Empire and indigestion: Materializing tannins in the Indian tea industry

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Abstract
In the mid-1800s, plantation-produced tea from India came onto the British market. Tea retailers blended this more malty and black tea with the lighter Chinese-grown tea to which consumers had become accustomed. By the turn of the 20th century, blending helped Empire-grown tea supplant Chinese-grown tea on the market. Scholars of tea have shown how British tea companies working in South Asia stoked racialized fears that Chinese tea arrived in Britain in an adulterated state, laden with impurities that included dyes, perfumes and even human sweat. This article describes how concerns about protecting tea leaves from outside adulteration gave way to concerns about the potential digestive threat that lay inside tea leaves themselves. Medical journals linked the increased consumption of Indian teas to a population-wide ‘epidemic’ of indigestion. The most cited culprits in this epidemic were tannins, chemical compounds that were also thought to give black tea its characteristic bitterness and color. The normalization of black tea consumption among the British public was not just a work of marketing or branding but a work of resolving uncertainty about what tannins were at a material, biophysical level. As this uncertainty was resolved scientifically, tea was materialized not as a singular, unified product but as an active chemical assemblage.

Keywords
chemistry, colonialism, food safety, historical ontology, nutrition, plantation, South Asia

Introduction
The product known today as ‘black tea’ was brought into being through a combination of mechanized industrial plantation production and commercial tea blending. In the 18th and early 19th centuries, the bulk of the tea on the European and American markets came from China. Chinese market dominance began to erode starting in 1836, when the first
shipment of tea grown in British-controlled Assam came to England. In the second half of the 19th century, the expansion of production in India, followed by Ceylon and Dutch-occupied Java and Sumatra, brought a new kind of tea into being. This tea, grown at scale on large plantations, processed in coal-powered plantation factories, and sold primarily in blended packets, was dark and malty. Its color and flavor made it readily distinguishable from floral, light, aromatic China teas grown on small farms.

Writing about plantations and empire in the long 19th century, Mintz (1979) describes tea, along with sugar and coffee, as a ‘proletarian hunger killer’ that fueled European industrial transformation and helped form laboring subjectivities. In what follows, I merge Mintz’s foundational emphasis on empire and consumption with the more recent attention in science and technology studies (STS) to techniques of perception (Berenstein, 2016; Lahne and Spackman, 2018; Murphy, 2006; Shapiro, 2015). STS scholars in this vein trace both discourses about the sensory qualities of things and the development of scientific knowledge about the underlying molecular and chemical basis of those qualities. In her study of chemical exposure in North American office buildings, Murphy (2006) does this through the framework of historical ontology. Historical ontology is an examination not only of the development of techniques of ‘truth telling’ that allow consumers, scientists, and others to make claims but also of how ‘the objects that are apprehended through that truth-telling’ become, as Murphy (pp. 7–8) puts it, ‘materialized’. In Murphy’s study, indoor air pollution and chemical exposure were made perceptible or imperceptible through historical processes of ‘materialization’ (p. 5).

With this in mind, I argue that the successful integration of plantation-grown black tea from India into the British market was not just an ideological or symbolic achievement – the result of ‘taste-making’ or branding. It was also material work: a series of interlinked practices, from mechanized processing on plantations to tea blending by retailers, to the brewing of tea itself. At the turn of the 20th century, these practices were joined by a series of laboratory investigations of the chemical constituents of tea. It was these material practices that helped establish what could (and could not) be known and said about tea and its effects on the bodies of those who consumed it (Abrahamsson et al., 2015; Shapin, 2012). Imperial food science worked to make Empire-grown plantation tea not just desirable, but digestible.

In the 19th century in Europe and the United States, a popular vision arose of the biophysical body as a kind of ‘human motor’, and of foods and drinks as a set of lubricating, energetic or corrosive inputs to that motor (Rabinbach, 1992). Medical experts, food producers and consumers began to imagine that through the intake of food, the body was materially entangled both with the increasingly polluted, urbanizing landscapes in which it lived and with the increasingly extensive systems of agrarian provision that sustained city life (see Bauch, 2017; Cronon, 1992). This new consumer consciousness led to a new governmental regime of food safety, which tracked consumable goods and their microbial, nutritive and chemical contents from farm to table (Biltekoff, 2013; DuPuis, 2015; Freidberg, 2010; Nestle, 2003; Scrinis, 2013; Zeide, 2018). Early food safety sought to maintain the moral and material ‘purity’ of bodies and products, a goal that had particular salience in the age of Euro-American empire. As Tompkins (2009: 54) notes in her analysis of dietetic movements centered on the consumption of bread in antebellum America, ‘the continuing materialization of the body, through the performative and
physiological functions of eating, [was] metonymic of the continually expanding material borders’ of the United States.

