# The essence of biology: tomatoes, broccoli and European patents on native plant traits

**Veit Braun**

**Angaben zur Veröffentlichung / Publication details:**

Braun, Veit. 2023. "The essence of biology: tomatoes, broccoli and European patents on native plant traits." In *Intellectual property and the design of nature*, edited by Jose Bellido and Brad Sherman, 49–73. Oxford: Oxford University Press. https://doi.org/10.1093/oso/9780192864406.003.0003.



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# The Essence of Biology

## Tomatoes, Broccoli, and European Patents on Native Plant Traits

*Veit Braun*[*]

### Introduction

With the surge of patents on cells, genes, organisms, and other living subject matter from the 1980s onwards, two dominant critiques developed in popular discourse and in scholarly analysis to address the issues that surround this form of intellectual property: one speaking of patents on 'life'; the other about the appropriation of 'nature'.[1] The first, largely of an ethical nature, seeks to problematize biopatents as a form of category error in which living subjects are wrongly turned into property objects. Why, it asks, do living beings have to be systematically disregarded as subjects in order to make the property fiction work—and what problems follow from that?[2] The second, situated in a political-economic tradition, criticizes biopatents as an instrument of privatizing nature or, in Rousseau's words, for forgetting that 'the fruits of the earth belong to all'.[3] Highlighting how living nature is far from self-reproducing, overabundant, or indeed invented by those who claim it, it focuses on biopatents as a means for redistributing wealth in unequal ways.[4]

[*] I would like to thank David Lahav for answering my questions about the Volcani Center, as well as Brad Sherman and Jose Bellido for their instructive and helpful editorial feedback on this text. Arthur Schaffer kindly provided a photo for this text.

[1] For the first tradition see eg Alain Pottage, 'The Inscription of Life in Law: Genes, Patents, and Bio-Politics' (1998) 61 *The Modern Law Review* 740; Melinda Cooper, *Life as Surplus: Biotechnology and Capitalism in the Neoliberal Era* (University of Washington Press 2008); Shobita Parthasarathy, *Patent Politics: Life Forms, Markets, and the Public Interest in the United States and Europe* (University of Chicago Press 2017); for the second one see Cori Hayden, *When Nature Goes Public: The Making and Unmaking of Bioprospecting in Mexico* (Princeton University Press 2003); Jack Ralph Kloppenburg, *First the Seed: The Political Economy of Plant Biotechnology* (University of Wisconsin Press 2004). Stefan Helmreich provides a useful taxonomy for the overlaps and divergences between prominent concepts from both traditions: Stefan Helmreich, 'Species of Biocapital' (2008) 17 *Science as Culture* 463.

[2] Some commentators have criticized this approach for reifying life and mystifying the origin of value in the organic; see David Tyfield, 'A Surplus of "Surplus"?' (2009) 18 *Science as Culture* 497; Kean Birch and David Tyfield, 'Theorizing the Bioeconomy: Biovalue, Biocapital, Bioeconomics or ... What?' (2012) 38 *Science, Technology & Human Values* 299.

[3] Jean-Jacques Rousseau, *Discourse on the Origin and Foundations of Inequality among Men* (first published 1755, Bedford/St Martins 2011) 70.

[4] For a problematization of this latter critique see Mario Biagioli, 'Vegetable Genius: Organic Figures of Originality' (ch 1 in this volume); Veit Braun, 'Tools of Extraction or Means of Speculation? Making

Veit Braun, *The Essence of Biology* In: *Intellectual Property and the Design of Nature*. Edited by: Jose Bellido and Brad

Both critiques have their merits, insofar as they bring to the fore important issues and questions that are all too quickly obscured by a mainstream discourse celebrating innovation and intellectual property. Yet despite their differences, they all too often rely on a juxtaposition of intellectual property with its alleged others which, at the same time, they seek to question and deconstruct. However, the life forms, things, and entities grouped together under the umbrellas of 'life' and 'nature' are not unified, and neither is the stance of patent laws (in the plural) towards them.[5] What 'nature' and 'life' thus do is to problematize certain notions and aspects of patent law, but at the price of coming heavily loaded with normative assumptions as to what these problems are and how they should be resolved.

The difficulty here is that both 'life' and 'nature' are terms very much ingrained in patent law. Practitioners speak of 'products of nature', 'living matter', or 'organisms' when discussing the intricacies of applying intellectual property to things that are, have been, or could be alive. 'Nature' and 'life' are thus not simply part of a scholarly vocabulary that is freely chosen. Rather, concepts from legal discourse, among both scholars and practitioners, reconnect to other established notions such as the dignity of life, the antecedence of nature, or the enclosure of open spaces. To avoid the established divisions and juxtapositions raised by these terms, how else could patented organisms, genes, cells, or organic substances be spoken of?

In this chapter, it is argued that 'biology' allows us to highlight a number of issues often overlooked when referring to 'life' or 'nature'. This argument is not entirely new: deviating from the common critiques of the latter two, intellectual property (IP) scholars have found themselves drawn towards 'biology' time and again.[6] What is less often discussed, however, is the significance of 'biology' in

Sense of Patents in the Bioeconomy' in Maria Backhouse and others (eds), *Bioeconomy and Global Inequalities: Socio-Ecological Perspectives on Biomass, Sourcing and Production* (Palgrave Macmillan 2021) 65–84.

[5] Brad Sherman, 'What Does It Mean to Invent Nature?' (2015) 5 *UC Irvine Law Review* 1193.

[6] Johanna Gibson (ed), *Patenting Lives: Life Patents, Culture and Development* (Ashgate Publishing 2008) is a case in point here: despite its title, the contributions overwhelmingly address 'technical' questions of biology rather than 'fundamental' ones of nature or life. Other examples include Daniel J Kevles, 'Ananda Chakrabarty Wins a Patent: Biotechnology, Law, and Society, 1972–1980' (1994) 25 *Historical Studies in the Physical and Biological Sciences* 111; Alain Pottage (n 1) 740; Jane Calvert, 'Patenting Genomic Objects: Genes, Genomes, Function and Information' (2007) 16 *Science as Culture* 207; Brad Sherman, 'Taxonomic Property' (2008) 67 *The Cambridge Law Journal* 560; Jane Calvert and Pierre-Benoît Joly, 'How Did the Gene Become a Chemical Compound? The Ontology of the Gene and the Patenting of DNA' (2011) 50 *Social Science Information* 157; Alain Pottage and Brad Sherman, 'Organisms and Manufactures: On the History of Plant Inventions' (2007) 31 *Melbourne University Law Review* 539; Alain Pottage and Brad Sherman, *Figures of Invention: A History of Modern Patent Law* (Oxford University Press 2010); Alain Pottage and Brad Sherman, 'Kinds, Clones, and Manufactures' in Mario Biagioli, Peter Jaszi, and Martha Woodmansee (eds), *Making and Unmaking Intellectual Property* (University of Chicago Press 2011); Jean-Paul Gaudillière, Daniel J Kevles, and Hans-Jörg Rheinberger (eds), *Living Properties: Making Knowledge and Controlling Ownership in the History of Biology* (Max Planck Institute for the History of Science 2009); Sherman (n 5).

discussions among practitioners and in legal texts. To shine a light on these aspects, two patent disputes dealing with biological subject matter are reconstructed:[7] *Broccoli/Tomatoes I* and *II*. From the filing of both patents in the early 2000s to the (so far) last word on the matter in 2020, the legal dispute dragged on for almost two decades. Upon the initial grants by the European Patent Office (EPO) in 2002 (*Broccoli*) and 2003 (*Tomatoes*), opposition was filed by Limagrain, Syngenta, and Unilever.

The EPO's Technical Board of Appeal examined the cases and relayed them to the Enlarged Board of Appeal to clarify the meaning and significance of 'essentially biological processes', as defined in the European Patent Convention. The EPO rejected the process claims of the applications in 2010 (*Broccoli/Tomatoes I*), but in 2015 upheld the patents as far as the plants resulting from the same breeding processes were concerned (*Broccoli/Tomatoes II*). After this decision, the case and the issue briefly left the closed walls of the EPO's headquarters in Munich and its boards of appeal in nearby Haar. Breeders' associations issued press releases, newspapers reported on the case, and national and European members of parliament set out to fix in legislation what apparently had gone wrong in the judiciary. In the aftermath, first the president of the EPO and then eventually the Enlarged Board of Appeal changed their minds and declared that plants resulting from 'essentially biological' processes were not patentable.

