Wisconsin:[58]

- According to Pierce and Nowak, "proof that [precision farming] is even benign in its environmental impacts is generally undocumented," and "environmental benefits are not necessarily forthcoming."[59]

- Unlike conventional agricultural technologies such as fertilizer or seeds, the adoption of precision farming's enabling technologies do not bring automatic value to the farmer. It is only through the interpretation and application of data that value is derived. The value comes from management decisions based on data – not the adoption of enabling technologies such as yield monitors and automated machine guidance.

- People frequently allude to the farmer or producer adopting and managing precision farming technologies. In reality, the interpretation and application of data are highly dependent on the support of private sector products and services.[60]

In other words, farmers will not control precision agriculture. Rather, precision agriculture is more likely to control and manage the farmer. A far more appropriate term for this bundle of tools and information technologies, is "***prescription*** agriculture" – because it is off-farm, private-sector enterprises that will provide the analysis of sophisticated data and decision making. Ultimately, the tools of prescription farming are part of the New Enclosure "identity preservation system" described in this Communiqué

Right of Venue: Right of venue clauses allow the seed company to force breach of contract disputes arising from technology agreements to be settled exclusively in court jurisdictions that are generally more favorable to the corporation. (For example, Pioneer Hi-Bred's current YieldGard Technology Agreement contains a clause allowing the company to force breach of contract disputes exclusively in the US District Court for the Southern District of Iowa[61] – a jurisdiction more likely to favor Pioneer.) Right of venue clauses typically make defense against infringement charges more costly to the farmer.[62]

- ***Dictate Farming Conditions:*** Growers who sign Pioneer Hi-Bred's Technology Agreement for YieldGard Gene Technology must agree to implement insect resistant management programs.[63] According to economist Dwight Aakre of North Dakota State University, Monsanto's 2001 technology agreement for RoundUp Ready GM crops states that the producer has responsibility for crop isolation to insure that pollen from GM crops does not trespass on a neighbor's crop.[64]

- ***Post-Harvest Liability:*** A farmer who signs Pioneer's contract for both YieldGard and LibertyLink gene technology "agrees to keep the harvested grain from these hybrids out of European grain export channels."[65] Monsanto's 2001 agreement on RoundUp Ready crops has similar provisions. Dwight Aakre, North Dakota State University economist, warns farmers, "Signing that agreement means you accept a risk that you have very little control over. If a ship load of grain arrives at one of these export markets, is tested and found to contain unapproved genetics and the source can be traced back to your farm, what is your responsibility?"[66]

- ***Seed Industry "Black Balling"?*** In addition to other penalties, a farmer who breaches Pioneer's contract on YieldGard forfeits any right to "obtain a license to Monsanto's technology in the future." That's because Pioneer licenses the YieldGard gene from Monsanto. If the Pioneer licensing agreement is terminated by either the grower or by Pioneer, the grower can no longer purchase Pioneer hybrids containing the YieldGard gene.[67] Considering that Pioneer and Monsanto are the first and second largest seed companies in the world, and together hold dominant market shares for crop commodities such as soybeans, cotton and maize – these clauses could have far-reaching implications for industrial farmers.

Monsanto has been aggressively monitoring and prosecuting seed-saving farmers with the help of private investigators (dubbed "gene police" by the *Washington Post*[68].) The company has filed more than 475 lawsuits against farmers for patent infringement and violation of technology user agreements.[69]

Technology user agreements are controversial; state governmental officials and university extension agents are beginning to offer farmers much-needed, independent analysis:

- According to Oklahoma's Secretary of Agriculture, Dennis Howard: "After reviewing Monsanto's 2001 Technology Agreement, I would discourage any farmer from signing this document. Not only does this contract severely limit the options of the producer, it also limits Monsanto's liability. Marketing agreements and contracts are only effective if they serve to protect the interests of all parties involved. The protection of the Monsanto contract is strictly one-sided and I would encourage producers to carefully consider this before entering into this agreement."[70]

- A North Dakota State University economist warns that growers of GM crops are exposing themselves to potentially huge financial risks by signing gene technology agreements. Dwight Aakre warns that "responsibility for providing assurance of non-contamination with GMO materials is being pushed back to the individual producer."

Material Transfer Agreements: A material transfer agreement (MTA) is a form of tangible or technical property that is frequently used to cover property such as germplasm, biological materials and their derivatives, and related information. MTAs are contractual agreements, usually a letter, accompanying the transfer of a proprietary technology.

