Taxonomy, Race Science, and Mexican Maize

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Abstract: This paper explores the intersection of race science and plant taxonomy in the creation of evolutionary taxonomies (phylogenies) of populations of *Zea mays*, also known as maize or corn. Following recent work in the history and sociology of race, it analyzes maize taxonomy as technology. Through an analysis of successive attempts to classify diverse maize varieties, especially those originating in Mexico, it shows that taxonomy created possibilities for researchers to intervene in commercial agriculture, state development projects, biological conservation, and domestic and international politics and policy. It further underscores that the modern science of maize taxonomy was distinct but never inseparable from assessments of maize's human cultivators. Attending to particularities of this relationship is crucial, because it reveals the application of maize taxonomy as a technology for ordering human diversity, and intervening in human lives, as well as managing the impressive diversity of *Zea mays*.

Many scholars have grappled with the histories of race and race science. An early narrative arc in the historiography of race traced its invention as a way of understanding human difference in Enlightenment Europe to its rejection by scientists as a category devoid of biological meaning after World War II.[1] Historians and other scholars have subsequently demonstrated the tenacious hold of race in biological and biomedical science, in everything from disease treatments to genomic databases.[2] They have also developed varied culture-, time- and place-specific accounts, which consider factors that shaped local or national variants of race science and thought. Latin America has been a particularly fruitful site for such accounts, perhaps as a result of what Peter Wade and his colleagues characterize as the "deep-rooted ambiguity" of race in Latin America, where today this is often both "erased and denied, and yet present in an everyday sense."[3] Scholars of science and

technology in Latin America have also been among the most persuasive contributors to the literature that reveals how racial thinking still informs human biological research, especially studies of population diversity, even as its biological reality is rejected. As they show, human race science has certainly not disappeared, despite some claims to the contrary.[4]

Taxonomy, the science of classifying living things, has also had its historians—though perhaps not as many—and has similarly attracted incorrect assertions that it is a dead or dying enterprise.[5] Modern taxonomy traces its intellectual roots to the same starting point as human race science: the sweeping classification project of the eighteenth-century Swedish botanist Carl Linnaeus.[6] The historiography of taxonomy (and the linked enterprise of systematics, which studies the relationships among groups of organisms) has at times suggested a rising trajectory into the nineteenth century and a subsequent decline. The decline is not attributed to its basis in a false idea, as with human race science, but instead taxonomy's being sidelined in favor of new areas of biological investigation.[7] Historians and sociologists of science have charted the succession of techniques and technologies that transformed taxonomy and systematics over time while the goals of carving up the natural world into defensible categories and teasing out the relationships among these remained the same.[8] In tracing their application to new social concerns and adoption of cutting edge technologies, scholars have also shown these to remain lively sciences in the twenty-first century.[9]

In this paper I explore a project at the intersection of race science and taxonomy: the creation of evolutionary taxonomies (phylogenies) of the races of *Zea mays*, also known as maize or corn, in Mexico. Since the 1940s, with little modification, plant scientists have identified a race of maize as "a group of related individuals with enough characteristics in common to permit their recognition as a group."[10] In contemporary maize biology, the category of race is distinct from that of landrace. The latter label typically refers to a locally adapted and recognized variety that is created and maintained through farmers' seed selection. A race encompasses a number of landraces and, depending on the race in question, may also include cultivated varieties developed by breeders.[11] In Mexico, the place of origin of domesticated maize, researchers have identified fifty-nine races, or *razas*, of maize.[12] Novel applications of genetic and genomic analysis have promised more exact determination of the number of races and their relationships, but the limitations of collections, extent of continued genetic mixing in maize, and contradictory results produced by different techniques suggest that this taxonomy will remain open to revision.[13]

My account of maize taxonomy traverses eighty years of research into the deep history and present extent of diversity of *Zea mays* in Mexico. As with others engaged in taxonomy and systematics in the twentieth-century, researchers who studied maize diversity relied on a changing repertoire of methods and tools, from the observation of morphological characteristics in the field to the study of chromosomes in the laboratory to the tallying of molecular markers *in silico*.[14] However, I find other transformations to be of greater interest, in particular the changing applications of the same taxonomic project across different institutional contexts and successive generations of researchers. Instead of looking at technologies *in* taxonomy, therefore, I consider taxonomy *as* technology. As I show, since the 1940s, the designation of races of maize in Mexico has created possibilities for researchers to intervene in commercial agriculture, state development projects, biological conservation, and domestic and international politics and policy. Understanding these varied uses of the races of maize reveals heterogeneity of purpose within a research program ostensibly unified around a single aim. This in turn explains how a project that should be doubly doomed, by dint of its being both racial (and therefore premised on a

deeply troubled biological concept) and taxonomic (and therefore too old fashioned to continue as cutting-edge science), not only survives but thrives.

My approach aligns with current scholarship on race and race science that interrogates race as technology. In discussing this analytic, the media studies scholar Wendy Hui Kyong Chun emphasizes that seeing "race as technology shifts the focus from the *what* of race to the *how* of race, from *knowing* race to *doing* race." In this framework, writing the history of race is not about revealing the historical construction of racial categories (thereby questioning their basis in biological fact) but examining the work these categories have done, and still do. It is, Chun writes, "an analysis of race's utility, regardless of its alleged essence."[15] The historian of science Staffan Müller-Wille similarly urges scholars of race to consider its history as a tool, one used to order or effect change in the world.[16] Taxonomists, and historians who have studied them, are well aware that systematic classifications do work, for example in advancing or foreclosing possibilities for species conservation.[17] However, in the case of maize taxonomy, the comparison to human race science is also apt, because races of maize have been used to organize and manage human as well as plant diversity.[18] To phrase this another way: the elaboration of races of maize has at times instrumentalized ideas about human races. As such, this work shares in the history of (human) race as technology.

This connection is, perhaps obviously, a consequence of the status of *Zea mays* as an agricultural crop, in this case a species whose entire evolutionary history is predicated on human intervention. It is itself profoundly technological in nature, in a way that wild species, and even some domesticates, are not.[19] To talk about maize is therefore always to talk about people. Despite this entanglement, there are reasons to consider the race sciences of each separately. The anthropologist John Hartigan, Jr. points to the 600-year history of distinguishing breeds of plants and animals as *razas* in his study of the contemporary project of analyzing races of *razas de maíz* (races of maize) in Mexico, and suggests this is one reason to maintain analytical distance between maize *razas* and human *razas*.[20] This acknowledgement of the long and (mostly) distinct history of the idea of *razas* as applied to plants and animals in European and subsequently Mexican culture is appropriate. It is also potentially misleading, in part because Hartigan's account does not include the mid-twentieth-century development of maize taxonomy. As I show through an analysis of four episodes in the history of efforts to classify the maize of Mexico, the modern science of maize taxonomy was distinct but never inseparable from assessments of maize's human cultivators. Attending to particularities of this relationship is crucial, because it reveals the application of maize taxonomy as a technology for ordering human diversity, and human lives, as well as the impressive diversity of *Zea mays*.

The Origins of a Race Science

Contemporary maize systematics—delineating races of maize and the relationships among these—has its roots in the work of the American botanist Edgar Anderson. Trained at Harvard University's Bussey Institution in the late 1910s and early 1920s, Anderson spent most of his career after 1922 at the Missouri Botanical Garden. He integrated various subfields of biological research in his botanical investigations, including genetics, morphology, physiology, and taxonomy. His proclivity for synthesis was especially evident in his use of population data and genetic thinking to improve taxonomic categorization.[21] In 1941 Anderson began an ambitious taxonomic project on maize, then (as now) the leading economic crop of United States. This research ultimately sustained his interest for more than two decades.[22] The topic posed difficult and absorbing genetic and evolutionary

puzzles for a botanist, but, as Anderson readily acknowledged, it was equally inspired by the demands of commercial corn production. It also encouraged Anderson to see the human sciences as an essential resource: among the many fields on which his early maize research drew, physical anthropology and studies of human race featured prominently. I elaborate on these aspects of Anderson's maize research here, to demonstrate that modern maize taxonomy gelled amidst specific technological ambitions and human racial ideas.