The case not only highlights the particularity of certain forms of life—conventionally bred plants—but also their relations to economic and political questions, as well as the geographically fragmented nature of an allegedly 'global' regime of biopatents. In its decisions, the EPO had to navigate the exemptions of Article 53 of the European Patent Convention (EPC), which were originally intended to function as a bulwark against the intrusion of patent law into the domain of plant breeding. Whereas the debate on patentability of genes and genetically modified organisms (GMOs) in 1980s and 1990s North America focused on the question of whether DNA or organisms were *products of nature*, *Tomato/Broccoli* and its aftermath had to answer a slightly different question: namely how *biology* fits into the framework of patent law. When compared with older controversies over genetically modified food and biotechnology patents, as well as patents on embryos and animals, there was very little critical public involvement in this case.

While informed by past battles over 'life' and 'nature' in European plant-breeding and patent law,[8] the question of 'essentially biological processes' and

[7] This text is a result of ethnographic research, expert interviews, and document analysis the author conducted for his PhD thesis from 2015 to 2018 and that he has followed up since.

[8] Sheila Jasanoff, *Designs on Nature: Science and Democracy in Europe and the United States* (Princeton University Press 2007) 94; Parthasarathy (n 1).

their implications for the patentability of plants had little resonance with these older debates. Although 'biology' might appear more or less synonymous with (animate) nature and is often treated as such in the literature, it has taken on a specific meaning in European patent law, referring not so much to ethical or political considerations, but rather to the pragmatics of distinguishing between different types and qualities of intervening in vital processes. What is of interest here, therefore, is who and what is mobilized by 'biology', rather than by 'nature' or 'life', and what may be learned from *Tomatoes/Broccoli* beyond the geographical confines of Europe. What the case and the term offer, it is suggested here, is a way of rethinking the relationship between technology and life, as well as the role of economics and politics when naming living subject matter.

## Public Plant Science and Patenting

In the early 2000s, in the midst of fierce debates and controversies over genetically modified plants—their potential benefits to agriculture, their effects on the seed industry, and their possible hazards for health and the environment—two inconspicuous patent applications reached the EPO's examining division. Neither gained public interest at the time. Although they both related to plants, more precisely vegetables, the applications referred to traditional breeding methods rather than to the techniques of genetic transformation that were at the centre of the debate over biotech plants. It was food and plant multinationals, not non-governmental organizations, who would oppose the patents, and while the EPO's Enlarged Board of Appeal was to arrive at a decision contested across the board, from seed activists to industry leaders, it was difficult to explain what exactly the controversy was about.

Indeed, the applications titled 'Method for selective increase of the anticarcinogenic glucosinolates in Brassica species' (EP1069819) and 'Method for breeding tomatoes having reduced water content and product of the method' (EP1211926), or the *Broccoli* and the *Tomatoes* patents, as they would respectively come to be known, were unlikely to strike their intended reader as containing ground-breaking inventions. The *Broccoli* patent in its initial form claimed a process for breeding plants of the genus *Brassica* that are high in glucosinolates, a group of compounds characteristic of the Brassicaceae family and responsible for the bitter, pungent aroma of brussels sprouts, mustard, rape, and horseradish, among others. Similarly, the *Tomatoes* application claimed a method for cross-breeding tomatoes (*Solanum esculentum*) with a wild relative (*S. hirsutum*) and subsequently selecting the offspring to obtain fruits that will shrivel and dry while still attached to the plant. While both vegetables are somewhat curious, they are far from the biotechnological marvels of herbicide-tolerant and insect-resistant plants

that excited the seed industry during the 1990s and 2000s and caused so much resistance among concerned activists and consumers in Europe. It would not be derogatory to characterize them as fairly ordinary vegetables, like hundreds of others that are planted in greenhouses and polytunnels every year. Yet it is precisely the fact that what was described and claimed in the applications was so conventional that led to their opposition.

Although the history recounted in this chapter is a European one, it did not start as such. Neither application was written with a particularly European focus in mind. Instead, both were filed via the World Intellectual Property Office (WIPO) and entered their regional phase in Europe after the WIPO relegated them to the EPO for examination.[9] Filing through the WIPO is standard procedure in many industries and saves applicants the trouble of sending applications to various patent offices around the world.[10] Other than Europe (ie the signatory countries to the European Patent Convention (EPC)), both *Tomatoes* and *Broccoli* were filed in the United States, Japan, Australia, and Canada. However, it was only at the EPO that they were opposed, ruled upon by two boards of appeal, and attained status as a landmark case with profound implications for plant IP law and the seed sector. While the applications were not (in a strict sense) biotechnological in nature or specifically aimed at the European seed market, their legal career cannot be understood without reference to the GM wars of the 1990s or the particular history of plant IP law in Europe.

The *Tomatoes* and *Broccoli* patents are part of a cohort of patent applications that started to reach the EPO from the early 1980s onwards. Initially only a trickle, their numbers increased over the 1990s to an average of ten every year until 2000, and twenty-three applications a year between 2001 and 2010.[11] While these figures may appear unimpressive, they are roughly equal to those of biotechnology plant applications over the same period of time. Graphs for both rise more or less in unison over the 1990s and 2000s.[12] Just as with the early biotech patents of the 1990s, many of the conventional applications of the time pertained to agricultural crops such as maize, rapeseed, and sunflowers. However, towards the turn of the millennium,

[9] 'About This File: EP1211926' European Patent Register (20 February 2022) https://register.epo.org/application?number=EP00940724&lng=en&tab=main (accessed 21 February 2022); 'About This File: EP1069819' European Patent Register (20 February 2022) https://register.epo.org/application?number=EP99915886&lng=en&tab=main (accessed 21 February 2022).

[10] Lionel Bently and others, *Intellectual Property Law* (5th edn, Oxford University Press 2018) 416.

[11] 'PATSTAT 2018 Spring edition', years 1991–2000 (PATSTAT 2018) https://data.epo.org/expert-services/index.html (accessed 2 October 2018). All patents in category A01H and subcategories whose cooperative patent classification (CPC) does not include biotechnology (C12N and subcategories), symbiosis with bacteria (A01H 3), or tissue culture (A01H 4) were searched for. To specify the search further, algae (A01H 13) and fungi (A01H 15) were excluded. Patents referring to processed plant materials instead of germplasm (F and subcategories) were excluded, as were patents for processes and products involving marker-assisted breeding (C12Q). Duplicates and false positives were removed from the results based on their abstracts and claims.

[12] PATSTAT 2018 (n 11), classification C12N and subcategories.

when the *Broccoli* and *Tomatoes* patents were filed, vegetable applications gained in prominence. And while the 'usual suspects'—leading biotech multinationals such as Monsanto, Pioneer, and Sandoz (later Novartis)—account for roughly a third of conventional plant patent applications at the EPO at that time, two other types of actors emerged towards the 2000s: traditional Dutch vegetable-breeding companies such as Rijk Zwaan, Enza Zaden, and Bejo, and national (non-university) public research institutions, such as the French INRA, the Spanish CSIC, and the Australian CSIRO.[13]

Attempts to understand the story behind *Tomatoes* and *Broccoli*—including the author's own—have largely focused on the antagonism between the former two groups: multinational public companies with a history in biotechnology and chemistry versus family-owned, conventional plant-breeding firms.[14] Indeed, there are good reasons to do so. Much of the political debate before and after the 2015 ruling by the EPO's Enlarged Board of Appeal in the case was driven by these actors. It is usually assumed that patents on native traits represent an extension of the business model behind genetically engineered traits such as herbicide tolerance or insect resistance.[15] In turn, both the European seed industry lobby and critical observers of the case emphasized that patents on native traits are at odds with the legal regime of plant variety protection and the business models of conventional breeders who rely on it (and have nonetheless participated in the native patent rush).[16] However, what has been neglected in this framing, it is argued here, is the third group, which is driven by quite different motives and incentives.

Notably, neither *Broccoli* nor *Tomatoes* were filed by seed companies in the strict sense. The former's applicant is Plant Bioscience (or PBL Technology), a technology-transfer joint venture of the John Innes Centre in Norwich, the Sainsbury Laboratory in Cambridge, and the UK Biotechnology and Biological Sciences Research Council, each being public, semi-public, or formerly public institutions.[17] The research behind the application was largely carried out by

[13] ibid classification A01H and subcategories excluding C12N, A01H 3, A01H 4, A01H 13, and A01H 15.