While MTAs are sometimes viewed as less stringent, informal mechanisms to share

germplasm and technology, they are proving to be a potent weapon to capture public sector research in service to corporate science. MTAs can be especially problematic because they often define the conditions under which research tools can be used by others.[71] For example, public sector researchers who seek licenses must often abide by an MTA that gives the patent owner first rights to any results, and prohibits the sharing of resulting materials with third parties. According to William Lacey, Vice-Provost of the University of California at Davis, MTAs can be used to restrict scientific communication and undermine a scientist's ability to carry out research, as well as limit the pace and direction of scientific efforts.[72]

University-Industry Relationships: Collaborative relationships between universities and the biotech industry are not new, but in recent years they have become increasingly aggressive, wider in scope, and sometimes non-transparent. The provisions of these contractual arrangements, while often involving intellectual property, go beyond the rights afforded by patents and plant breeders rights. William Lacey outlines, in broad strokes, some of the diverse approaches pursued in legal and contractual arrangements between universities and industry[73]:

- Large grants and/or contracts are sometimes made to universities in exchange for patent rights and exclusive licenses to discoveries;

- University programs and/or centers may be organized with industrial funds that give private firms privileged access to university resources and a role in shaping research agendas;

- Professors may serve in extensive consulting capacities on scientific advisory boards or in managerial positions in the contracting firm;

- Faculty may receive research funds from private corporations in which they hold equity positions;

- Public universities may establish for-profit corporations to develop and market innovations arising from research.

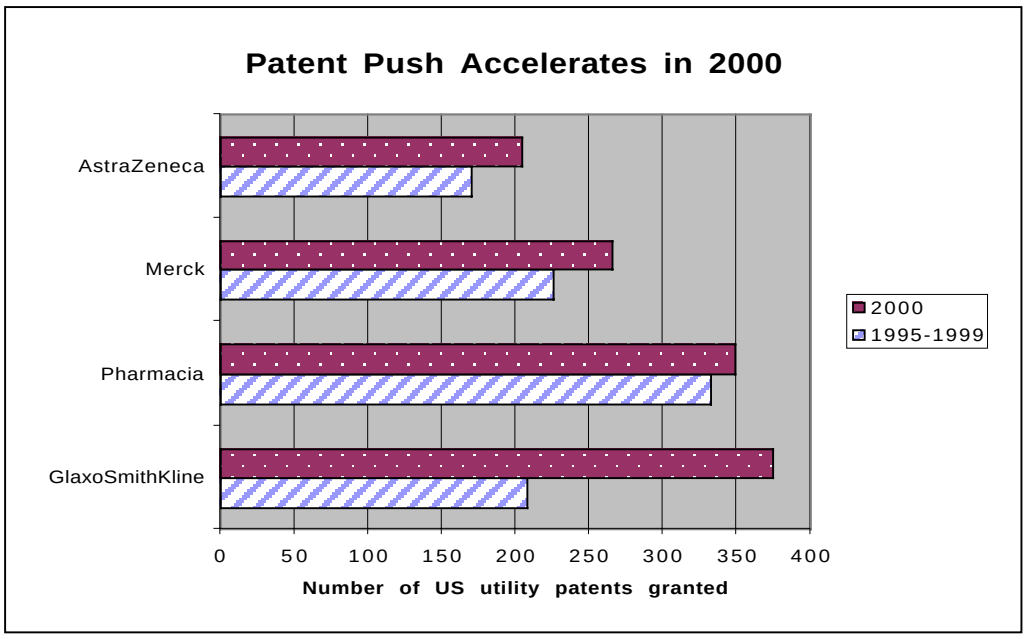
The ETC Group does not attempt to provide an in-depth review of university-industry contracts in this report. However, it is a trend that has far-reaching implications for the future of public sector research. Contractual agreements between university and industry are a form of New Enclosures. Technology and knowledge is being appropriated and transferred from the public sector to industry.

Strategies to Reinforce IP Monopoly

The ETC Group is not suggesting that the concept of IP is outmoded, or that patents are about to disappear as a strategy to protect corporate monopoly. On the contrary, in some industry sectors, the number of patents issuing to large corporations is growing exponentially.[74] Consider these examples from the biotech and pharmaceutical sector: In the five-year period from 1995-1999, GlaxoSmith-Kline won 208 US patents; in 2000 the company was awarded 374 US patents. Pharmacia won 332 US patents from 1995-99; last year it won 349. Merck received 265 patents in 2000; the five previous years combined it was awarded only 226. AstraZeneca won 204 US patents last year; the five previous years combined it won only 170 (see graph below).