Anderson launched his maize research already boasting significant experience in the genetics and evolution of both wild plants and domesticated crops. As a graduate student working under Edward East, he had studied hybridization among *Nicotiana* (flowering tobacco) species. East is often remembered for his contributions to the study of hybrid vigor in maize and its application in corn breeding, and several of the students who gathered around him during Anderson's graduate years went on to become prominent maize experts. Initially, Anderson was not one of them. Instead, after arriving at the Missouri Botanic Garden in 1922, he turned to the genetics and evolution of the wildflower *Iris versicolor*; a decade later, he began applying techniques and ideas developed in the *Iris* research to the genus *Tradescantia*, the spiderworts. In both areas of research, he sought (among other things) to understand hybridization under "natural conditions" and the role it played in speciation—and therefore its importance to taxonomic analyses.[23]

What prompted Anderson to take a similar set of research interests to maize? One spur was the 1939 publication of a theory of origin for *Zea mays*, co-authored by his graduate school roommate, the botanist Paul Mangelsdorf.[24] Anderson felt too little was known about maize and its relatives to determine with confidence their origins and history as Mangelsdorf claimed he had done; in Anderson's opinion, a thorough taxonomic analysis was needed to point the way.[25] An additional motivation came from the imperatives of maize breeding. Although as "Geneticist to the Garden" he had landed a job that did not demand an agricultural focus (unlike his many of his Harvard classmates now working at state experiment stations), Anderson had nonetheless forged an association that encouraged it. From the late 1930s onward, he carried on an informal partnership with the country's first hybrid corn seed outfit, Pioneer Hi-Bred Corn Company. For years, he regularly drove north to Iowa to talk with Pioneer breeders and look at their corn, and in exchange Pioneer occasionally provided Anderson and his students with research funds and technical support.[26]

As a geneticist with interest in population dynamics, it was a unique moment to turn to the study of maize. Farmers of the US Corn Belt were in the midst of a mass transition from open-pollinated to hybrid maize, swapping out freely interbreeding (that is, open-pollinated) populations for ones created through the controlled crossing of multiple inbred lines. Anderson described this transition in 1944: "In terms of gene combinations and their distributions, the whole genetic pattern of *Zea Mays* in the United States has been catastrophically overhauled in the last two decades." He was convinced that understanding this new "genetic pattern"—an appreciation that depended in part of reconstruction of what had come before it—would be essential for the future of corn breeding.[27] For example, as he became more familiar with the recombinations of distinct maize populations that had produced the preferred corn type of the US Midwest—"Corn Belt Dent"—he made a case that a sound evolutionary taxonomy would provide a guide to breeders hoping to create similarly productive combinations in the future.[28] In short, Anderson saw his genetic and taxonomic investigations as immediately relevant to corn breeders' decisions about what kinds of maize to combine to achieve specific breeding goals.[29]

At the time Anderson launched his maize research, the immense morphological diversity of *Zea mays* was only just beginning to be charted by scientists in the United States and Europe. Plant hunters who travelled to Mexico, Guatemala, Peru, Brazil, and other Latin American countries in the 1920s and 30s regularly identified locally adapted varieties (landraces) they considered novel. In the early 1940s, as his maize project got underway, Anderson attempted to gather as much of this diversity as he could. He collected specimens of maize varieties from the US, Mexico, and Guatemala from colleagues and through his own travels; he also had access to the extensive maize herbarium of E. Lewis Sturtevant, an agronomist whose 1899 maize classification system, based chiefly on kernel type, was a prime target of Anderson's revised approach.[30]

Anderson wanted to impose order on the barrage of morphological diversity apparent in collections of maize varieties like his own. As distinct types of a single domesticated species, these specimens demanded intraspecies classification to an extent rarely broached in botanists' taxonomies of wild species. Anderson did have experience in distinguishing among "races"—a category that designated distinct subpopulations that did not possess the taxonomic rank of species—in his studies of flowering plants.[31] However, when it came to his maize work, he looked elsewhere for inspiration. One place he found it was in studies of human race. "The problem of races and their recognition is indeed almost the same in *Zea Mays* as in mankind," he wrote with a collaborator, the plant explorer and ethnobotanist Hugh Cutler.[32] In the early 1940s, Anderson and Cutler engaged with the human race science of preceding decades in developing a "natural" classification system for maize based on its evolutionary history. In search of instruction in how to divide a freely interbreeding species into subpopulations, they studied the methods and definitions used by physical anthropologists such as Earnest Hooton and Carleton Coon for determining racial groupings among human populations.[33] Hooton's racial studies provided a model of the measurement and statistical analyses of multiple non-adaptive characteristics in order to accurately aggregate humans into groups of common descent.[34] Meanwhile Coon's *Races of Europe* outlined the need for flexibility rather than certainty in bounding human populations as races, an approach that resonated with Anderson and Cutler's observation of the challenges confronting them with respect to maize.[35]

The precedent for delineating races in physical anthropology also provided a handy way for Anderson and Cutler to explain this program of research to others. In their study of "Races of *Zea mays*" they explained the difference between "natural" and "artificial" methods of classification of corn and their usefulness by reference to human classification. The earlier artificial system of classifying corn by kernel texture and color was like trying to classify people based on hair color alone. As Anderson and Cutler warned, "Such a classification would be rapid and complete and would, to a certain extent, group like peoples together, but it would separate a black-haired Norwegian from his fair-haired relatives and put him in the same class with Sicilians and gypsies."[36] They suggested that the classificatory methods of physical anthropology offered a means of arriving at a "natural" categorization that would better differentiate among types. The main obstacle to this approach was assembling sufficient data. "It is as though the physical anthropologist were called upon to classify the races of man with no published data except those concerning eye color and hair color," Anderson lamented in drafting a subsequent classification study.[37]

In his collaboration with Cutler and later analyses, Anderson advanced a method for classifying races of maize that relied on collecting measurements of a defined set of heritable morphological characteristics of individual maize plants constituting a single sample (for example, coming from one field or one farm). These he subjected to graphical

and statistical analyses, applying ideas developed in his earlier botanical research, in order to group them into subpopulations whose defining "complexes" of characteristics emerged from the analysis.[38]

Taking this approach with varieties he assembled from his own and others' collections, Anderson attempted to create a natural classification of Mexican maize types in the mid-1940s, first in conjunction with Cutler and later on his own. Through his measurements and analyses, he identified races whose genetic commonalities within-group suggested shared descent, while their distinctiveness to other types warranted demarcation. For example, corn typical to central Mexico with broad leaves, hairy leaf shanks, and shallow roots (among other qualities) he dubbed "Mexican Pyramidal" in light of its short, tapered ears. This form was easily contrasted to the typical form of the western part of the country, which had narrow leaves, smooth leaf shanks, and strong roots. Anderson called the latter "Mexican Narrow Ear." (Farmers in Mexico of course had their own names for these and other types of maize.) Anderson knew that his work was preliminary, not definitive, as he was aware of other types yet-to-be studied, and he no doubt entertained the possibility of those yet to be noticed by US and European researchers.[39]

Anderson envisioned the end goal of his "simple and fundamental work" of creating an evolutionary taxonomy of maize as providing "a broad but objective picture of *Zea Mays* as a whole."[40] Fundamental did not mean without application, however. Expanding the classification of Mexican maize types was essential, he insisted, because otherwise "[s]ome of the problems of commercial maize breeding in the United States... cannot be solved."[41] He appears to have thought this true in general. In his field studies of Guatemalan maize, Anderson noted that surveying the crop "systematically and comprehensively" across

Guatemala would lead to knowledge essential to better corn breeding in that country and also to the identification of "useful genes for modern corn-breeding" in the United States.[42] The business of breeding demanded the tool of taxonomy.