[14] Ivan Mammana, 'Concentration of Market Power in the EU Seed Market: Study Commissioned by the Greens/EFA Group in the European Parliament' (The Greens/EFA in the European Parliament 2014); Fabien Girard and Christine Noiville, 'Propriété industrielle et biotechnologies végétales: la Nova Atlantis: À propos de la recommandation du Haut Conseil des Biotechnologies' (2014) 28 *Revue internationale de droit économique* 59; Fabien Girard, '"Though the Treasure of Nature's Germens Tumble All Together": The EPO and Patents on Native Traits or the Bewitching Powers of Ideologies' (2015) 33 *Prometheus* 43; Veit Braun, 'Holding on to and letting go of seed: Quasi-commodities and the passage of property' (2021) 14 *Journal of Cultural Economy* 306; Braun (n 4); Christine Noiville and Fabien Girard, 'Gènes des plantes: International Licensing platform' in Marie Cornu, Fabienne Orsi, and Judith Rochfeld (eds), *Dictionnaire des biens communs* (Presses universitaires de France 2021) 632.

[15] Girard (n 14) 46.

[16] Braun (n 4).

[17] 'About Us' (2022) PBL Technology https://www.pbltechnology.com/about-us; 'A Short History of the John Innes Centre' John Innes Centre (8 June 2009) http://web.archive.org/web/20131207040

Kathy Faulkner (first a PhD student and later postdoctoral researcher at the John Innes Centre), Ruth MacCormack (who led the Brassica Department at the John Innes Centre, Gary Williamson (leader of a phytochemicals research group of the Institute of Food Research in Norwich), and Richard Mithen, who supervised Faulkner's PhD. The group had specialized in commercial *Brassica* species and their wild relatives and had made a series of experimental crosses between commercial broccoli (*B. oleracea* var. *italica*) and two endemic and threatened Sicilian species of cabbage (*B. villosa* and *B. drepanensis*) to increase the low glucosinolate content of the former.[18] The *Tomatoes* application was an outcome of research carried out by Arthur Schaffer's research group at the Volcani Center, Israel's national institution for agricultural sciences, and a subsidiary of the Israeli Ministry for Agriculture.[19] It resulted from experimental breeding with commercial tomatoes (*Solanum esculentum*) and a Peruvian relative (*S. habrochaites*), which was aimed at introducing a fruit cuticle (or peel) that would allow water to evaporate from the intact fruit, thus letting tomatoes dry while still attached to the plant (Fig 3.1).[20]

Although Plant Bioscience and the Volcani Center are very different institutions and with different histories, they share roots in the public sector as well as the pressure to monetize potentially useful outcomes of their research—something they also have in common with other public and semi-public research institutes after the advent of 'academic capitalism'.[21] Starting with the 1980 US Bayh–Dole Act,[22] public

745; http://www.jic.ac.uk/corporate/about/history.htm (accessed 28 July 2022); for the recent history of British plant-breeding see Andrew J Webster, 'Privatisation of Public Sector Research: The Case of a Plant Breeding Institute' (1989) 16(4) *Science and Public Policy* 224 https://doi.org/10.1093/spp/16.4.224 (accessed 28 July 2022); Katrina Stengel and others, 'Plant Sciences and the Public Good' (2009) 34 *Science, Technology & Human Values* 289; Viktoriya Galushko and Richard Gray, 'Privatization of Crop Breeding in the UK: Lessons for Other Countries' Paper prepared for presentation at the 87th Annual Conference of the Agricultural Economics Society, University of Warwick (8–10 April 2013).

[18] Richard Mithen, K Faulkner, and G Williamson, 'Method for the selective increase of the anticarcinogenic glucosinolates in *Brassica* sp.'; Sally Hines, 'From Lab to Classroom: an Alumni Career' John Innes Centre (9 September 2020) https://www.jic.ac.uk/blog/lab-to-classroom-alumni-career (accessed 21 February 2022); Richard Mithen, 'Richard Mithen' (2022) OMICS International https://biography.omicsonline.org/united-kingdom/quadram-institute/richard-mithen-874840 (accessed 21 February 2022).

[19] Arthur Schaffer, 'Method for breeding tomatoes having reduced water content and product of the method'. For a short history of the Volcani Center and its role in Israel's agricultural and research policies see Danielle Abraham and others, *How Israel Became a World Leader in Agriculture and Water: Insights for today's developing countries* (2019) Tony Blair Institute for Global Change.

[20] Schaffer (n 19). The application refers to *Lycopersicon esculentum*, a common taxonomic synonym for *Solanum esculentum*, and *L. hirsutum* (a synonym for *S. habrochaites*).

[21] Rebecca S Eisenberg, 'Biotech Patents: Looking Backward While Moving Forward' (2006) 24 *Nature Biotechnology* 317; Sheila Slaughter and Larry L Leslie, *Academic Capitalism: Politics, Policies, and the Entrepreneurial University* (Johns Hopkins University Press 1997); Sheila Slaughter and Gary Rhoades, *Academic Capitalism and the New Economy: Markets, State, and Higher Education* (Johns Hopkins University Press 2004).

[22] Bayh–Dole Act 1980 (US).

research institutions around the world were first allowed and then increasingly obliged to patent findings that had a potential industrial application. The philosophy behind this push for public patenting is to use patents as an interface for public–private partnerships to facilitate technology transfer and reclaim some of the profits the private sector makes with tax-funded, public knowledge. Today, this obligation to deliver a 'return on investment' to the taxpayer and transfer technology by filing for patents and licensing them to interested parties is one of the main drivers behind public research bodies' attempts to patent conventionally bred plants.[23]

For public research institutes operating under the 'imperative of valorisation',[24] patents thus represent an indispensable instrument for transferring technology and receiving royalties across the globe. Through the Paris Convention, the World Intellectual Property Organisation (WIPO) Convention, the Patent Cooperation Treaty (PCT) and the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPs), patents have become ever-more globalized, allowing national entities to license their IP worldwide and to attract licensing offers from companies around the globe. This is especially important with vegetables, since greenhouses, polytunnels, and irrigation technologies have largely detached them from local or regional agricultural regimes such as climate, topography, or seasonality, which still govern field crops to a large extent.[25] 'Shotgun' filing of patents through the WIPO without knowing in advance which licensees or markets would be interested in a patented plant is characteristic of this business model for technology transfer, and stands in contrast to the strategies of patent hoarding, defensive patenting, and rigorous financial valuation of patents that corporate patent holders often pursue.[26] Public plant-breeding institutes usually follow a liberal, non-exclusive licensing strategy, as they do not use their patents themselves.[27] Nevertheless, although such patents are biologically independent of their place of origin and should ideally operate everywhere in a legally homogenized world, *Broccoli/Tomatoes I* and *II* (as well as the later *Pepper* case) had to deal with the question of whether a particular regional history of plant IP and innovation would disrupt this globalized logic in the complicated and contradictory legal space all too often conflated in the term 'Europe'.

[23] Although few plants and technologies successfully make it from a research finding to a commercial product, there are exceptions to the rule, such as the French INRA's Ogura rapeseed, a cytoplasmic male sterile hybrid, which was successfully licensed to a number of plant-breeding companies. See Steward Redqueen, *Who Benefits from IP Rights for Agricultural Innovation? The Case of Ogura Oilseed Rape in France* (2015) Croplife International and EuropaBio).

[24] Florence Bellivier, 'Biobanque' in Marie Cornu, Fabienne Orsi, and Judith Rochfeld (eds), *Dictionnaire des biens communs* (Presses universitaires de France 2021) 143.

[25] Annabel Ipsen, 'Manufacturing a Natural Advantage: Capturing Place-based Technology Rents in the genetically modified corn seed industry' (2016) 2 *Environmental Sociology* 41; Barbara Brandl, *Wissenschaft, Technologieentwicklung und die Spielarten des Kapitalismus: Analyse der Entwicklung von Saatgut in USA und Deutschland* (Springer VS 2018) 17.

[26] Holger Ernst, 'Intellectual Property as a Management Discipline' (2017) 19 *Technology & Innovation* 481; Braun (n 4).

[27] This is somewhat in contrast to (especially US) universities, which in some fields of technology pursue exclusive partnerships for technology transfer: Bhaven N Sampat, 'Patenting and US Academic Research in the 20th Century: The World before and after Bayh–Dole' (2006) 35 *Research Policy* 772.

**Figure 3.1** The Volcani Center's self-drying tomatoes on the vine, 2002.
Courtesy of Ari Schaffer. Reproduced here with permission.