Given the current popularity of IP regimes, it is not surprising that companies are developing strategies to strengthen the scope of IP monopoly. These include, for example, numerous bilateral and regional treaties (such as the Free Trade Agreement of the Americas) that propose to strengthen the scope of IP beyond what is required by the World Trade Organization's Trade-Related Intellectual Property Agreement (WTO/TRIPs).[75] In addition, in order to avoid anti-trust laws or nationalist policies, companies increasingly form alliances to share patents, know-how and turf in less regulated ways. The following are just a few examples:

- Benedicte Callan, head of Genetics Invention, Intellectual Property Rights and Licensing Issues at the OECD warns that large pharmaceutical companies, such as GlaxoSmithKline, Novartis and Bayer, are



forming "patents consortia" to ensure mutual access to proprietary genes. Callan told *BioMedNet News*, "This is the strategy that corporations are using to get around the privatization of genes."[76] By forming patent consortia, the corporations are restricting access by public sector researchers and small biotech companies.

- Patents are pending in the Canada and US that lay claim to not only gene sequences, but also to the digital representation of those sequences in computers. Biotech companies such as Human Genome Sciences want to extend intellectual property protection not just on the sequence of nucleotides in the DNA itself, but on any computer-readable medium that represent the patented gene sequence.[77] If such patent claims are approved, it would be illegal to store, retrieve and analyze the patented genetic information in computers without the patent holder's permission.

- In 1998, US courts confirmed that methods of doing business – specifically trading practices and investment strategies – were patentable. In 1999, a San Francisco-based investment bank announced plans to create a patent futures market by 'securitising' corporate patent portfolios and selling shares to investors. At the same time, a virtual trading floor in patent licenses was created by Yet2.com so that companies such as 3M, Allied Signal, Boeing, Dow, Dupont, Ford, Honeywell, Polaroid, and Rockwell could 'exchange' patented technologies.

- Breaking the tradition that all inventors are created equal before the patent office, the Japanese government has announced plans to grant venture capitalists and major IP (intellectual property) investors 'various preferential treatments'.[78]

Conclusion

The ETC Group's survey of New Enclosure mechanisms demonstrates that IP is no longer the sole mechanism for corporations to achieve market monopolies and long-term control over new technologies. New Enclosures must be carefully monitored, analyzed and independently regulated. Specifically:

At the National Level:

Governments should review and, as necessary, update competition and anti-combines legislation and regulation in order to fully take into account multi-technology and multi-sectoral mergers and alliances.
Governments should act to strengthen their regulatory monitoring capacities to ensure their

independence and integrity in the light of New Enclosures.
Governments should re-examine national intellectual property legislation and current practices in order to prevent compound monopoly with respect to certain technologies or markets.
At the international level:

CBD – When the SBSTTA of the Convention on Biological Diversity convenes in Montreal this September, the scientific body should review the implications of new GM monitoring mechanisms with reference to the Biosafety Protocol and the implications for effective governmental regulation. The Convention, in particular, should address the implications of contracts between the companies developing monitoring devices and companies engaged in agricultural biotechnology.
FAO - The FAO Commission on Genetic Resources for Food and Agriculture is scheduled to review its initial work on a Code of Conduct for Biotechnology. As part of this process, the Commission should undertake an evaluation of New Enclosures and take steps to incorporate regulation of these new mechanisms in the Code.
WIPO (including UPOV) – At its annual conference later this year, WIPO should evaluate the possible exacerbation or distortion or circumvention of intellectual property regimes posed by the New Enclosures. Information on how such mechanisms could restrict scientific research or extend monopoly should be made available to governments.
UNCTAD – Through its Science and Technology Division, UNCTAD could undertake a study of the implications of these New Enclosures for the South. The review should be careful to look beyond biotechnology to also include traditional manufacture and nanotechnology.
ILO and UNIDO – Both specialized agencies of the UN have a contribution to make to an evaluation of New Enclosures from their expertise in labour and in industrial technologies. Either independent studies could be undertaken and/or the ILO and UNIDO could collaborate with FAO and the CBD in a comprehensive programme.

More than one decade ago, on the eve of an era that would witness a stunning concentration of corporate power, the **United Nations Centre on Transnational Corporations** was forced to shut down. The creation of a new UN Centre on TNCs, with an expanded mandate to monitor and analyze multi-technology and multi-sectoral mergers and alliances, is long overdue.