For the (white) British public, consumption of plantation-grown tea, with its distinct flavor, color and texture, was metonymic in this way. But the advent of Empire-grown tea presented an ‘alimentary challenge’ (Roy, 2010: 9) to the bodies of the colonial metropole. Linking desire to digestion, Roy argues that the colonial encounter ‘manifested itself very signally in new forms of appetite, new notions of health and hygiene, and new modes of disgust’ (p. 8). Imperial food production engendered a contradiction. Empire-grown foods constituted a new market opportunity, but their circulation also heightened racial anxieties. Scholars of tea have discussed how, in the mid-19th century, British tea companies stoked racially charged fears that Chinese tea arrived in Britain in an adulterated state, laden with impurities that included dyes, perfumes and even fingernails. Indian and Ceylon plantations were cast as a safe alternative. The ‘plantations, machinery, and British men were … said to produce a pure, healthy, civilized “British” brew’ (Rappaport, 2017: 148; also Liu, 2015).

Over time, however, concern about protecting tea leaves from outside adulteration gave way to the project of managing the potential digestive threat that lay inside tea leaves themselves. At the turn of the 20th century, Britain witnessed a flurry of studies about tea’s material constituency. Some doctors had begun to argue that Indian-grown black tea had an effect on the body quite unlike that of Chinese-grown tea. Medical journals linked the increased consumption of malty, astringent black tea to a population-wide rise in indigestion and constipation. For some medical professionals, the culprits in this wave of indigestion were tannins, little-understood chemical compounds that were also thought to give black tea its characteristic bitterness and color.1 Debates about what tea tannins were and what effects they might have on human health played out in the pages of medical and trade journals between the 1890s and the 1930s. Scientific writing often cited the British Pharmacopoeia, which placed tea tannins in the category of acidum tannicicum – the tannic acid used in leather tanning. Fears grew that tea tannins did to intestinal tracts what tannic acid did to the hides of animals. (Black tea did, after all, ‘tan’ the table cloths and teeth of those who consumed it.) The presence of tannins was further linked to the environmental conditions of plantation production in India.

In response to the concerns about tannins, the Indian Tea Association (ITA), the trade organization that represented British planters, joined allied producer organizations to summon experts from the burgeoning science of industrial chemistry. Questions about what tannins were, about which other substances tannins resembled (or did not), and about whether tannins were good or bad for human health, fueled the growth of an elaborate scientific infrastructure that spanned Indian plantations and London laboratories. This imperial scientific effort worked to recast tea tannins as safe. Chemistry and industrial regulation were blended to produce two seemingly stable, standardized objects – black tea and tannins – and a stable, standardized mechanism for circulating them.

As the uncertainty about tannins played out, tea was ‘materialized’ not as a singular, unified product but as an active assemblage of chemical agents. In Murphy’s formulation of materialization, ‘matter’ must be understood ‘not in terms of a prior thingness but rather in terms of the process of history, concrete social and technical arrangements and the effects of power’ (Murphy, 2006: 15). Elsewhere, STS scholars have examined the
role of such materialization, in analyses of the health effects of MSG (Tracy, 2018), the microbial liveliness of fermented or raw foods (Paxson, 2012; Spackman, 2018), the potability of water (Spackman and Burlingame, 2018), and the potency of generic drugs (Banerjee, 2017; Hayden, 2007). Whether for drugs, milk or water, palatability and digestibility are underwritten by what Murphy (2006: 10) terms a ‘regime of perceptibility’, ‘the way a discipline or epistemological tradition perceives and does not perceive the world’. Such regimes can be co-present; they can be contradictory, overlapping or mutually exclusive. Looking at the productive tensions between them can help shed light on how uncertainty itself – manifested the simple alimentary question, ‘Is this good for me?’ – becomes actionable.

It is the uncertain character of tea tannins during this period that makes it ripe for the kind of historical ontology for which Murphy (2006: 7) calls. This article explores how tea – and tea tannins – became recognizable objects in mass consumer society. It is important to note that concern with Indian tea’s chemical components did not obviate racialized anxieties. Rather, the process of scientifically determining the harms or benefits of manufactured tea – as in the process of making similar determinations when it comes to pesticides or offices or lakes and oceans – is freighted with the baggage of the colonial racial order that brought them into being (Liboiron et al., 2018; Murphy, 2013; Nash, 2007; Shapiro, 2015).