Taxonomy, in turn, both demanded knowledge of people and could be used to distinguish among them. As Anderson reflected in his studies of Guatemalan maize, "Maize is a sensitive mirror of the people who grow it. It is so highly heterozygous that good or bad management and careful or careless selection leave their imprints upon the character of the [maize] population... One cannot interpret population samples of maize efficiently without understanding as much as possible about the people who grew that maize."[43] As his accounts from Guatemala especially show, by the late 1940s the anthropological dimensions of his taxonomic thinking had expanded, from a borrowing of statistical methods to the incorporation of ethnographic field research. The insights of this research, moreover, seemed to teach him as much about types of people as about types of corn.

The Races of Maize in Mexico

In classifying maize, Anderson, Cutler, and their collaborators drew in part on methods and ideas forged in the study of human populations. As researchers developed these into maize-specific methods, and configured them still more explicitly as indispensable aids to breeding, they continued to align the projects of sorting maize and sorting peoples. This is especially evident in the first attempt at a country-wide taxonomic assessment of maize, the 1951 study *Razas de Maíz en México*. This ambitious effort to produce an evolutionary account of maize was nestled within a research program that shared in the Mexican government's ambitions for agricultural modernization and in an evolutionary national narrative that emphasized national progress through racial mixing, or *mestizaje*. As I show

through a discussion of *Razas de Maíz*, maize taxonomy in Mexico ultimately aligned with these narratives, asserting the possibility of racial improvement through population mixing, and pointing the way to the efficiency and productivity in agriculture that Mexican leaders desired.

In the 1940s, a key site for maize research in Mexico, and the place where the study *Razas de Maíz en México* was produced, was the Ministry of Agriculture's Office of Special Studies (*Oficina de Estudios Especiales*). This had been created as a cooperative agricultural research venture of the Rockefeller Foundation, a US-based philanthropy, and the Mexican government. It was tasked with enhancing agricultural productivity through research, especially breeders' development of "improved" crop varieties that would replace farmers' local types, understood to be inferior.[44] The origins of this program are often traced back to US geopolitical concerns, namely securing stable, productive neighbors friendly to US interests. However, agricultural change was also sought after and embraced by Mexican leaders and scientists, many of whom saw a need to align the country's agriculture with its hoped-for industrial trajectory. They believed that investment in science and technology would help Mexican farms produce more with less labor, feeding urban workers and creating new ones by "freeing" peasants from working the land.[45] In general, most foreign experts and Mexican agronomists agreed that achieving this goal entailed transforming the methods and varieties used by most farmers—especially those associated with cultivating Mexico's staple crop, maize.[46]

This vision had a significant human racial component, given that many peasant farmers in Mexico were identified as Indigenous—and that Indigenous inferiority had long been identified with the inferiority of maize and maize based diets.[47] In forging a new nationalist narrative in the 1920s, influential Mexican thinkers had rejected an earlier elite perspective that saw little room for Indigenous peoples—who constituted a large, visible, and diverse part of the national population—in a modernizing, Europeanizing Mexico. Many espoused *indigenismo*, celebrating Indigenous cultures (but focusing mostly on pre-Columbian attainments) and articulated a vision in which contemporary Indigenous peoples would be integrated into a unified *mestizo* nation. Through educational and economic programs, including agricultural extension, diverse Indigenous peoples would become loyal Mexicans.[48]

In this context, maize taxonomy was caught up in the application of racial ideas in the management of peoples. At the most fundamental level, the raw material and motivation for classification arose directly from the imperative of "improvement" in both crops and people. From its founding in 1943, staff associated with the Office of Special Studies had collected maize from farmers across the country, hoping to identify promising landraces as the bases of their breeding projects; within a few years, they had amassed some 2000 samples.[49] In 1948, this collection became the foundation of a classificatory effort along the lines pioneered by Anderson and Cutler. Mangelsdorf, who was a consultant to the Rockefeller Foundation and had been a co-architect of the Office of Special Studies' maize breeding program, explained to the head of the Mexican agricultural ministry that understanding the origins of contemporary maize varieties would inform breeders' selection of the initial lines for inbreeding and enable "a more intelligent combining of inbred strains" in making hybrids.[50] Mangelsdorf joined Edwin Wellhausen, the head of the maize breeding program, and Wellhausen's colleagues Lewis Roberts and Efraím Hernández Xolocotzi—plus more than a dozen Mexican agronomists, Vivian Wellhausen and Betty Roberts—in preparing the 1951 taxonomic study *Razas de Maíz en México*.[51] An English translation, *The Races of Maize in Mexico*, appeared in 1952.[52]

Razas de Maíz appeared to deliver on Mangelsdorf's promise that classification would be an aid to the breeding program. The contributing researchers gathered and parsed agronomic, morphological, cytological, and geographical data in order to group samples from the collection into twenty-five "more or less well-defined natural races."[53] Having produced what was, to their minds, a "natural classification" of Mexican maize types into races, they then proceeded to arrange the races in terms of their evolutionary relationships to one another, and to hypothesize their origins. Their evolutionary tree identified four major clusters of races: "Ancient Indigenous" (*Indígenas Antiguas*) races, which had arisen directly from a "primitive" corn in Mexico; "Pre-Columbian Exotic" (*Razas Exóticas Pre-Colombiana*) races, introduced from Central and South America; "Prehistoric Mestizo" (*Razas Mestizas Prehistóric*) races, the products of prehistoric hybridizations between Ancient Indigenous and Pre-Columbian Exotic races; and "Modern Incipient" (*Modernas Incipientes*), variable races that had "developed since the Conquest and which ha[d] not yet reached a state of racial stability." Recent origin was not a defect. On the contrary, the authors noted that *Celaya*, a landrace crucial to production in the *Bajío*, "Mexico's counterpart of the Corn Belt," was one of the "incipient" types.[54] As this suggests, the evolutionary taxonomy of maize provided a way to organize diversity and also to trace the origins of productivity in particular combinations—with the latter suggesting where further efforts to increase productivity ought to be directed.

The overarching evolutionary narrative of *Razas de Maíz en México* had still other advantages. It told a story of early, stable indigenous races, transformed by racial mixing with newly arriving populations from other geographical regions, giving rise to valuable new "incipient" but as-yet-unstable racial types. This seemed to fit the available data and might prove useful in breeding. It also aligned with Mexican racial politics. Under President

Manuel Ávila Camacho, the government's nationalist rhetoric continued to emphasize the integration of Indigenous communities into the social and economic life of the country. *Mestizaje* was one hoped for outcome of this integration process, and it was seen as contributing to a stronger, more unified nation: the integration and assimilation of Mexico's Indigenous peoples meant *their* improvement and in turn that of the country as a whole.[55] The account of maize's history produced at the Office of Special Studies dovetailed with this dominant narrative about human mixing in Mexico. It offered more than a simple parallel in evolutionary narratives, however. To the extent that the classifications would help maize breeders "improve" corn, as Mangelsdorf had suggested it would, it also was also a tool for enacting the evolutionary narrative imagined for humans, making "modern" farmers, and ultimately Mexican citizens, of Indigenous cultivators.

Indigenous Strains of Maize

A subsequent phase of maize taxonomy focused on classifying and conserving "indigenous strains" of maize in the Americas. In the 1950s, partly inspired by the publication of *Razas de Maíz en México* but equally driven by concerns about the future production of commercial maize, a group of American biologists (including Anderson, Cutler, and Mangelsdorf) organized a hemispheric collecting corn collecting and classification effort. This was overseen by a new Committee on Preservation of Indigenous Strains of Maize, created under the auspices of the US National Research Council. Its members maintained that the survival of local maize diversity, potentially valuable for breeding, was threatened by the industrialization of agricultural production. As the following analysis of the activities of this "Maize Committee" shows, its members recognized a connection between diversity in human groups and diversity in maize, but nonetheless sought to maintain a distinction

between the two. They wanted their taxonomic study to enable the conservation and management of "indigenous strains" without the labor or knowledge of Indigenous peoples. However, as more scientists came to participate in the project, especially some who worked closely with maize farmers in Latin America, this separation came under increasing scrutiny. Subsequent studies of races of maize contributed to a new appreciation of local and Indigenous knowledge, and ultimately to a transformation in conservation strategies.