## From Field to Paper: Disclosing Organisms

In retrospect, it is unclear why the *Broccoli* and *Tomatoes* patents, of all the applications for conventionally bred vegetables, would become the landmark cases they are. They were opposed by Syngenta and Limagrain, as well as by Unilever, respectively; companies that each had stakes in the vegetable business in Europe.[28] While there were concerns over monopolization and that competitors would be locked out from central technologies, there is little in the patents that justify such concerns.

[28] Limagrain, a former French cooperative, is one of the biggest plant-breeding companies in Europe, as is Syngenta, a spin-off from the biotech multinational Novartis and today a subsidiary of ChemChina. Unilever has dabbled in the seed business in the past, briefly owning the Plant Breeding Institute, which was later merged with the John Innes Centre.

Both the *Tomatoes* and *Broccoli* patents describe and claim a fairly straightforward (if generic) process of introgression and back-breeding, ie transferring desired traits from one species or variety of plant to another, as well as a plant that results from this process: self-desiccating tomatoes in the former, a glucoraphanin-rich broccoli in the latter. In fact, the process as described in the *Broccoli* patent reads as if it could have been taken straight from an introductory plant-breeding textbook:

I.) Crossing wild species with broccoli double haploid breeding lines;
II.) Analyzing F1 hybrids, selecting the hybrids with the highest level of 4-methylsulfinylbutyl and/or 3-methylsulfinylpropyl glucosinolates and back-crossing to broccoli breeding lines;
III.) Analysis of glucosinolates in individual plants of the B1 (Backcross 1) generation;
IV.) One or two further rounds of backcrossing (B2, B3) with selection of plants with the highest level of 4-methylsulfinylbutyl and/or 3-methylsulfinylpropyl glucosinolates, anticarcinogenesis screening of selected individuals by induction of phase II enzymes;
V.) Analysis of B3 (Backcross 3) population with selection of plants with the highest level of 4-methylsulfinylbutyl and/or 3-methylsulfinylpropyl glucosinolates, anticarcinogenesis screening of selected individuals by induction of phase II enzymes;
VI.) Selection of a broccoli line with elevated levels of 4-methylsulfinylbutyl and/or 3-methylsulfinylpropyl glucosinolates which carries the anticarcinogenic trait capable of causing a strong induction of phase II enzymes.[29]

In a similarly straightforward fashion, *Tomatoes* claims:

1. A method for breeding tomato plants that produce tomatoes with reduced fruit water content comprising the steps of:
   - crossing at least one *Lycopersicon esculentum* plant with a *Lycopersicon* spp. to produce hybrid seed;
   - collecting the first generation of hybrid seeds;
   - growing plants from the first generation of hybrid seeds;
   - pollinating the plants of the most recent hybrid generation;
   - collecting the seeds produced by the most recent hybrid generation;
   - growing plants from the seeds of the most recent hybrid generation;
   - allowing plants to remain on the vine past the point of normal ripening; and
   - screening for reduced fruit water content as indicated by extended preservation of the ripe fruit and wrinkling of the fruit skin.
2. The method according to claim 1 wherein the steps of pollinating, collecting the seeds, and growing plants are repeated at least once.

[29] Mithen, Faulkner, and Williamson (n 18) 17.

3. The method according to claim 1 wherein the step of pollinating includes self-pollination.[30]

Both plants failed to make a considerable commercial impact: the self-drying tomatoes were licensed to a company but never turned into a product,[31] while the anticarcinogenic broccoli enjoyed some modest spotlight on Marks & Spencer and Asda supermarket shelves in the UK.[32] Even so, there was much to take issue with, in the eyes of the industry. On 22 April 2004, Syngenta filed a formal notice of opposition to the *Broccoli* patent at the EPO. Its grounds included lack of novelty, a false date of priority, lack of inventive step, and insufficient disclosure either for selected claims or the patent in total.[33] Two days later, Limagrain followed, citing the same reasons.[34] Unilever's notice of opposition to the *Tomatoes* patent arrived on 12 August in the same year, similarly citing insufficient disclosure, lack of novelty, and a lack of inventive step.[35]

The two patents had a number of flaws in common. The plants claimed relied on a random recombination of alleles during the breeding process and the patents did not, in the eyes of the opposition, provide enough information as to how to arrive at the final plant from the initial cross or, in the case of *Broccoli*, define the attribute 'elevated' in relation to the plant[36] or consistently stick to one definition of *Brassica oleracea*[37] (insufficient disclosure). The EPO opposition claimed that neither plant was in fact new, seeing as there had been publications predating the applications that mentioned broccolis 'with elevated levels of [glucosinolates]';[38] and Arthur Schaffer had described the same tomato-breeding process in a previous patent[39] (lack of novelty). Furthermore, all three notices of opposition claimed that introgression of traits using wild relatives and back-breeding was an entirely obvious procedure for anyone reading plant science publications.[40] The *Broccoli* application had further been amended compared with its US priority application to claim 'A

[30] Schaffer (n 19) 10.

[31] Interview with IP lawyer (November 2017).

[32] Plant Biosciences Ltd teamed up with the Dutch seed company Seminis (acquired by Monsanto shortly after) to develop a commercial variety marketed under the name 'Beneforté' from 2011 onwards: 'The Story behind Super Broccoli' https://nutraceuticalbusinessreview.com/news/article_page/The_story_behind_super_broccoli/97820 (accessed 28 December 2021). At the time of writing, it is not available in either Asda's or M&S Ocado partner's online stores.

[33] W Smolders 'Opposition to European Patent No EP-1 069 819-B1 (Appl No 99915885.8)' (22 April 2003) 2.

[34] Carol Almond-Martin, Notice of opposition, 'Opposition against European Patent No. EP-B-1 069 819 Granted on 24 July 2002 in the Name of Plant Bioscience Limited' (24 April 2003) 3.

[35] G Tjon Tiel Ril, Annex 1 to the Notice of Opposition against EP-B-1 211 926 (Appl No 0094 0724.8) (State of Israel—Ministry of Agriculture)—Facts and Arguments' (12 August 2004) 4.

[36] Smolders (n 33) 2.

[37] Almond-Martin (n 34) 16.

[38] Smolders (n 33) 4; Almond-Martin (n 34) 9.

[39] Tjon Tiel Ril (n 35) 8.

[40] Smolders (n 33) 4; Almond-Martin (n 34) 12; Tjon Tiel Ril (n 35) 12.

*Brassica* plant cell' rather than 'plant cell extracts' (incorrect priority date).[41] More important than all these concerns was one that encompassed and yet transcended them and thus takes a prominent place in all three notices of opposition:[42] the issue of whether the two applications sought to claim essentially biological processes and their products.

The applications were badly drafted, perhaps owing to the fact that public research institutes often lack the capacities for writing patent applications effectively and strategically. They also demonstrate a more fundamental problem that goes beyond the flaws of the two applications, namely how to discern and document human contributions to the evolution of a particular plant, and how to make the documentation comply with the genre of the patent. The question of how to disclose and recreate properly has a long history, going back to the early twentieth century, when plant breeders on both sides of the Atlantic first sought patent protection for their plants.[43] Patent offices had difficulty processing plant applications, which described plant phenotypes through words and drawings, but failed to provide a theory on how exactly a particular plant phenotype came about—and more importantly, how another breeder could recreate that phenotype from scratch. Unlike mechanical, electrical, or chemical inventions, which could be disclosed in technical drawings and recipes, the process of producing new plants was too random to be considered repeatable. Furthermore, in the absence of a doctrine that would enable another person to make a patented plant themselves (as in *Tomatoes* and *Broccoli*), it was even doubtful whether breeders were actually the creators, rather than the plants themselves.[44]

Early twentieth-century breeders seeking patent protection were faced with the difficulty of stating how their new traits, sports, and mutants had come about; or, perhaps more importantly, how others could imitate what they sought to disclose in their patent applications. Although they enclosed detailed drawings of new petal colours or unheard-of leaf shapes, neither these graphical depictions nor a minute account of the steps taken to arrive at the plant to be patented were sufficient to reproduce it. Even if the same breeder were to repeat one and the same cross-pollination between two parental plants, the possibility that a plant identical to the one described in the patent application would emerge from them was minuscule. Patent offices thus began to reject such applications not so much for metaphysical

[41] Smolders (n 33) 2.

[42] ibid 4; Almond-Martin (n 34) 2; Tjon Tiel Ril (n 35) 2.

[43] Pottage and Sherman (n 6) 153; Daniel J Kevles, 'New Blood, New Fruits: Protections for Breeders and Originators, 1789–1930' in Mario Biagioli, Peter Jaszi, and Martha Woodmansee (eds), *Making and Unmaking Intellectual Property* (University of Chicago Press 2011) 253–68; Pottage and Sherman, 'Kinds, Clones, and Manufactures' (n 6); Braun (n 14).