RIO+10 – ETC Group believes that New Enclosures must become an important element for discussion in the process leading up to the World Summit on Sustainable Development to take place in South Africa in September 2002. As proposed in The 'ETC' Century (*Development Dialogue*, p. 118-120) ETC Group believes that the Summit should adopt an International Convention for the Evaluation of New Technologies (ICENT). Such a Convention would have to take into account the risk of monopolistic practices posed both by IP and by New Enclosures.

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[1] *IBM news release*. "IBM announces $100 Million investment in the Life Sciences Revolution," August 16, 2000.
[2] Anonymous, "Patent Wars," *The Economist*, 8 April 2000.
[3] Aharonian, Greg. "PTO Gets 400,000 page biotech patent application," *Internet Patent News Service*, 23 February 2001.
[4] Ibid.
[5] Barton, John H., "Reforming the Patent System," *Science*, Volume 287, Number 5460, 1933-1934, March 17, 2000.
[6] The remark is attributed to John Barton of Stanford Law School. Source: "A Summary of Workshop Proceedings: An Industry-Academia-International Development Roundtable Workshop: Intellectual Property Clearinghouse Mechanisms for Agriculture," February 16, 2001, University of California.
[7] Mullaney, Timothy J., and Spencer E. Ante, 'Info Wars', *Business Week*, June 5, 2000, p. 107.
[8] Love, James. 2001.
[9] Thomas, J."Congressional Research Service Report for Congress," RL30648, Congressional Research Service, Washington, DC, 31 August 2000, p. 8.
[10] Thomas, J. August, 2000.

[11] The problem of submarine patents will be partly resolved because the US PTO implemented a new policy in March 2001 to publish all US patent applications 18 months after they are filed.
[12] United Nations Development Programme, *Human Development Report 1999*, New York: Oxford University Press, July, 1999.
[13] Sub-Commission on Intellectual Property Rights and Human Rights, Commission on Human Rights, United Nations, "Resolution on Intellectual Property Rights and Human Rights," E/CN.4/Sub.2/2000/7, 17 August 2000.
[14] Thomas Bodström (Minister of Justice, Sweden), Kjell Larsson (Minister for the Environment, Sweden), Leif Pagrotsky (Minister for Trade, Sweden), "Patent på gener måste förbjudas" (No Monopoly on Genes), *Dagens Nyheter* (Stockholm), 10 December 2000. From the unofficial courtesy translation, http://www.dn.se
[15] Pollack, Andrew. "News Analysis: Defensive Drug Industry Fuels Fight Over Patents," *New York Times*, 20 April 2001.
[16] Swarns, Rachel. "Drug Makers Drop South Africa Suit Over Aids Medicine," *New York Times*, 20 April 2001.
[17] McNeil, D. "Oxfam Joins Campaign to Cut Drug Prices for Poor Nations," *New York Times*, 13 February 2001.
[18] UN Commission on Human Rights, United Nations, *Press Release*, "Commission On Human Rights Adopts Resolutions On The Right To Development," Commission on Human Rights, 57th session 18 April 2001.
[19] Anonymous, "Metal bashing," *Nature Biotechnology*, Vol. 19, May 2001, p. 391.
[20] Robertson, D. "US Supreme Court decision could compromise biotech patents," *Nature Biotechnology*, Vol. 19, May 2001, p. 394.