The initial impetus for a hemispheric maize conservation initiative came to the National Research Council via Friedrich Brieger, a German-Jewish emigré geneticist working in Brazil. Brieger reported that the diverse corn varieties of Central and South America were rapidly vanishing. In ten years, there would be "practically nothing left of these strains." Corn varieties "developed in various civilized areas" had been brought into these regions and, according to Brieger, "the natives are taking to these strains and abandoning the ones they have grown for countless centuries."[56] In other words, as agricultural practices "modernized", the highly variable landraces of corn found in many places were disappearing, replaced by more uniform "improved" varieties. In response to this concern, the National Research Council supported the creation of the Committee on Preservation of Indigenous Strains of Maize, which in its initial phase mobilized collectors across the Americas to seek out "native" or "indigenous" corn varieties.[57]

As Brieger's analysis indicates, the work of the "Maize Committee" was motivated by a belief that Indigenous farmers in rural areas were moving inexorably toward the style of agriculture practiced in "civilized areas." In adopting this view, the committee recapitulated existing settler colonial narratives, declaring Indigenous peoples and their crops to be slated for inevitable extinction in light of the inexorable expansion of "superior" cultures.[58] The extinction of "indigenous strains" alone might not have been worrying to scientists, were it not for the genes of potential interest to biologists and breeders that were thought to exist in the maize varieties still cultivated by farmers across Latin America. As the Maize Committee described, the disappearance of these varieties would mean the loss of "essential raw material" ripe for scientific study and needed to continue enhancing the key economic crop of the United States.[59] Formulating their ideas amidst rising Cold War tensions, and especially new articulations among US policymakers of the national security threat posed by hungry populations worldwide, the Maize Committee also proposed conservation (and the future breeding it would enable) as tool in forestalling the destabilization of states across Latin America.[60]

What, exactly, did the Maize Committee hope to conserve, however? "Indigenous strains" proved to be a slippery object, an ostensibly botanical category that in practice was inflected by ideas about Indigenous peoples. On paper, the Maize Committee members typically interpreted the remit of "indigenous strains" as including all the landraces of maize grown in a country, leaving aside only commercial hybrids or very recently imported varieties. In this view, "indigenous" meant something like "originating in a particular area." On the ground, however, collectors often interpreted the task of collecting "indigenous strains" explicitly as collecting corn from Indigenous American communities. The collecting work carried out by Friedrich Brieger, the geneticist from Brazil whose correspondence had sparked the Maize Committee's formation, offers a useful illustration. Not only did he target Indigenous communities when collecting, he also consistently identified corn that he collected as coming from peoples and not just places. For example, in 1956 he offered the following categories to encompass all the material under examination at his laboratory in Piracicaba, Brazil: races of the Guaraní people, races of Humahuaca (a region in Argentina), races of the Kaingain people, races of the Calchaquí tribe (Diaguita people), and commercial

corn of the Paraguay-Paraná Basin.[61] The extent to which the Maize Committee prized collections made directly from Indigenous peoples was also evident in the United States and Canada. Here Committee members understood Native American farmers to be the only ones in possession of varieties of possible interest to the project. As a result, nearly all of their samples from these countries came from Native farmers or reproduced earlier collections of the same.[62]

The slippage in the Committee's use of "indigenous"—sometimes meaning "local" and sometimes "from Indigenous peoples"—to describe the varieties of greatest value to their mission produced various problems. This included induced blindness among collectors who fixated on finding farmers conforming to their ideas about "primitive" peoples.[63] It also rendered whole regions (such as the Caribbean) of lesser interest due, as one researcher put it, to the "mongrelization" of their maize amidst changing social conditions and especially social integration and human population mixing.[64] Confusion over the nature of a maize sample's status as "indigenous" also arose in relation to technical aspects of conservation. In 1951, Brieger asked the chair of the Maize Committee about the methods that would be used to regenerate the seeds in the collection. This would have to be done at regular intervals in order to maintain seeds' viability and was therefore an essential component of long-term conservation. Brieger wondered whether and how the "technique of the Indians" in maintaining their own varieties ought to be perpetuated in regenerating samples. For example, he knew that Guaraní farmers relied on three plots, one to maintain their typical field corn, a second for a popcorn, and the third for ceremonial corn. The last of these involved planting two distinct strains of the ceremonial corn, in order to obtain the particular color pattern of the mixed offspring each year. "In such a case…, it would be advisable, to maintain the two ceremonial races in the same way, and not in separate lots," Brieger suggested.[65] The Committee evidently disagreed. Guaraní knowledge was not needed to conserve Guaraní maize.

As this last example suggests, although on the ground the Maize Committee's collectors sought Indigenous peoples as known stewards of corn diversity, back in the office diverse varieties were no longer the products of human ingenuity and effort but simply samples reflective of the botanical diversity of a region. Realizing this separation of indigenous maize and Indigenous people was essential to the Maize Committee's long-term goal of conserving diverse varieties in perpetuity without the aid of their cultivators. Relying on (for initial identification) but then stripping away the human or cultural component of crop diversity generated samples that could be preserved without recourse to particular peoples and distinct agricultural practices. With good recordkeeping the historical specificity of the collection could be perpetuated indefinitely: a seed regenerated by a technician at an experimental station in Mexico City would still count as "Guaraní" or from "the Paraguay-Paraná Basin" so long as that label traveled with seeds from one generation to the next.

Racial classification was a still more powerful tool for achieving this separation and thereby enabling conservation. Through systematic taxonomy, individual maize samples initially identified by time, place, and local name were subsequently tagged with a racial designation that situated them within a millennial, continental history and a broad scientific project. Once this racial taxonomy was established, samples tied to singular moments and places could be reorganized into a single generalized framework. The completeness of a collection—and therefore its conservation value—could be judged by its representativeness in terms of agreed races, and distinct collections in different locations could be made comparable and interchangeable.

This taxonomic endeavor was the focus of a second phase of the Maize Committee project that officially began in 1955, also sustained by US foreign aid dollars. In this second phase of the Committee's work, it generated successive national and regional maize taxonomies through a book series on "The Races of Maize." Individual numbers followed the model established in *Razas de Maíz en México*, itself derived from Anderson's earlier methods: researchers studied as many examples of the variations of maize in a particular country or region, measured or otherwise gathered data about a range of characteristics thought to be important in distinguishing related populations, and then analyzed these data and geographical information to delineate races.[66] From 1957 well into the 1960s, the National Research Council published volumes covering Bolivia, Brazil and eastern South America, Central America, Colombia, Cuba, Ecuador, Peru, the Caribbean (West Indies), and Venezuela.[67]

The taxonomic research produced challenges to the Maize Committee's founding assumptions. Echoing existing concerns about the lack of biological bases of race in humans, least one contributor came to question the biological reality of races in maize.[68] A larger number of contributors engaged in debate over the relationship between Indigenous knowledge and the Committee's work. Some contributors dismissed the idea that Indigenous groups had the knowledge and skill needed to consciously create new strains of corn. In *Races of Maize in Central America*, one of the first of the studies to be published, Edwin Wellhausen, Alejandro Fuentes Orozco, and Antonio Hernández Corzo reported on the close correlation of the extraordinary diversity of corn in Guatemala with the presence of many distinct Indigenous groups. They nonetheless downplayed the significance of this correlation. "That the Guatemalan Indian also played a conscious role in the creation of new races of maize is doubtful," they contended.[69] Other accounts challenged such assessments, elaborating on the methods and aims of pre-Colombian and more recent communities of Indigenous Americans, thereby affirming the link between human creativity and maize diversity. The lead authors of *Races of Maize in Peru*, Alexander Grobman, Wilfredo Salhuana, and Ricardo Sevilla, counted among those who held a different view. Describing the Incan Empire at the height of its agricultural attainments, they identified this as a period in which the farmer "exercised his best breeding ability, which was manifested in an orientation of the evolution of maize, through selection, towards larger yield per unit area."[70] Brieger and colleagues who conducted the studies of maize in eastern South America similarly contended that the skills of "the Indian" in developing types ought not to be dismissed, referring to the "efficient breeders" and "breeding programs" found among Indigenous peoples past and present. They also pointed out that the task of "preserving and perpetuating strains," which had been casually dismissed in *Races of Maize in Central America* as a routine task, in fact "requires a considerable skill" which "has been carried out and maintained successfully and constantly through many hundreds or even thousands of years."[71]