[44] Kevles (n 43) 262.

reasons (because they had in fact been found in nature rather than created through human ingenuity) or political–economic reasons (because they would deprive others of what had already been 'published' by nature) as for simple technical difficulties. In other words, breeders could not fulfil their part of the patent bargain by enabling others to use the knowledge behind the invention. Therefore, plant breeders were imperfect inventors, relying on the (largely undefined) biology of their plants to produce and reproduce new traits and varieties.[45] They could provide suitable conditions for such innovations to occur (for example, by increasing the number of crosses between two parental plants), but eventually relied on the plants' own knowledge for bringing these about. At a loss when asked about the principle behind their invention, they could only point to the organism itself as the source.

Politics in the US and Europe, caught between the desire to stimulate the plant-breeding industry and breeders' inability to comply with the basics of patent law, came up with two similar yet diverging answers to the problem. The US Plant Patent Act of 1930 provided reduced protection (compared to full patent protection) for breeders working towards new plant traits. The question of whether a breeder invented or simply discovered a particular plant feature—one of the tests for telling technology from nature—did not play a role for plant patents, unlike the ability to reproduce that feature true to form.[46] As a result, the US Plant Patent Act only grants protection for those plants that can be reliably reproduced, that is clonally reproduced plants (excluding tubers).[47] The Act targeted the horticultural sector (ie fruit trees), which relies heavily on grafting and is characterized by extremely long generational times.[48] While every new act of sexual reproduction involves new mixing and therefore unforeseeable results, clonal propagation promises to recreate a filial plant identical to its parent.[49]

Whereas 'nature' was one of the biggest roadblocks for the expansion of US patent law into the realm of life, the situation in Europe was somewhat different. The dualism in Europe, as became apparent once more in *Tomatoes/Broccoli*, was not between 'nature' and 'technology' or 'invention', but between 'biology' and

[45] Jay Sanderson, *Plants, People and Practices: The Nature and History of the UPOV Convention* (Cambridge University Press 2017) 81.

[46] 'Whoever invents or discovers and asexually reproduces any distinct and new variety of plant, including cultivated sports, mutants, hybrids, and newly found seedlings, other than a tuber propagated plant or a plant found in an uncultivated state, may obtain a patent therefor, subject to the conditions and requirements of this title.' Plant Patent Act 1930 (US).

[47] ibid.

[48] Cary Fowler, 'The Plant Patent Act of 1930: A Sociological History of Its Creation' (2000) 82 *Journal of the Patent & Trademark Office Society* 621.

[49] In practice, asexual reproduction, too, is of course subject to variation: George Acquaah, *Principles of Plant Genetics and Breeding* (2nd edn, Wiley 2012) 152. Compared to sexual reproduction, however, reproduction true to kind is much more likely with asexual than with sexual reproduction.

'technicity', a seemingly trivial yet crucial difference.[50] European plant variety protection (PVP) laws, first established in the 1940s and harmonized in 1961 in the International Union for the Protection of New Varieties of Plants (UPOV) Convention, took a different approach from the US Plant Patent Act by protecting asexually as well as sexually reproducing plants. PVP, modelled on field crops rather than horticulturals as in the US plant patents, was more optimistic when it came to the ability of sexually reproducing plants to yield identical offspring, but also relied on thorough inbreeding of varieties to achieve genetic homogeneity.[51] At the time, breeders freely crossed existing varieties, selected the offspring, and selfed it to achieve genetically homogenous plants. PVP limited protection to varieties, excluding other forms of plant innovations such as traits, individual mutants, or sports because they did not comply with an idea of breeding that saw breeders as producers and farmers as consumers of commodified farm input.[52] Importantly, PVP also explicitly allowed third parties to use protected varieties for cross-breeding (the so-called 'breeder's exemption') precisely because the random nature of sexual reproduction would produce new varieties rather than reproducing existing ones. In this regard, PVP reflects the nature of commercial plant breeding in the twentieth century as well as its epistemic and ontological underpinnings whereby breeders invested money, time, and labour into developing new plants, not inventive ideas. What they needed protection for was a marketable, standardized product, not for a speculative and more or less abstract idea that was still in search of a commercial embodiment.[53]

## The Essence of Biology

When European countries sought in the 1960s and 1970s to establish a common legal space for patents with the EPC, one aim was to keep PVP and patent law separate.[54] Far-reaching prohibitive powers of patent holders were not to interfere with the liberties granted by PVP legislation, while the breeder's exemption should not undermine the economic principles of patent protection. This resulted in Article 53(b) of the 1973 EPC, wherein plant varieties and 'essentially biological processes

[50] Kelvin W Willoughby, 'How Much Does Technology Really Matter in Patent Law? A Comparative Analysis of Doctrines of Appropriate Patentable Subject Matter in American and European Patent Law' (2009) 18 *Federal Circuit Bar Journal* 63. The European doctrine of technicity bears resemblance with the considerations raised in the early US legal discourse on plant patents, and in fact it is tempting to contemplate how *Chakrabarty* would have turned out if technicity and biology, not nature and technology, had been at the heart of it. See Sherman (n 6); Pottage and Sherman, *Figures of Invention* (n 6); Pottage and Sherman, 'Kinds, Clones, and Manufactures' (n 6).

[51] Sanderson (n 45) 116.

[52] Braun (n 14).

[53] ibid. For the epistemics of plant breeding see Martin Timmermann, *Der Züchterblick: Erfahrung, Wissen und Entscheidung in der Getreidezüchtung* (Shaker 2009).

[54] For the history of the EPC see Parthasarathy (n 1); Sanderson (n 45) 126.

for the production of plants and animals' are explicitly exempt from patentability.[55] The clause is clearly related to the preceding Article 52, which precludes non-technical innovations from patenting, in turn also (implicitly) requiring patented inventions to be of technical character.[56] However, the biological is not always simply the technological's other, as the German Federal Court's *Rote Taube* ruling of 1969, a landmark case for European patent law, clarifies. While the judges found animal breeds to lack reproducibility and therefore patent eligibility, they explicitly noted that the relationship between technical and biological was ambiguous and non-technicality alone did not preclude inventions from patentability.[57] As far as plant varieties are concerned, the motives behind Article 53(b) of the EPC can be read economically, as an attempt at protecting an established industry and its existing IP instruments from disruption. With PVP, there was already an IP specifically for plant varieties, while breeders should not be excluded from using the most basic of plant-breeding techniques, ie crossing, selecting, and back-breeding. However, a legal–technical reading is also possible, whereby plant varieties are not patentable because their biological character does not lend itself to the same forms of explication as chemical compounds, machines, or electronic devices. For the same reasons, the same clause exempts 'essentially biological processes' as they can be described in minute detail, but the relationship between this description and the results produced by following it is loosely defined at best.

The frequent mixture of biological and technical elements in plant—and animal breeding has remained a contentious issue at the EPO for the last three decades. With the end of patent barriers to conventional as well as biotech organisms in the US, Europe, also, saw a rise in non-transgenic plant patent applications between 1990 and 2010, with a total of 438 applications for non-transgenic plants filed at the EPO.[58] Against this background, the EPO found itself prompted to take a clear stance on the matter in *State of Israel/Tomatoes* and *Plant Biosciences/Broccoli*.[59] Two main questions arose with regard to Article 53(2). First, what was the meaning and extent of 'essential' in 'essentially biological'? Secondly, what about the non-variety products of essentially biological processes? The former was raised with regard to breeding techniques that were more or less conventional; that is, they were based on cross-fertilization and subsequent selection of progeny, but involving one or more elements that were clearly non-biological or in their totality qualifying as non-biological. In both *Hybrid Plants/Lubrizol*[60] and *Transgenic Plant/*

[55] EPC 1973, art 53(b). The article was carried over into the 2000 revision of the EPC without changes to the numbering or wording: EPC 2000, art 53(b).

[56] Bently and others (n 10) 478.

[57] BGH X ZB 15/67, 8.

[58] PATSTAT 2018 (n 11). During the same period, the EPO received 7,859 applications for patents on biotech plants.

[59] Rumour within the patent lawyer community has it that there were forces in the EPO specifically pushing for the two applications to be granted to bring about a landmark decision that would clear up open questions in plant patent law.

[60] T 032087 (EPO 1988).