[21] Industry observers speculate that the Festo decision (which would apply retroactively) could have serious repercussions for the biotech industry, and that it would put biotech start-ups at a distinct disadvantage compared to larger corporations. The attorney for Festo Corporation, Charles Hoffmann, told *Nature Biotechnology*, "Large companies would like to use the limited claim interpretation to be able to reproduce any product threatening their market."
[22] Garber, Ken. "Homestead 2000," *Signals Magazine*, 3 March 2000, on the Internet: http://www.signalsmag.com
[23] Pollack, Andrew. "Double Helix With a Twist; Do Fewer Genes Translate Into Fewer Dollars?" *New York Times*, 13 February 2001.
[24] Pollack, Andrew. "Bristol-Myers and Athersys Make Deal on Gene Patents," *New York Times*, 8 January 2001.
[25] Anonymous, "New Transformation Technology," *AgBiotech Reporter*, May 2001, p. 2.
[26] Meek, James. "Genetic chickens get DNA copyright tag," *The Guardian*, 31 July 2000, p. 4.
[27] Baker, John C., Kevin M. O'Connell, and Ray A. Williamson, eds., *Commercial Observation Satellites: At the Leading Edge of Global Transparency*, Co-published by RAND and the American Society of Photogrammetry and Remote Sensing, 2001.
[28] Both are getting images of electromagnetic radiation, but in different wavelengths of light. Synthetic aperture radar takes a picture in microwave wave lengths, whereas multi-spectral imaging uses near infrared wavelengths. The advantage of radar technology is that it can see through clouds or in the dark.
[29] Anonymous, "Bug Your Fields," *Top Producer*, October 2000.
[30] Comis, Don. "Have You Taken Your Plant's Temperature Lately?" US Department of Agriculture, *ARS News & Information*, 10 May 2001. http://www.ars.usda.gov/is/pr/2001/010510.htm
[31] Anonymous, "Bug Your Fields," *Top Producer*, October 2000. Available on the internet: www.agweb.com
[32] Fairchild, Barbara "Early Detection System" *Farm Journal*, 1/19/2001
[33] Knight, Alan. "Top Producer: Big Eye in the Sky," *Top Producer*, January, 2001. On the internet: www.agweb.com
[34] Fairchild, Barbara, "Remote Sensing Down Low," *Farm Journal*, Mid-February 2001.
[35] US Patent No. 6,232,880."Animal control system using global positioning and instrumental animal conditioning." Issued on 15 May 2001 to Dean M. Anderson and Craig S. Hale, assigned to US Secretary of Agriculture.
[36] The averse stimuli is applied bilaterally to the right or left side of an animal as a cue to change its location through a specific direction of movement.
[37] Francisco Manzano-Agugliaro, et al., "Farming Pays: Andalucia's Agricultural Application of GPS, on the internet: http://www.precisionfarming.com/features/o199pf_manz.html
[38] Anonymous, Financial Times Global News Wire, "Satellite Photos to aid Efforts Against Tax Evasion in Argentina," 9 January 2001.
[39] "Tecnología satelital para detectar comercio illegal," *Revista Chacra*, on the Internet: http://www.revistachacra.com.ar/notas/cne200006n06.htm
[40] O'Reilly, Brian. "Reaping a Biotech Blunder," *Fortune*, 19 February 2001.