The reliability of the knowledge of present-day Latin American farmers, Indigenous or not, was also debated. The two US scientists tasked, separately, with preparing the *Races of Maize of Cuba* and *Races of Maize of the West Indies* openly disputed this subject. While collecting in Cuba, the Harvard graduate student William Hatheway had had his initial idea of locating "primitive" maize or "pure old races" grown by Indigenous cultivators upended. Although he occasionally encountered "people of undoubted Indian blood," he inevitably found that "they were growing the same mongrelized corn as everyone else."[72] A better approach turned out to be talking to farmers, and using their networks to locate individuals still cultivating older varieties. Based on his experience, Hatheway argued in his final

account that maize researchers should rely on the breeding or seed saving practices and naming conventions of local farmers as guides to classification.[73] This caused a hang-up in publication, when the geneticist William Brown of Pioneer Hi-Bred, who had been collecting maize elsewhere in the Caribbean for the Maize Committee, objected that, in his experience, the vast majority of farmers "knew very little about their maize."[74] The races picked out by scientists did not need to match up with the types recognized by farmers, because scientists had greater knowledge, in this case of the traits with "true diagnostic value" in racial analyses and of the range of possible variation.[75]

The work of the Maize Committee was built around hierarchies of peoples, and especially of the quality of knowledge and technical capacities they were thought to possess. It could hardly have been otherwise, given that the project emerged out of a concern for "modern" agricultural technologies born of "civilized" areas—including breeders' crop varieties—overtaking the tools and practices of Indigenous farmers and driving their "primitive" crop varieties from existence. This story recapitulated narratives of "the vanishing native" unable to resist a more advanced Euro-American culture and drew on the entrenched association of Western technologies with cultural superiority.[76] Yet, as the debates about Indigenous and local knowledge indicates, the Maize Committee's taxonomic project also generated challenges to the very hierarchies on which the Committee was premised. As I discuss below, these would go on to influence subsequent applications of taxonomic knowledge in participatory breeding conservation programs, activities in which farmers featured as central, and knowledgeable, contributors. Initially, however, the taxonomic project that facilitated the Maize Committee's conservation project worked to make the knowledge and labor of farmers, especially Indigenous farmers, superfluous—with the effect that domestic or foreign-imposed efforts to transform, displace, assimilate, modernize, or otherwise disappear those farmers need not be worrying to science or industry.

Races Revisited and Revised

The National Research Council's maize research program came to an end in the early 1960s, but the wider project of classifying maize types into races continued. Subsequent decades saw its diversification along various axes. These included the expansion of taxonomic activities to include other geographical regions, for example Portugal (1971), India (1977), Japan (1979), and Yugoslavia (1989). It involved the application of new technologies for characterizing diversity and aggregating samples into races, such as isozyme and DNA microsatellite analyses.[77] In some cases, maize taxonomy also incorporated greater appreciation of local knowledge, for example that possessed by peasant and Indigenous farmers or by the agronomists who worked with those farmers. In Mexico, where new lines of research followed this trajectory, maize taxonomy was a tool for reclaiming crop diversity as a sovereign resource, available for local or national development but not foreign exploitation. As I show here, by following the a few of these lines of research, this revised approach to maize taxonomy also recognized and valorized the capacity and authority of the peoples of Mexico in governing maize diversity.

The first significant revision to *Razas de Maíz en México* came nearly two decades after its initial publication. This revision was led by the botanist and agronomist Efraím Hernández Xolocotzi, formerly a member of the Office of Special Studies staff and a co-author of *Razas*. His revision followed on from a collecting mission that he and a team had undertaken for the successor organization to the Office of Special Studies, the International Center for the Improvement of Maize and Wheat, also known as CIMMYT. This mission

aimed to obtain new materials for its maize breeding program. In 1968, Hernández Xolocotzi presented an account of five additional races of maize found in the region of the Sierra Madre Occidental during the trip. He also suggested a revised methodology of collecting, one centered on the role of Indigenous cultivators as creators of and guides to diversity.[78]

According to Hernández Xolocotzi, earlier methods of collecting used by the Office of Special Studies and the Maize Committee missed maize diversity because they did not systematically incorporate farmers' knowledge or acknowledge cultural diversity. Improved methods—that is, the methods he and his colleagues employed to discover new races—considered farmers' assessments of different soil types and other ecological requirements as well as the culinary or ceremonial uses of maize in a particular cultural setting. Such ethnobotanically informed collecting was sure to lead collectors to distinct maize types that had been crafted to meet these needs.[79] In short, according Hernández Xolocotzi, acknowledging human cultural diversity and appreciating local and Indigenous knowledge produced better taxonomy.[80]

Taxonomy, in turn, was also a tool for generating social change. As he wrote up his five new races, Hernández Xolocotzi was formulating principles of ethnobotanical and agroecological investigation that would subsequently influence a generation and more of agronomic and botanical researchers, in Mexico and beyond.[81] His ethnobotany centered on understanding and appreciating peasant and Indigenous crops and agricultural methods, and on recognizing this local knowledge as the most effective for particular social and ecological conditions. From the early 1970s onward, this approach formed part of an ever-sharper critique of imported agricultural solutions such as those that had been promoted by the Office of Special Studies.[82] In forming this critique, Hernández Xolocotzi shared ideas with a larger group of Mexican or Mexico-based social scientists who, like him, saw *campesino*, or peasant, agriculture not as a problem to be solved through "modernization" but "modernization" as a project that had created the problems faced by peasant and Indigenous farmers.[83] This perspective pushed Hernández Xolocotzi to a transformed politics of taxonomizing maize. In his hands, and those of his colleagues and students, it was no longer an instrument of US researchers, motivated by US political and economic interests, but instead a project of recognizing the ingenuity of Mexico's smallholder and subsistence farmers, whether *campesino*, Indigenous, or both, and positioning their knowledge as that best suited to address Mexico's agricultural needs.

In part thanks to the influence of Hernández Xolocotzi, the next decade saw a boom among Mexican researchers in the collection and study of maize types native to Mexico. This activity was linked to immediate agricultural concerns as well as ethnobotanical interests. For example, in the late 1960s, Mexican agronomists at the National Institute for Agricultural Research (*Instituto Nacional de Investigaciones Agrícolas*) sought resources for the development of more drought-resistant maize in locally adapted varieties.[84] In the 1970s, thanks in part to institutional changes and an influx of funding, public plant breeders in Mexico had greater opportunities to address the needs of regions and peoples left out of the industrial development-driven research agenda of preceding decades. Many saw *maíces nativos* (maize varieties native to Mexico, sometimes referred to as *criollo* maize) as possessing qualities that would better serve the needs of poor farmers.[85]

Ultimately, both ethnobotanic and agronomic enterprises (categories not neatly separated) led to the accumulation of new maize samples, especially in the national collection.[86] The additional samples in turn encouraged new efforts to delineate and organize the races of maize of Mexico. By the 1990s the number of defined races had increased from the original twenty-five set out in *Razas de Maíz en Mexico* to forty-one

distinct races.[87] The expanded collections and improved systematic knowledge created new possibilities for breeding. According to Mexican scientists in charge of the national collections, they also shed light on "the socio-cultural evolution of our nation, as well as the unity and the variation of the cultures that have developed in our current territory."[88] In other words, maize taxonomy also revealed and reaffirmed Mexico's history of cultural diversity and its contemporary national identity.