**Blending out difference**

Tea from Indian plantations took up more and more of the market over second half of the 19th century (Rappaport, 2017). In 1867, British consumers purchased 104,500,000 pounds of China tea and 6,250,000 pounds of Indian tea. Forty years later, in 1907, British consumers purchased 9,750,000 pounds of China tea and 162,500,000 pounds of Indian tea (Buckingham, 1910: 4, 13). At the turn of the 20th century, as today, a blended package might be composed of twenty to thirty different teas grown across East, South, and Southeast Asia. The components of a reliable blend – say, PG Tips – might be completely different from one week to the next.

Tea production in colonial India began in the 1830s. Initially, European tea planters adopted a ‘Chinese’ production model they heard about while trading opium, silver, textiles and tea through the East India Company hub at Canton. In this model, small farmers grew green leaf and brought it to a centralized location for processing and packaging. British planters quickly shifted to an industrial economy of scale, carving out plantations first in Assam, and later across the Himalayas and South India (Chamney, 1930: 43–45; Ukers, 1935a: 297–308; Walsh, 1892: 57–58; see also Ball, 1848). Soon afterwards, planters switched from hand-processing tea to using coal-fired machines located in factories on plantations (Baildon, 1882: 30–34; McGowan, 1860).

The colonial penchant for agricultural ‘improvement’, however, did not stop at the gates of the plantation (Arnold, 2005; Drayton, 2000). As the 1893 instructional text *The Art of Tea Blending* (Author, 1893: 44) explained:

The cultivation of tea is in India much more a matter of science that it is in the Celestial Empire … the growth of the tea industry in India has been fostered by many experiments – experiments
as to the climate most suitable to tea growing, as to the soil most congenial to it, and the manure by which it is most nourished; experiments as to the best methods of manufacture, and also experiments to ascertain the best kind of plant to cultivate.

Colonial science gave birth to the vertically integrated plantation system and to a rigid system of ethnic labor hierarchy (Besky, 2014; Chatterjee, 2001; Daniel, et al 1992; Dey, 2018; Jegathesan, 2019; Sharma, 2011). The ranks of field and factory labor in British plantations were dominated by racially marked and marginalized groups, such as Nepalis in Darjeeling, Adivasis in Assam and Tamils in Ceylon. Management was, unsurprisingly, white and European.

The results of these transformations included not just a new system of industrial and racial inequality, or a dramatic spike in tea supplies in the metropole, but an entirely new kind of taste. Black tea was not considered palatable on its own. As the authors of the 1894 guidebook *Tea and Tea Blending* explain,

[Indian teas’] harshness made them unacceptable to the public by themselves … the producers, especially in India, gradually ceased to aim at turning out teas which should possess a combination of qualities rendering them suitable for drinking by themselves, and became specialists aiming to secure for their teas some one striking and distinctive quality; thus one strove to produce tea which should draw liquor of very dark colour; another, to secure a delicately fine aroma and flavor, a third, to secure intense pungency, and so on … (Lewis & Co, 1894: 131–132).

Plantation owners started planning the manufacture of teas knowing full well that they would be drunk in combination, rather than alone. Indeed, with the exception of some Darjeeling teas, grown on high-altitude plantations that could viably produce the Chinese *jaat* (variety) of tea (*Camellia sinensis*), most teas from colonial India, Java, Sumatra and Ceylon were put into blends before they were steeped and served.

Getting a blend to taste right – getting it sufficiently standardized – was difficult. As *The Art of Tea Blending* (Lewis & Co, 1894: 5–6) explains, ‘no two parcels of tea are exactly alike’, even when grown in the exact same region under the same conditions. To meet this challenge, a commercial tea packeting industry arose. English businessman John Horniman started blending teas on the Isle of Wight as early as 1826, but his packets were so popular that his operations quickly expanded and moved to London (Rappaport, 2017: 120–121; Ukers, 1935b). By the 1880s, Horniman’s, as well as Lipton, Brooke Bond, and other brands still recognizable today, had proliferated on the market.