[41] Barboza, David. "As Biotech Crops Multiply, Consumers Get Little Choice," *New York Times*, 10 June 2001, p. 1.
[42] Personal communication with Tom Weschler, Strategic Consulting Inc., author of "World Market for GM-Food Testing," For more information, see: www.strategic-consult.com
[43] Barboza, David. "As Biotech Crops Multiply, Consumers Get Little Choice," *New York Times*, 10 June 2001, p. 1
[44] PCR analyzes the DNA of a sample; ELISA uses antibodies to detect specific proteins produced by genetically modified DNA.
[45] Stave, James and Donald Durandetta, "GM Crop Testing Grows Amid Controversy," *Today's Chemist at Work*, Vol. 9, No. 6, on the internet: http://pubs.acs.org/hotartcl/tcaw/00/jun/stave.html
[46] Anonymous, "How Lab Tested 'Non-GMO' Foods Sent by The Wall St. Journal," *Wall St. Journal Interactive*, April 5, 2001. http://interactive.wsj.com/archive/retrieve.cgi?id=SB98641878870968234.djm
[47] Anonymous, "SDI StarLink Test Validated," *AgBiotech Reporter*, May 2001, p. 2.
[48] Strategic Diagnostics Inc., New Release, "Strategic Diagnostics Receives USDA Verification Of New SDI Traitcheck Bt9 Lateral Flow Strip Test," January 18, 2001.
[49] Anonymous, *PR Newswire,* "GeneScan Europe AG And Motorola Establish Technical Collaboration To Detect Genetically Modified Crops," 30 January 2001.
[50] Anonymous, *Technology Review*, May 2001, p. 22.
[51] Dietz, John. "GIS and IP Crops," *IP Review*, Winter, 2001, p. 20-22.
[52] Mock, Jim. "Thinking in Different Terms: Traceability and Your Brand Promise," Food Safety Summit & Expo 2001, Washington, DC, April 17, 2001, http://www.cropverifeye.com/PRTraceabiility.html.
[53] Mock, Jim. April 17, 2001.
[54] Dietz, John. "GIS and IP Crops," *IP Review*, Winter, 2001, p. 20-22.
[55]About one-third of the total value of farm production in the US is generated under contractual arrangements, for example.
[56] Hamilton, Neal D. "Possible Effects of Recent Developments in Plant Related Intellectual Property Rights in the US," prepared for presentation at the International Seminar on Effects of Intellectual Property Rights on Agriculture in Developing Countries," March 7-8, 1995, Santa Fe de Bogota, Colombia. Neil Hamilton, Director of Drake University Agricultural Law Center, notes, for example, that Stine Seed Company (soybean seed company based in the US) has relied on contract provisions rather than intellectual property to enforce ownership of its soybean seeds. If a farmer or breeder violates the purchasing agreement by using or selling a harvested crop for seed or breeding purposes, the company is authorized to use breach of contract claims in local courts. The company's use of contract provisions limits the rights that farmers and breeders would normally have if the seed was protected under standard plant variety protection laws.
[57] Dorris, Eva Ann. "Monsanto Contracts: To Sign or Not to Sign," *Mississippi Farmer*, December 1, 2000. The article can be found on the internet at: http://www.biotech-info.net/to_sign_or_not.html.
[58] Pierce, Francis J. and Peter Nowak, "Aspects of Precision Agriculture," *Advances in Agronomy*, Vol. 67, 1999.
[59] Pierce and Nowak, 1999, p. 58.
[60] Pierce and Nowak, 1999, p. 57.
[61] Pioneer Hi-Bred, *Pioneer Hi-Bred Technology Agreement*, October, 2000.
[62]Brief *Amici Curiae* of American Corn Growers Association & National Farmers Union in Support of the Petitioners, J.E.M. AG Supply, Inc. v. Pioneer HiBred International, Inc. Submitted by Joseph Mendelson III and Andrew C. Kimbrell, International Center for Technology Assessement, No. 99-1996. The brief was prepared in 2001.
[63] Pioneer Hi-Bred, *Pioneer Hi-Bred Technology Agreement*, October, 2000.
[64] North Dakota State University Agriculture Communication, News Release, "GMOs Bring Increased Liability Risk for Producers," March 22, 2001.
[65] Pioneer Hi-Bred, 2001 *YieldGard Product Use Guide*.
[66] North Dakota State University Agriculture Communication, March 22, 2001.
[67] Pioneer Hi-Bred, *Pioneer Hi-Bred Technology Agreement*, October, 2000.
[68] Weiss, Rick. "Monsanto's Gene Police Raise Alarm on Farmers' Rights, Rural Tradition," *Washington Post*, February 3, 1999, p. 1.
[69] The statistic is cited in *Amici Curiae* brief prepared by Joseph Mendelson and Andrew C. Kimbrell.
[70] Dorris, Eva Ann. "Monsanto Contracts: To Sign or Not to Sign," *Mississippi Farmer*, December 1, 2000. The article can be found on the internet at: http://www.biotech-info.net/to_sign_or_not.html.
[71] Personal communication with Dr. Gary Toenniessen, Rockefeller Foundation. April, 2001.
[72] "Generation and Commercialization of Knowledge: Trends, Developments and Models for Public and Private Agricultural Research and Education." This article will appear in: S. Wolfe (ed.), *Knowledge Generation and Transfer: Implications fro the 21st Century*. Forthcoming.

[73] Ibid.
[74] Anonymous, "The TR Patent Scorecard 2001," *Technology Review*, May, 2001. On the internet: http://technologyreview.com/magazine/may01/scorecard3.asp
[75] See GRAIN's excellent report: GRAIN in cooperation with SANFEC, "TRIPs-plus" through the back door: How bilateral treaties impose stronger rules for IPR on life than the WTO," July 2001. www.grain.org
[76] Louet, Sabine. "Free Access to Genomic Databases Under Threat," *BioMedNet News*, 7 April 2001.
[77] Stix, Gary. "Code of the Code," *Scientific American*, 20 March 2001. See also, Anonymous, "Patents for Gene Data," *AgBiotech Reporter*, May, 2001, p. 6.
[78] Rivette, Kevin G. and David Kline, *Rembrandts in the Attic*, Harvard Business School Press, Boston, 2000, pp. 8–10.

Cartoon by Reymond Page

The Action Group on Erosion, Technology and Concentration, formerly RAFI, is an international civil society organization headquartered in Canada. The ETC group (pronounced Etcetera Group) is dedicated to the advancement of cultural and ecological diversity and human rights.

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