Research on maize diversity took on increasing political significance from the 1980s, first as a result of international debates about the ownership of plant genetic resources, and second in light of international trade agreements, most notably the North American Free Trade Agreement (NAFTA) in 1994. NAFTA enabled a flood of subsidized (and therefore cheap) US grain into Mexican markets, simultaneously disadvantaging Mexican growers and introducing transgenically altered (genetically modified or GM) varieties into Mexican markets and fields.[89] In this context, the races of maize of Mexico represented a valuable national resource threatened by multiple forces: their appropriation by foreign governments and especially transnational seed companies, their disappearance from farm fields as poverty-stricken peasant farmers abandoned cultivation, and their cross-pollination with GM varieties which would irreversibly alter their genetic constitution.[90]

These concerns are evident in the most recent comprehensive revision of the races of maize in Mexico: *Origen y Diversificación del Maíz: Una Revisión Analítica*. This 2009 study emerged from a government-sponsored research program on the history and contemporary status of maize diversity in Mexico, the "Proyecto Global de Maíces Nativos." Policymakers had required an up-to-date analysis of native Mexican maize to inform the regulatory regime for maize required by a 2005 biosafety law, *La Ley de Bioseguridad de Organismos Genéticamente Modificados* (introduced, in theory, to govern the introduction of genetically modified organisms).[91] The product of collaboration among several Mexican scientists, *Origen y Diversificación* assessed competing theories of the origin of *Zea mays* and offered an overview of known races, which had increased from the forty-one described by 1991 to fifty-nine in 2009. According to the authors, detailed knowledge of Mexican maize diversity, such as the study's account of its evolution and its classification into distinct races, provided compelling grounds for resisting the importation of GM maize varieties to Mexico. Among other responses, the authors called for revision of Mexico's biosecurity law that would bring it into line with the "scientific evidence developed through more than 100 years of research on maize."[92]

The authors additionally recommended that, for the sake of conserving the valuable genetic diversity of maize, it was necessary to protect Mexico's "small-scale or marginalized" farmers: "They are the guardians of the native germplasm of maize: they retain, maintain and even modify the genetic diversity present in their territories through exchange, gene flow, and the testing of new seeds."[93] They argued for government resources to support these farmers as part of a program of *in situ*, or on farm, conservation. The reversal of the ideas espoused by the Committee on Preservation of Indigenous Strains of Maize could hardly be more stark. Not only did the taxonomic endeavor captured in *Origen y Diversificación* value the knowledge of peasant and Indigenous farmers in cultivating maize diversity, it insisted that these farmers must play a central role in conserving it, too.

The difference in politics extended beyond valorizing the knowledge of farmers to encompass a more general assertion of national sovereignty. This is arguably the most influential application of maize taxonomy in Mexico today. The classification of maize as carried out at the Rockefeller Foundation and later by the Maize Committee is best understood as part of a Cold War ambition of "modernizing" Latin America while also

making Latin American resources available for US exploitation. By comparison, the maize studies of *Origen y Diversificación* aimed at resisting US imperialism in the form of a flood of cheap, subsidized, transgenic maize and regulations that advanced the interests of transnational corporations over those of Mexican citizens. In recent years, many Mexicans, with strong representation from Indigenous communities, have rallied against free trade and the importation of transgenic maize. As one collective has insisted, "Sin Maíz, No Hay País"—without maize, there is no country.[94] This declaration, and the movement that insists on it, is informed by centuries of maize cultivation and its imbrication with Mexican culture, but also by decades of taxonomic analysis that sustain claims to the distinct identity and history of Mexican maize.

Conclusion

Reading the politics of maize taxonomy is anything but straightforward. The very idea of establishing an evolutionary taxonomy of maize types came from the US botanist Edgar Anderson, who in the 1930s found inspiration for his work in the problems of commercial maize production in the United States and sought guidance for methods in the studies of human race conducted by physical anthropologists in preceding decades. When researchers based in Mexico, tasked with "improving" crops, and by extension farmers, too, conducted a study of Mexican maize landraces in the late 1940s, they produced an evolutionary tree that mapped on to mid-century thinking about the mixing of peoples in Mexico. In the 1950s and 60s, when a group of US maize experts decided to collect "indigenous" maize landraces of the Western hemisphere for conservation and categorization, they relied on but also effaced local knowledge, to support a project that would in turn facilitate the elimination (through assimilation or "modernization") of peasant and Indigenous cultures. In each of these cases, ideas about human diversity informed the taxonomic study of maize. In the hands of scientists associated with the Office of Special Studies and the Maize Committee, taxonomy in turn provided a tool for dealing with human diversity.

Conscious of the potential for contemporary researchers to misapply current, and especially US-based, concepts of human race to Mexican maize science, the anthropologist John Hartigan urges analytical separation between the two, as I described in the introduction. By comparison, the American studies scholar Aaron Eddens insists on their being collapsed. Referring to the involvement of the Rockefeller Foundation in collecting and describing Mexican maize in the 1940s, Eddens argues that human "racial logics… were central to the collection and appropriation of Mexican landraces" and maintains that these logics continue to shape agricultural projects based on those activities.[95] They are, as he says, "embedded" in the "'modern' seeds" that later agricultural development programs still push today.[96] By situating the maize taxonomic project within the context of a larger project informed by white supremacy, and insisting on the endurance of this association, Eddens collapses human racial, and racist, science with racial studies of maize.

Informed and inspired by the literature on colonialism and the construction of human racial hierarchies, Eddens correctly identifies these at work agricultural development. But he does not account for the possibility that a racial science of maize could be—and has been—put to many different ends. As I have described, even as the US-led maize collection, conservation, and categorization program begun in the 1950s imposed a hierarchical vision of agricultural achievement that placed white farmers and breeders from the United States at the apex and Indigenous cultivators of the Americas at the bottom—and sought to remake the latter into the former—scientists working in Mexico, Brazil, Peru and other Latin American countries contested this vision. Their taxonomies of maize

highlighted the knowledge and contributions of the farmers who created and maintained maize landraces. In subsequent decades, this critique went from being the subversive view to the dominant narrative. In Mexico, maize taxonomy became a tool for defending peoples and the nation from unwanted impositions.

Scholars of race have observed that human racial classifications are not just ideas but also instruments, tools that carve up humanity to achieve specific ends. In agriculture, taxonomy was and is similarly instrumentalized. Some of these applications are obvious, for example, to conduct breeding experiments or to sustain intellectual property rights.[97] My analysis suggests still other purposes: extracting resources for development, imposing hierarchies of agricultural peoples and practices, championing Indigenous knowledge, and resisting threats to national sovereignty. These uses of maize taxonomies were all the more powerful because they aligned with ideas about human races, and with efforts to intervene in societies along perceived human racial lines.

Recognizing this flexibility, this amenability to different aspirations and applications, in turn suggests a reconsideration of the notion of plasticity with respect to ideas about race. Hartigan reminds readers of the plasticity that inheres in categorizations of the races of maize of Mexico, which for him contrasts to ideas of racial fixity prevalent in the United States.[98] Meanwhile, scholars of race in Latin America, and the Global South more generally, point to the plasticity of human racial categorizations, again contrasting these to notions of racial fixity in the United States and Europe.[99] Attending to race as technology challenges these static dualisms (US/Mexico and North/South) by exploring a different plasticity: that of purpose. Successive mobilizations of the same research program, centered on an unchanging and mostly uncontested concept of biological race in maize, supported strikingly different social and political projects. In other words, it was not the plasticity of *razas* that defines the history of the racial science of maize in Mexico (although races of maize were, and are, entities in continual motion) but rather of the reasons for creating taxonomies in the first place. If we are to understand what the races of maize are, and the politics they embody, we need first to account for these recurrent retoolings.

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[33] This analogic thinking built on a real biological similarly (freely interbreeding populations) that would not have been true for all crops. I thank Staffan Müller-Wille for this observation.

[34] Anderson and Cutler, "Races of Zea Mays," p. 77. See also E. A. Hooton, "Methods of Racial Analysis," *Science*, New Series, 63, no. 1621 (1926), pp. 75–81.

[35] Anderson and Cutler, "Races of Zea Mays," p. 71. See also Carleton S. Coon, *The Races of Europe* (New York: Macmillan, 1939).