Although the commercialization of blending may have relieved people of the need to understand the geographical diversity of the empire, racialized anxiety about the empire’s human diversity persisted. While tea’s value throughout the 1700s and early 1800s came largely from its association with the exotic and mysterious world of ‘the East’, and China in particular, by the early 20th century, fascination had given way to fear. As Rappaport (2017: 164–166) explains, promoters of Indian tea argued that the use of machinery on plantations, while it might have yielded unfamiliar tastes, actually prevented contact between workers’ hands and feet and processed tea. Popular guidebooks on Indian tea alleged that the hand-processing methods Chinese producers used to make tea more visually appealing for shipment to the UK included the adulteration of pure tea leaves with
foreign dyes, perfumes and other matter (Baildon, 1882: 20–34; Money, 1884; Walsh, 1892: 134–145). Gervas Huxley, Chief Publicity Officer of the Empire Marketing Board in London, explained that the tea packet served to protect the consumer against fraud. … Cunning Chinese merchants, to enlarge their profits, formed the practice of coloring their teas with artificial powders of Prussian blue, green-grey and red, in order to disguise the common brown flavorless leaves, which were thus rendered, in appearance, equal to the best tea and sold at a much higher price.2

Packeting (or so Huxley’s and other industry actors’ logic went) foreclosed the possibility of such material manipulations, even though such packeting took place in the industrial corridors of urban Britain.

The purchase of standardized blends from Horniman’s or Lipton – blends in which machine-processed Indian tea predominated – ensured a what Solomon (2015), writing about contemporary food safety in India, calls a ‘reliability’ in both the palate and the digestive tract. Combined with factory processing, then, blending made the abstract notion of quality – a combination of fair price, consistent taste and safety – commensurable with an increasingly complex, racially and ethnically diverse, and geographically variable supply chain. Blends were touted as preferable because they interacted in a reliable way with local milk and water sources and looked and felt the same way on a given day to the way they looked and felt the day, week, and year before.

Mechanization, blending and packeting thus arose amid a racialized drive for bodily and material purity. They were key constituents of a new ‘regime of perceptibility’ that would govern the colonial tea trade. The work of making Indian tea a metonym for empire was a work of materialization at several levels (Tompkins, 2009). Mechanization disciplined tea workers’ bodies, and it ensured similarly disciplined product. Blending and packeting provided reliable flavor and insulation from contact with racialized others. This story of how tea-making technologies softened racial anxieties is well-known among historians of tea (Dey, 2018; Liu, 2015; Rappaport, 2017; Sharma, 2011), but it speaks more broadly to the organoleptic and visceral labor that goes into materializing standardized, reliable comestible matter. I turn now to how, once fears of adulteration started to subside, questions began to arise about what comestible matter itself might be capable of ‘doing’ to and with human bodies (Abrahamsson et al., 2015).

**Tea as an experimental object**

At the end of the 19th century, consumers started to notice not only that the tea blends that had become so popular were more pungent but also that something in those blends was leaving stains on cups, teeth and tablecloths. This something – nebulously categorized as ‘tannins’ – might even be slowly poisoning the tea-drinking public. A new kind of ‘chemosocial’ materialization started to emerge in this period (Shapiro and Kirksey, 2017). The term ‘chemosociaity’ refers to the ways in which substances that make up everyday products, such as mass-market tea, help remake bodies and ecologies at a material level. Recent engagements with the idea of chemosociality associate anxieties about toxicity with the conditions of late 20th and early 21st-century industrial production
(Shapiro and Kirksey, 2017). Substances from lead to antibiotic-resistant bacteria to polychlorinated biphenyls (PCBs) are frequently depicted as by-products of negligent production practices, either by large Northern corporations or emerging economic powers, including China and India (Chen, 2012; Fortun, 2001; Landecker, 2016; Murphy, 2013). The story of tea tannins reveals an earlier history of chemosociality, in which fears about foreign and industrial production were tied to broader popular and scientific interest in the digestive system.

The potency of chemicals – whether inorganic like PCBs or organic like tannins – is neither uniform nor stable; rather, it is a product of historically particular materializing practices (Murphy, 2006). Even as tannins came under scrutiny, precisely what they were and how they behaved was far from certain. When talk of tea-induced indigestion first arose in the 1890s, blenders, retailers and plantation owners claimed that it must be consumers who over-steeped and over-brewed their tea who were to blame. The author of Tea and Tea Blending (Lewis & Co, 1894: 139–140) warned against ‘careless or improper brewing’, advising tea drinkers that, ‘tea should not stand under a cosy indefinitely … the first five minutes bring out the quality, the next five minutes add to the body, and after that the longer it stands the worse it gets.’