*Novartis*,[61] the EPO's Technical and Enlarged Board of Appeal (EBA), found that either overall composition of the process or the presence of key non-biological elements could qualify breeding processes for patentability but did not set a general position for the EPO to adopt in this regard. In *Transgenic Plant/Novartis*, the EBA also ruled that genetic material could be patented as long as such 'material' was either more (ie included in several varieties) or less than a variety (ie included in one plant or cell line only, which did not amount to a variety in the UPOV sense).[62] It thus gave clear guidance with respect to the variety provisions in Article 53(2) of the EPC.

In their response to the opposition, the Volcani Center's lawyers pointed out that the last step of the breeding process claimed in the patent, 'screening for fruit water content', went beyond mere selection as performed by breeders and amounted to a technical step, in turn qualifying the entire process for patentability. They argued that since the trait could be applied to more than one variety of plants, the variety clause of Article 53(2) of the EPC did not apply either.[63] The same stance was taken by Plant Bioscience, whose lawyers claimed that the preparation of cell extracts went beyond 'essentially biological' and therefore rendered the entire process 'essentially technical'.[64] Oral proceedings were held by the EPA's Opposition Division in June 2004 (*Broccoli*) and March 2006 (*Tomatoes*), where Richard Mithen and Arthur Schaffer testified as inventors and technical experts. In both cases, the Opposition Division rejected the opposing parties' demands to reject the patents but instead granted them in amended form after both patent proprietors dropped the methods claims from their applications.[65] As was to be expected, the opposing parties appealed these decisions, taking the cases to the Technical Board of Appeal, which in turn relegated both patents to the Enlarged Board of Appeal in 2006 and 2007, respectively, asking for clarification on the nature of a process that contained an additional non-biological step and, in case the Enlarged Board of Appeal deemed it essentially biological, on the patentability of its products.[66]

The Enlarged Board of Appeal gave interested observers time to file a total of 233 *amici curiae* to comment on the matter and consolidated both cases into one in July 2010 before handing down its ruling in December of the same year.[67] Therein,

[61] G1/98 (EPO 1999).

[62] Sanderson (n 45) 130.

[63] R Perry, Reply of the patent proprietor to the notice of opposition, 'Proprietor's Observation on the Opposition' (8 April 2005) 1.

[64] A Maschio, Reply of the patent proprietor to the notices of opposition, 'Opposition to European Patent No EP-1 069 819-B1 (formerly Appl No 99915885.8) Plant Bioscience Limited' (21 November 2003) 8.

[65] T Kania, 'Minutes of the Oral Proceedings before the Opposition Division' (17 April 2004); J Puonti-Kaerlas, 'Minutes of the Oral Proceedings before the Opposition Division' (3 April 2006).

[66] ibid.

[67] European Patent Office, 'All Documents: EP1069819' European Patent Register https://register.epo.org/application?number=EP99915886&lng=en&tab=doclist (accessed 21 February 2022) (43 *amicus* briefs); European Patent Office, 'All Documents: EP1211926' European Patent Register) https://

the EBA focused on the meaning and implications of Article 53(2) EPC and of rule 26(5) of the EPC, which defines the terms of the EPC and states that 'A process for the production of plants or animals is essentially biological if it consists entirely of natural phenomena such as crossing or selection'[68] but remains silent on whether an additional technical step would in turn confer a technical nature on the same process. The patent holders and some *amicus* writers argued that what the EPC authors had in mind was to exclude only plant varieties and their production from patent protection, rather than plants and plant breeding in general. They pointed to the drafting history of the EPC, in which the first exemptions referred to 'plant varieties' rather than 'plants', and claimed that this showed the authors only intended to carve out a narrow exemption. Given the lack of historical evidence for such an intention, the EBA rejected this view, interpreting the article as applying to all plant-breeding processes.[69]

The main challenge faced by the EBA was to situate the 'essentially biological' between the poles of 'all or nothing'; that is, the idea that any technical step in a process automatically rendered the whole process technical or, conversely, that even a single biological step within a process exempted it from patentability altogether.[70] In this decision, the EBA argued that there are technical elements that in the spirit of the EPC should be considered accidental to the breeding process or the plant that results from it (such as greenhouses, scissors for cutting branches, or molecular markers), whereas other technical elements and steps are central to it because their effects could not occur in nature, without human intervention.[71] The EBA concluded that it was the plants, their genomes, and the process of meiosis in sexual reproduction that determined the outcomes of an essentially biological process and not human ingenuity and control.[72] The EBA argued that the opposite was the case where human intervention did not occur before or after but during reproduction.[73]

register.epo.org/application?number=EP00940724&lng=en&tab=doclist (accessed 21 February 2022) (180 *amicus* briefs).

[68] EPC 2000, r 26(5).

[69] G 2/7 (EPO 2010) 52.

[70] ibid 55, 60. The 'technical' character of an invention is of special importance to the EPC, especially because of the German version of EPC 2000, art 52(1). Although German has 'Technologie' as a cognate to English 'technology', German patent law prefers *Technik* when referring to the realm of patentable subject matter. The doctrine that inventions refer to 'technical teachings' (*technische Lehren*) was first put forward by the German Federal Court in *Rote Taube*: see n 57.

[71] The board refers to the early drafts of the EPC from 1961 here, in which 'purely' was changed to 'essentially,' and argues that it was knowledge of such auxiliary breeding technologies that prompted the authors of the convention to do so. See G 2/7 (EPO 2010) 64.

[72] ibid 66.

[73] The Enlarged Board of Appeal justified this stance with the existence of EPC 2000, R 27(c), which explicitly mentions technical or microbiological steps as qualifying elements for patent eligibility of biotechnological inventions. See G 2/7 (EPO 2010) 68.

The 'biological', as construed here, can neither be fully subsumed under nature nor under human intervention. Although, as the EBA noted, recombination and selection are natural processes, the exclusion of biology in the case of plant breeding cannot be reduced to crossing and selection in the wild without human intervention, as it would render the provisions of the EPC irrelevant because such processes would never qualify for patent protection in the first place. To the contrary, the judges noted that recombination and selection in the nursery always take place under a regime of human intervention.[74] At the same time, as they pointed out, the results of the breeding process cannot fully be attributed to human intervention, as the mixing of whole genomes is unpredictable and can only be sorted out through subsequent reiterative selection. The 'biological' in the EBA's reasoning is best understood as a third instance, neither simply 'out there' nor invented, but instead creative in its own right. Curiously, however, the EBA remained silent on the status of plants resulting from essentially biological processes. If the latter were unpatentable, did that also extend to the former?

## Of Products and Processes: Delimiting an Exemption

After the first ruling by the Enlarged Board of Appeal, both patents were amended and all process claims dropped by the applicants. As it was still unclear whether Article 53(b) of the EPC only had implications for processes, or conversely, if patent protection for conventionally bred plants rendered the process exemption meaningless, the cases were again referred to the Enlarged Board of Appeal for clarification in May 2012 (*Tomatoes II*) and July 2013 (*Broccoli II*).[75] The Technical Board put forward four questions with regard to the patents, asking whether the exclusion of breeding processes could have a negative effect on the patentability of conventionally bred plants and whether such plants were patentable as product-by-process—even if the process as a whole or in part was biological and it was the only way to obtain such a plant.[76] Benoît Batistelli, then president of the EPO, was asked by the Enlarged Board to give his opinion on these questions and strongly affirmed that conventionally bred plants should indeed be considered patentable.[77] Interestingly, he was joined in this opinion not only by the patent proprietors

[74] G 2/7 (EPO 2010) 39.

[75] Although the Technical Board of Appeal, following *Transgenic Plant/Novartis*, considered plants and plant parts patentable in general (hence not touching upon the 'variety' provision of art 53(2)), the key difference here rested on the fact that the tomatoes and the broccoli had been obtained only by conventional, non-biotechnological reproductive techniques. See G 2/7 (EPO 2010) 9–10.

[76] The first referral (*Tomatoes*) included three questions, which the Technical Board expanded to four in its referral of *Broccoli* a year later. See G 2/13 (EPO 2015) 3, 12.