[36] Anderson and Cutler, "Races of Zea Mays," p. 71.

[37] Edgar Anderson, "Races of Zea Mays II: A General Survey of the Problem," undated typescript copy, Carl Ortwin Sauer Papers (Bancroft Library, University of California, Berkeley), Box 6, Folder Anderson, Edgar 1948–1964.

[38] On Anderson's pictorial analyses, see Kim Kleinman, "How Graphical Innovations Assisted Edgar Anderson's Discoveries in Evolutionary Biology," *Chance* 15, no. 3 (2012), pp. 17–21.

[39] Edgar Anderson, "Maize in Mexico a Preliminary Survey," *Annals of the Missouri Botanical Garden* 33, no. 2 (1946), pp. 147–247.

[40] Anderson to Mangelsdorf, undated draft, Edgar Anderson Papers (Missouri Botanical Garden Archives, St. Louis, MO), RG 3/2/4, Series 3, Box 11, Folder 1.

[41] Anderson, "Maize in Mexico a Preliminary Survey," p. 147.

[42] Edgar Anderson, "Field Studies of Guatemalan Maize," *Annals of the Missouri Botanical Garden* 34, no. 4 (1947), pp. 433–467, on 447 and 449.

[43] Anderson, "Field Studies of Guatemalan Maize," p. 435.

[44] There are many accounts of the Office of Special Studies, which offer diverging assessments of its activities. A sampling of the range of views (in addition to other texts cited below) includes: E. C. Stakman, Richard Bradfield, and Paul C. Mangelsdorf, *Campaigns Against Hunger* (Cambridge: Harvard University Press, 1967); Cynthia Hewitt de Alcantara, *Modernizing Mexican Agriculture: Socioeconomic Implications of Technological Change, 1940–1970* (Geneva: UNRISD, 1976); Gustavo Esteva, *La Batalla en el México Rural* (Mexico: Siglo XXI, 1980); Bruce Jennings, *Foundations of International Agricultural Research: Science and Politics in Mexican Agriculture* (Boulder: Westview Press, 1988); J. H. Perkins, *Geopolitics and the Green Revolution: Wheat,*

Genes, and the Cold War (Oxford: Oxford University Press, 1997); Karin Matchett, "Plant Sciences Research and Agriculture in Mexico: Tensions and Collaboration Among Mexican and U.S. Scientists, 1935–1965," Ph.D. thesis, University of Minnesota, 2002; Ana Barahona, "Mendelism and Agriculture in the First Decades of the XXth Century in Mexico," in *A Cultural History of Heredity IV: Heredity in the Century of the Gene*, Preprint 343 (Berlin: Max Planck Institute for the History of Science 2008), pp. 111–126; Netzahualcóyotl Luis Gutíerrez Núñez, "Cambio Agrario y Revolución Verde: Dilemas Científicos, Políticos y Agrarios en la Agricultura Mexicana del Maíz, 1920–1970," Ph.D. Thesis, Colegio de México, 2017.

[45] Joseph Cotter, "The Origins of the Green Revolution in Mexico: Continuity or Change?" in David Rock, ed., *Latin America in the 1940s: War and Postwar Transitions* (Berkeley: University of California Press, 1994), pp. 224–241. See also Tore C. Olsson, *Agrarian Crossings: Reformers and the Remaking of the US and Mexican Countryside* (Princeton: Princeton University Press, 2017); Matthew Caire-Pérez, "A Different Shade of Green: Efraím Hernández Xolocotzi, Chapingo, and Mexico's Green Revolution, 1950–1967," Ph.D. Thesis, University of Oklahoma, 2016.

[46] For the perspective of US scientists, see, e.g., "Agricultural Conditions and Problems" (1941), Report of the 1941 Survey Commission of the Rockefeller Foundation, Rockefeller Foundation Archives (Rockefeller Archive Center, Tarrytown, NY), RG 1.1, Series 323, Box 1, Folder 2. There were exceptions to this view among Mexican agronomists, but Cotter suggests they did not predominate; for perspectives in Mexico, see Cotter, "The Origins of the Green Revolution in Mexico"; Joseph Cotter, "Cultural Wars and New Technologies: The Discourse of Plant Breeding and the Professionalisation of Mexican Agronomy, 1880–1994," *Science, Technology & Society* 5, no. 2 (2000), 141–168; Joseph Cotter, *Troubled Harvest: Agronomy and Revolution in Mexico, 1880–2002* (Westport: Praeger, 2003), ch. 3.

[47] Jeffrey M. Pilcher, *Que Vivan Los Tamales! Food and the Making of Mexican Identity* (Albuquerque: University of New Mexico Press, 1998).

[48] Claudio Lomnitz, "Bordering on Anthropology: The Dialectics of a National Tradition in Mexico," *Revue de synthèse* 4, nos. 3–4 (2000), pp. 345–380; Roberto J. González, "From Indigenismo to Zapatismo: Theory and Practice in Mexican Anthropology," *Human Organization* 63, no. 2 (2004), pp. 141–150. See also Alan Knight, "Racism, Revolution, and Indigenismo," in Richard Graham, ed., *The Idea of Race in Latin America, 1870–1940* (Austin: University of Texas Press, 1990), pp. 71–113; Alexander S. Dawson, "From Models for the Nation to Model Citizens: Indigenismo and the 'Revindication' of the Mexican Indian, 1920–40," *Journal of Latin*

American Studies 30, no. 2 (1998), pp. 279–308; Rodolfo Stavenhagen, "La Política Indigenista del Estado Mexicano y los Pueblos Indígenas en el Siglo XX," in Bruno Barronet and Medardo Tapia, eds., *Educación e Interculturalidad: Política y Políticas* (Cuernavaca: CRIM-UNAM, 2013), pp. 23–48.

[49] Helen Anne Curry, "Breeding Uniformity and Banking Diversity: The Genescapes of Industrial Agriculture, 1935–1970," *Global Environment* 10, no. 1 (2017), pp. 83–113.

[50] [Mangelsdorf], report to Ing. Marte Gómez, 15 April 1946, Mangelsdorf Papers, HUG(FP) 37.51, Box 1, Folder Rockefeller Foundation - PCM papers/reports.

[51] E. J. Wellhausen, L. M. Roberts, and E. Hernández X., in collaboration with P. C. Mangelsdorf, *Razas de Maíz en México, su Origen, Características y Distribución*, Folleto Técnico No. 5 (Mexico City: Oficina de Estudios Especiales, Secretaría de Agricultura y Ganadería, 1951).

[52] E. J. Wellhausen, L. M. Roberts, and E. Hernández X., in collaboration with Paul C. Mangelsdorf, *Races of Maize in Mexico: Their Origin, Characteristics and Distribution* (Cambridge: Bussey Institution of Harvard University, 1952).

[53] Wellhausen et al., *Races of Maize*, foreword.

[54] Wellhausen et al., *Races of Maize*, discussion of Celaya on pp. 161–162.

[55] Anne Doremus, "Indigenism, Mestizaje, and National Identity in Mexico during the 1940s and the 1950s," *Mexican Studies/Estudios Mexicanos* 17, no. 2 (2001), pp. 375–402. For an overview of mestizo identity in Mexico, see López-Beltrán and García Deister, "Aproximaciones Científicas al Mestizo Mexicano."

[56] Cleland to Mangelsdorf, 20 September 1949; Mangelsdorf Papers, HUG(FP) 37.10, Box 5, Folder: Preservation of Indigenous Strains of Maize – letters.

[57] J. Allen Clark, "Collection, Preservation, and Utilization of Indigenous Strains of Maize," *Economic Botany* 10, no. 2 (1956), pp. 194–200. See also Curry, "Breeding Uniformity and Banking Diversity"; Diana Alejandra Méndez Rojas, "El Programa Cooperativo Centroamericano para el Mejoramiento del Maíz: Una Historia Transnacional de la Revolución Verde desde Costa Rica y Guatemala, 1954–1963," Master's Thesis, Instituto Mora, 2018.

[58] Patrick Wolfe, "Settler Colonialism and the Elimination of the Native," *Journal of Genocide Research* 8, no. 4 (2006), pp. 387–409; Lorenzo Veracini, "Introducing Settler Colonial Studies," *Settler Colonial Studies* 1, no. 1 (2011), pp. 1–12.

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[63] See, e.g., correspondence from William Hatheway to Paul Mangelsdorf in Mangelsdorf Papers, HUG(FP) 37.10, Box 3, Folder: Hatheway, Wm. H.

[64] William L. Brown, *Races of Maize in the West Indies*, Publication no. 792 (Washington, DC: National Academy of Sciences–National Research Council, 1960), pp. 1–2.

[65] Brieger to Cleland, 10 February 1951, Rockefeller Foundation Archives, RG 1.2, Series 300, Box 1, Folder 2.

[66] For a description of the project from the grant proposal, see Clark to Harrar, 31 March 1954, Rockefeller Foundation Archives, RG 1.2, Series 300, Box 1, Folder 5.

[67] These have been digitized by the USDA, along with other taxonomic studies of maize: https://www.ars.usda.gov/midwest-area/ames/plant-introduction-research/docs/races-of-maize/

[68] See e.g., Hatheway to Mangelsdorf, 29 June 1953; Mangelsdorf Papers, HUG(FP) 37.10, Box 3, Folder: Hatheway, Wm. H., and subsequent letters in the same folder.

[69] E. J. Wellhausen, Alejandro Fuentes O., Antonio Hernández Corzo, in collaboration with Paul C. Mangelsdorf, *Races of Maize in Central America*, Publication 511 (Washington, DC: National Academy of Sciences–National Research Council, 1957), p. 29.

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[71] F. G. Brieger, J. T. A. Gurgel, E. Paterniani, A. Blumenschein, M. R. Alleoni, *Races of Maize in Brazil and Other Eastern South American Countries*, Publication 593 (Washington, DC: National Academy of Sciences–National Research Council, 1958), pp. 4–5, 56–57.

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[74] Mangelsdorf to Hatheway, 21 November 1955, Mangelsdorf Papers, HUG(FP) 37.12, Box 7, Folder: Hatheway, W. H.

[75] Brown, *Races of Maize in the West Indies*, p. 13.

[76] Brian W. Dippie, *The Vanishing American: White Attitudes and U.S. Indian Policy* (Middletown, CT: Wesleyan University Press, 1982); Russell McGregor, "The Doomed Race: A Scientific Axiom of the Late Nineteenth Century," *Australian Journal of Politics and History* 39 (1993), pp. 14–22; Patrick Brantlinger, *Dark Vanishings: Discourse on the Extinction of Primitive Races, 1800–1930* (Ithaca: Cornell University Press, 2003); Michael Adas, *Machines as the Measure of Men: Science, Technology, and Ideologies of Western Dominance* (Ithaca: Cornell University Press, 1989).

[77] Many subsequent Races of Maize studies have been digitized by the USDA; see https://www.ars.usda.gov/midwest-area/ames/plant-introduction-research/docs/races-of-maize. A bibliography of the past twenty years of maize diversity research is provided by the Panzea project; see http://www.panzea.org. I thank an anonymous reviewer for bringing the latter resource to my attention.

[78] Efraím Hernández X. and Glafiro Alanís Flores, "Estudio Morfológico de 5 Nuevas Razas de Maíz de la Sierra Madre Occidental de México: Implicaciones Filogenéticas y Fitogeográficas," *Agrociencia* 5, no. 1 (1970), pp. 3–30.

[79] Hernández X. and Alanís Flores, "Estudio Morfológico de 5 Nuevas Razas de Maíz," p. 28.

[80] Soto Laveaga recounts the history of an earlier *Dioscorea* research commission in which Hernández Xolocotzi was involved; under the guidance of the botanist Arturo Gómez Pompa, the commission adopted the same stance to local expertise. See Gabriela Soto Laveaga, *Jungle Laboratories: Mexican Peasants, National Projects, and the Making of the Pill* (Durham: Duke University Press, 2009), ch. 4.

[81] Efraím Hernández X., *Apuntes sobre la Exploración Etnobotánica y su Metodología* (Chapingo: Colegio de Postgraduados, Escuela Nacional de Agricultura, 1970).

[82] Caire-Pérez, "A Different Shade of Green."

[83] Caire-Pérez, "A Different Shade of Green," pp. 281–283.

[84] Hermilo H. Ángeles Arrieta, "El Maíz y el Sorgo y sus Programas de Mejoramiento Genético en México," February 1968, SOMEFI, Chapingo, Mexico, pp. 390–391; José de Jesús Sánchez González and Lorenzo Ordaz Suarez, "Reestudio de las Razas Mexicanas de Maíz," March 1984, Zapopan, Jalisco, INIA, p. 11.

[85] Joaquín Ortíz Cereceres, "Antecedents de la Investigación Agricola en Mexico y sus Repercusiones," *Germen*, no. 3 (1985): 1–17; Rafael Ortega Paczka, "Reorganización del Mejoramiento Genético del Maíz en el INIA," in Efraím Hernández Xolocotzi, ed., *Agrosistemas de México: Contribuciones a la Enseñanza, Investigación y Divulgación Agrícola*, 2nd ed. (Chapingo: Colegio de Postgraduados, 1981), pp. 369–390.

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[87] Rafael Ortega Paczka, J. Jesús Sánchez González, Fernando Castillo González, and Juan Manuel Hernández Casillas, "Estado Actual de los Estudios sobre Maices Nativos de México," in R. Ortega P., G. Palomino H., F. Castillo G., V. A. González H., and M. Livera M., eds, *Avances en el Estudio de los Recursos Fitogenéticos de México* (Chapingo: SOMEFI, 1991).

[88] INIA, Unidad de Recursos Genéticos, Banco de Germoplasma de Maíz y Sorgo, "Informe de Actividades Desarrolladas Durante 1978," p. 23.

[89] See, e.g., Oxfam, "Dumping without Borders: How US Agricultural Policies are Destroying the Livelihoods of Mexican Corn Farmers," Oxfam Briefing Paper no. 50 (August 2003); Commission for Environmental Cooperation, *Maize and Biodiversity: The Effects of Transgenic Maize in Mexico; Key Findings and Recommendations* (CEC Secretariat, 2004); Norbert Fiess and Daniel Lederman, "Mexican Corn: The Effects of NAFTA," International Trade Department, Trade Note 18, 24 September 2004. See also Jonathan Fox and Libby

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[91] Fitting, *The Struggle for Maize*, pp. 72–73.

[92] Kato Yamakake at al., *Origen y Diversificación del Maíz*, p. 99.

[93] Kato Yamakake at al., *Origen y Diversificación del Maíz*, pp. 10, 12.

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[95] Aaron Eddens, "White Science and Indigenous Maize: The Racial Logics of the Green Revolution," *Journal of Peasant Studies* 46, no. 3 (2017), pp. 653–673, on p. 655.

[96] Eddens, "White Science and Indigenous Maize," p. 655, 667.

[97] Staffan Müller-Wille, "Early Mendelism and the Subversion of Taxonomy: Epistemological Obstacles as Institutions," *Studies in History and Philosophy of Science Part C: Studies in History and Philosophy of Biological and Biomedical Sciences* 36, no. 3 (2005), pp. 465–487; Bronwyn Parry, "Taxonomy, Type Specimens, and the Making of Biological Property in Intellectual Property Rights Law," *International Journal of Cultural Property* 19, no. 3 (2012), pp. 251–268; Matthew Holmes, "Changing Techniques in Crop Plant Classification:

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[98] Hartigan, "Translating 'Race' and 'Raza,'" p. 37–38; Hartigan, *Care of the Species*, pp. 56–57.

[99] Wade, *Race and Ethnicity in Latin America*, pp. 39–40; Warwick Anderson, "Racial Conceptions in the Global South," *Isis* 105, no. 4 (2014), pp. 782–792.