[77] B Batistelli, 'Case G 2/12: Invitation to Comment under Article 9 of the Rules of Procedure' (28 November 2012); B Batistelli, 'Case G 2/13: Invitation to Comment under Article 9 of the Rules of Procedure' (21 November 2013).

and dozens of *amicus* authors, but also by the opponents to the *Broccoli* patent, Syngenta and Limagrain.[78]

After joining both cases into *Broccoli/Tomatoes II*, the Enlarged Board of Appeal eventually sided with the proponents of patent protection for conventionally bred plants. The EBA concluded that there was nothing in the EPC (or elsewhere) that would preclude the EPO from issuing such patents. It thus read the exclusion for essentially biological processes narrowly and drew a clear line between processes on the one hand and products on the other, despite considerable criticism and demands to the contrary from outside the court.[79] While the EBA acknowledged the existence of 'various ethical, social and economic aspects in the general debate',[80] it refrained from engaging with them, pointing out that 'considering such general arguments in the present referrals did not fall under the judicial decision-making powers of the enlarged board'.[81] Instead, it focused on the letter of the applicable law, an approach that led Axel Metzger, pre-eminent commentator on plant IP law in Germany, to speak of '[l]egal [p]ositivists at [w]ork'.[82] Beyond the court chamber, it was indeed difficult to explain why breeding processes should be exempt, yet the plants produced by such processes to be perfectly patentable.

However, this was not entirely the Enlarged Board's decision. During the drafting of the EPC, there was, as the EBA pointed out in its 2010 decision, a strong intention to keep patent law and PVP separate. At the time, varieties were the only manifestation of plants that had a legal status in Europe and, seven years before *Diamond v Chakrabarty*, the patenting of organisms was not on anyone's mind. Hence, it was only breeding processes that were explicitly exempt from patent eligibility, and so there was in practice no interference between patent and PVP law. When in the 1980s the European Community (later Union) sought to stimulate research and development in biotechnology and create a domestic industry in that field, there was a clear interest in granting patent protection for transgenic plants, a technology then expected to revolutionize agriculture. Although the legislative process started in 1988, it would take ten years to pass the final Biotechnology Directive 98/44/EC.

[78] G 2/13 (EPO 2015) 23. Limagrain, however, added that a breeders' exemption similar to UPOV would be desirable for patents on native traits. Unilever had at that point withdrawn its appeal. For the possible motives of plant biotech and conventional breeding companies to endorse and pursue patents see Braun (n 4).

[79] Some European legislators, such as the Dutch and the German parliaments, had already moved towards excluding conventionally bred plants from patent eligibility in their national patent laws. See Timo Minssen and Ana Nordberg, 'The Impact of "Broccoli II" and "Tomatoes II" on European Patents in Conventional Breeding, GMOs, and Synthetic Biology: The Grand Finale of a Juicy Patents Tale?' (2015) 34 *Biotechnology Law Report* 81; Parthasarathy (n 1) 183.

[80] G 2/13 (EPO 2015) 63.

[81] ibid 64.

[82] Axel Metzger, 'Patents on Tomatoes and Broccoli: Legal Positivists at Work' (2016) 47 *IIC—International Review of Intellectual Property and Competition Law* 515.

Many of the issues that slowed down the drafting and adoption of the directive were ethical concerns over the patenting of life forms, especially in 'red' (ie medical) biotechnology.[83] However, in the field of plant breeding, the foreseeable clash between the exclusions afforded by patent protection and the liberal breeders' exemption, which allowed companies to use any commercial variety for breeding, prompted economic rather than ethical concerns among the plant-breeding industry. Since the right to exclude competitors in patent law is limited by the breeders' exemption, the existence of a commercial variety with a transgenic trait such as herbicide tolerance would have rendered either one or the other meaningless. The Biotechnology Directive sought to remedy this by limiting patent protection to traits that were not restricted to one variety and by offering the possibility of compulsory licences if inventors or breeders found that they could not practise their business without infringing on others' variety titles or patents.[84] In practice, however, the requirements for a compulsory licence are high and they are costly and uncertain to obtain.[85]

Thus, what stopped patent and PVP law and new and old plant-breeding companies from clashing was not so much the legal provisions of European patent law, but the political death of agricultural biotechnology on the continent. From the early 2000s onwards, first consumers, then supermarkets, farmers, and politicians turned their backs on genetic engineering. With skyrocketing regulatory costs and no market for biotechnological traits, they could no longer interfere with the free cross-breeding of varieties as practised by breeders.[86] Yet the architecture of European plant patent law remained in place, disproportionately favouring patents on traits over titles on plant varieties. What *Tomatoes/Broccoli* did was to lay bare the latent conflict between the two forms of IP. The exemption of PVP from the patent framework carved out in the 1990s was very limited. It froze the status quo of PVP law and laid the groundwork for a further extension of patent law to new subject matters.[87] What the Enlarged Board of Appeal did in *Tomatoes/Broccoli II* was to read the spirit of the 1990s into the matter, concluding that wherever legislators had failed to put a clear stop to the expansion of patent law, they had at least implicitly approved of it. By seeking to refrain from practising politics, the board had simply reproduced the politics baked into the 1998 directive.

[83] Parthasarathy (n 1).

[84] Directive 98/44/EC of the European Parliament and of the Council of 6 July 1998 on the legal protection of biotechnological inventions [1998] OJ L 213/13, art 12(1–3).

[85] A breeder or inventor needs to apply for a regular licence first and, after failing, has to demonstrate that 'the plant variety or the invention constitutes significant technical progress of considerable economic interest compared with the invention claimed in the patent or the protected plant variety'. See Directive 98/44/EC (n 84) art 12(3). As variety breeders are much more dependent on a licence than inventors, the directive puts the former at a disadvantage. See Girard (n 14).

[86] Sanderson (n 45) 81; Braun (n 14).

[87] See Eisenberg (n 21) for a discussion of patent law and its transformation from an IP right for specific industries into a general regime expanding into ever-new fields of technology.

In doing so, however, the board had misread that things had changed since the 1990s. The European public and politicians had become suspicious of plant patents, viewing them as instruments for the business interests of powerful biotech multinationals.[88] Conventional breeders, once excited about the possibilities of new molecular tools, now faced the threat of increasing transaction costs for obtaining licences and entering into patenting themselves, without the prospect of benefiting from a new technology.[89] Although technically the last word on the matter, the Enlarged Board of Appeal's ruling became more and more untenable in the aftermath of the decision. Plant breeders' associations and members of the EU Parliament pushed for exemptions for conventional plants in national and European patent law. The EU Commission was called upon to clarify that no one had originally intended to grant patents for conventionally bred plants. In 2017, the president of the EPO, abandoning his earlier stance on the matter, took the Commission's clarification as cause for introducing a new rule to the implementing regulations of the patent convention, stating that no patents should henceforth be granted for plants obtained by essentially biological processes.[90]

This step would prove problematic for several reasons. First, there was now a divide within the EPO, with the president on one side and the boards of appeal on the other. Secondly, while the EPO's president is in charge of executive matters and implementing regulations, the Enlarged Board of Appeal is its highest juridical authority in interpreting the EPC. Lastly, the 'change of mind' had come about through political rather than legislative means. The Commission had given (unsolicited) legal advice to a non-EU entity (the EPO) on a directive created by the Council and the Parliament some twenty years earlier. Unsurprisingly, the case entered another round, this time under the title *Pepper*. Syngenta filed an appeal to the Technical Board of Appeal, this time demanding that one of its applications on a bell-pepper plant rejected under the new rule be re-examined. Citing the Enlarged Board's decision in *Tomato/Broccoli II*, the Technical Board of Appeal sided with Syngenta in late 2018 and ruled that the former's interpretation of the European Patent Convention trumped the presidential office's implementing regulations.[91] The new president of the EPO, António Campinos, again requested an authoritative interpretation from the Enlarged Board of Appeal, which seized the opportunity to declare the new rule valid in May 2020.[92] After more than two decades, the question raised by two inconspicuous vegetable patent applications was finally answered—for now.

[88] See Daniel Charles, *Lords of the Harvest: Biotech, Big Money, and the Future of Food* (Perseus Books Group 2001); Bernhard Gill, *Streitfall Natur: Weltbilder in Technik—und Umweltkonflikten* (Westdeutscher Verlag 2003); Jasanoff (n 8).

[89] Braun (n 14).

[90] EPC 2000, r 28(2).

[91] T 1063/18 (EPO 2018).

[92] G 3/19 (EPO 2020).

## Conclusion: Biology and After

At first sight, little remains of *Tomatoes/Broccoli*, other than the status quo and 'common sense' with respect to conventionally bred plants being reinstated. Yet two things are worth noting about the series of cases and decisions that came in its wake. First, the question of what was 'essentially biological' was opened by the EPO in order to answer questions it had inherited from the biotech revolution of the 1990s, but subsequently took on a life of its own. Just as patent law had redefined life in the 1980s and 1990s, biotechnology redefined the boundaries between old and new plant-breeding industries and their practices. In addition, the 'old' plant-breeding industry had changed too, with traits gaining in importance compared with varieties.[93] The attempts by the Enlarged Board to discern the meaning of 'essentially biological' at the end of the 1990s or calls by plant-breeding associations to return to the legal status quo before *Tomatoes/Broccoli* were thus understandable but ultimately futile. Even if the EPO, much to the dismay of some constitutional scholars, patent lawyers, and plant-breeding institutes dependent on patent royalties, eventually relented following pressure from politics, the economic and political consensus of 1961, 1973, or 1998 could not be revived.

This leads to my second point. In *Tomatoes/Broccoli I*, the Enlarged Board of Appeal went to great lengths to arrive at an understanding of biology that was compatible with patent law. At the same time, it showed a deep sense of the historical shifts that plant breeding had undergone over the past half century, from glasshouses to molecular markers. What if, instead of seeking simply to re-enact the status quo of the late twentieth century, the board had pursued the same sensibility in *Tomatoes/Broccoli II*? While the Enlarged Board's wish to limit itself to legal questions is understandable, staying out of politics, ethics, and economics is not the same as staying out of biology, as its earlier ruling had demonstrated. What the board risked in sticking to the letter of the law was not only an eventual loss of face at having to bow to political pressure; it also risked losing sight of the conflicts and contradictions resulting from a biology infused with law and economics. Legally, the reaffirmation of 'biology' in *Tomatoes/Broccoli II* thus enshrines a form of post-war plant breeding whose practices, tools, and plants have changed considerably over the past decades.[94]

The blame would be misplaced if laid solely on the Enlarged Board of Appeal. The focus on 'biology', rather than 'nature' or 'life' made it difficult for activists and groups critical of life science patents to intervene, as their usual critiques

[93] Veit Braun, 'Die Neuerfindung Des Rades? Zur Rolle Der Innovation in Der Bioökonomie' in Lukas Fehr and Reinhard Johler (eds), *Bioökonomie(n). Ethnografische Forschungszugänge und Felder* (TVV-Verlag 2021).

[94] Sanderson (n 45) 81; Braun (n 14).

and arguments hardly resonated with the matters discussed in court.[95] Actors with much more political space for manoeuvre, such as the breeders' associations and legislators, did little more than press for a return to the status quo during the twenty years of *Tomatoes/Broccoli*. Proposals that acknowledged the shifting realities of plant breeding, calling for a harmonization rather than separation of patent and PVP law, were few and far between.[96] There is a general pessimism within the European plant-breeding industry that plant patent law can be reformed. Plant-breeding associations fear that any attempt to facilitate access to patented traits and to waive the right to exclude for native trait patents would be read as attempts to undermine biopatents as a whole. They would be met with considerable resistance by more powerful industries. As such, the sector pursued the path of least resistance and the reaffirmation of the consensus reached in the Biotechnology Directive.[97]

This attitude is understandable. But is it tenable? With the advent of new molecular tools for plant breeding, the demarcation line between the biological and technical is once again up for debate. Plant-breeding companies are eager to use molecular techniques such as gene editing to breed plants faster and cheaper, yet there is no clear idea as to how this desire can be squared with the idea of a separation of PVP and patent law. In order to maintain the status quo so acrimoniously defended in *Tomatoes/Broccoli I* and *II*, the European plant-breeding industry would have to stay 'clean', or rather 'essentially biological'. Already, European plant breeders' wish to do business as usual is being undermined by their hope of transcending the limits of traditional breeding techniques and the proliferation of gene-edited seeds elsewhere in the world.[98] This is reminiscent of the late 1990s, when the sector endorsed genetic engineering despite the negative consequences that

[95] Viola Prifti, 'Die Rolle Des Öffentlichen Interesses an Pflanzenpatenten: Eine Europäische Perspektive' in Barbara Brandl and Stephan Schleissing (eds), *Biopatente* (Nomos 2016); Parthsarathy (n 1) 182.

[96] The greatest exception here is certainly the ILP Vegetable, a clearinghouse initiated by Michael Kock, then head of IP at Syngenta and the company's representative in the *Broccoli* appeal. The initiative seeks to remedy the shortcomings of European patent law through contract law and elaborate arbitration mechanisms and is regarded as a model for similar platforms in field crops. See Michael A Kock and Floris ten Have, 'The "International Licensing Platform—Vegetables": A Prototype of a Patent Clearing House in the Life Science Industry' (2016) 11 *Journal of Intellectual Property Law & Practice* 496; Geertrui Van Overwalle, 'Patent Pools and Clearinghouses in the Life Sciences: Back to the Future' in Duncan Matthews and Herbert Zech (eds), *Research Handbook on Intellectual Property and the Life Sciences* (Edward Elgar Publishing 2017). Limagrain's endorsement of conventional plant patents, combined with its simultaneous calls for a facilitated compulsory licence system in *Tomatoes/Broccoli II*, can be read along the same lines. Girard (n 14) provides a critical perspective on the ILP.

[97] Braun (n 4). The *Tomatoes/Broccoli II* ruling has since been followed by Mexico's national IP office, which issued a similar regulation regarding conventionally bred plants: Corina Silva, 'Mexico: New Hurdles for Plant Rights Owners' *Life Sciences Intellectual Property Review* (23 September 2021) https://www.lifesciencesipreview.com/contributed-article/mexico-new-hurdles-for-plant-rights-owners (accessed 28 July 2022).

[98] Michael A Kock, 'Open Intellectual Property Models for Plant Innovations in the Context of New Breeding Technologies' (2021) 11 *Agronomy* 1218.

patent law had had on the North American seed market.[99] Back then, the European sector was 'saved' by the political failure of agricultural biotechnology and consumers' disavowal, which rendered the collision of PVP and patents a purely theoretical scenario. Whether molecular technologies will sail under the radar of public scepticism or trigger it once more is difficult to tell at this point. But what is already clear is that the issues and contradictions debated in *Tomatoes/Broccoli I* and *II* are bound to resurface once gene editing and other molecular technologies are adopted by plant breeders.

Disregarding political and economic considerations about the effects of patent protection on the legal side, only to push them through in a haphazard, semi-legislative, semi-judicial process is unlikely to make these two forms match. Whereas 'nature' almost automatically conjures—albeit in an often crude juxtaposition between the few and the many— matters of distribution, access, and political economy, 'biology' does not come with the same ability. What is at stake instead is a rather technical question of which types of forces and elements contribute to an organism and whether it can be reproduced without relying on that organism itself. Similarly, where 'life' brings into question the applicability and legitimacy of patents on organisms as such, 'biology' can at best modify the universal claim of patent law to all practices and objects of innovation. European patent legislators did not exempt conventionally bred plants from patent protection because they considered IP's idea of ownership as being at odds with the dignity of life, but because patent law historically had difficulty applying some of its assumptions to them and because the plant-breeding industry could rely on other ways of claiming IP in living beings.

And yet, although 'biology' has, as argued here, become problematic again, *Tomatoes/Broccoli I* and *II* also demonstrate its usefulness. Unlike 'nature', which mostly denotes an abstract realm predating human interference, 'biology' can in fact be meaningfully employed and upheld as a concept in the vicinity of technicity and invention, as the Enlarged Board of Appeal demonstrated in its 2010 ruling. In delimiting the boundaries of 'biology', it also pointed to the limits of 'technology', two concepts that in the field of plant breeding should best be understood as going hand-in-hand, not separately. In this regard, 'biology' seems to be more productive than the battles over 'nature' and 'life' that haunted public debate over biopatents in the 1990s and 2000s. As Hannah Landecker so aptly remarks, there is not only a history of biology (a genealogy and trajectory science), but also a biology of history (a material force entering into the politics of its time).[100] At the heart of *Tomatoes/Broccoli I* and *II* is not a shifting understanding of biology but rather a shifting

[99] Piet Schenkelaars, Huib de Vriend, and Nicholas Kalatzaidonakes, 'Drivers of Consolidation in the Seed Industry and Its Consequences for Innovation' (COGEM 2011).

[100] Hannah Landecker, *Culturing Life: How Cells Became Technologies* (Harvard University Press 2007).

biology, which undermines established notions of what is biological and technical, bred and invented in the wake of new biotechnologies, changing ways of breeding plants, and novel techniques that enter into the relationship of humans and plants. If there is anything to learn from these two cases, it is that 'biology' is not a fixed realm to look to in search for ethical, political, or legal clarity, but a standing call to critically re-examine our relationship with our organic others, time and again.