The making of tea, then, was at the same time the making of a digestive experience. Over roughly forty years from the late 1800s to the late 1930s, tea tannins became the focus not only of friendly advice from blenders like the author above but also of a series of comparative laboratory experiments. Through these experiments, scientists linked (usually negatively), the sensations of consumption, from taste buds to intestinal tracts, to the industrial landscapes of production.

In an 1893 report, The Lancet Analytical Commission on Tannin and Theine in China and Indian Teas hypothesized that the quantity of tannin depended on the place of production. Indian teas were thought to contain more tannin than teas grown in either China or Ceylon (The Lancet, 1893: 48). According to the authors, the tannin in tea was a ‘marked poison’, ‘known to produce … gastric and nervous disturbances’. They depicted tannins as a ‘kindly provision of nature intended to warn the drinker when the tea is too strong’ (p. 48).

By the time of the Lancet study, caffeine (or theine) had already been widely discussed in the scientific literature. The novelty of the Lancet study rested in its attention to brewed tea, rather than dry leaf, which had been the object of analysis in earlier experiments. The researchers compared one sample of brewed Indian tea with three brewed China teas (The Lancet, 1893: 48). One-teaspoon samples were steeped in just-boiling water for five and fifteen minutes, after which they were examined for the presence of tannin, caffeine, and ‘total extracted matter’. The price per pound for each tea was also indicated, with the Indian tea being the cheapest by almost a shilling (The Lancet, 1893: 48).

The experiment showed that after five minutes, the Indian tea yielded slightly more tannin than the China teas. After fifteen minutes, the tannin levels increased marginally in the China samples but rose considerably in the Indian sample. The caffeine levels, after five or fifteen minutes, stayed almost the same. What was surprising to the scientists was that when the experiment was repeated with distilled water, the tannin levels across all four samples went up – doubling across the three China samples and increasing 2.5-fold in the India sample. Caffeine increased minimally across the samples. The scientists
concluded that the fifteen-minute steep ‘practically represents the total amount of tannin and theine [caffeine]’. As they wrote, ‘tannin, of course, imparts astringency to tea’, but Indian teas are ‘undesirably rich in tannin’ (*The Lancet*, 1893: 49). They recommended that, ‘[c]onsequently, tea should never be allowed to stand longer than fifteen minutes at the most and probably half this time is sufficient to dissolve nearly the whole of the theine, whilst less than one half of the total tannin will be taken up’ (*The Lancet*, 1893: 49). Ordinary tap water, they added, could deter tannin release. If that water was hard, it would prevent full tannin take-up, while soft water dissolved tannin more readily.

The report did little to quell debate about the digestive impact of tea tannins. As the pages of subsequent scientific papers show, this debate was not only about the taste or toxicity of finished products (though cases of ‘tannin poisoning’ were reported in the *Lancet* and other venues) but also about the means of their production (*The Lancet*, 1903: 838). A 1908 *Lancet* article offered a particularly succinct version of the mutually antagonistic positioning of Indian and Chinese tea at the time:

> The persons, on the one hand, whose business it is to sell China tea affirm that Indian tea was long ago tabooed by medical men because unless it is prepared for use under very careful directions it contains an excessive amount of … tannin. On the other hand, the parties interested in the sale of Indian and Ceylon teas declare that China tea is objectionable because the leaf is prepared under unwholesome conditions, that it sustains in fact contamination owing to its manipulation by hand (*The Lancet*, 1908: 325).

While the authors doubted that the hand-finishing of tea common in Chinese production could cause it to be adulterated with harmful bacteria, they were quick to declare it ‘idle and impossible’ for advocates of Indian tea to deny that Indian tea contained more tannin. Scientifically, the authors declared, China teas were ‘more suited to the requirements of persons with delicate digestive apparatus’ (*The Lancet*, 1908: 325).

In response to these claims, a reader named HWG MacLeod, introducing himself as the holder of a medical degree from Edinburgh, member of the Royal College of Physicians, and a Doctor of Public Health, penned a letter to the Editor of the *Lancet*. In defense of Indian teas, MacLeod wrote: ‘It is known that much of the China tea exported is artificially coloured, or “faced.” Facing, according to MacLeod, was ‘a filthy process … carried on by the Chinese’, involving artificially coloring the tea. Dyes were

> smeared on the perspiring back of an ‘assistant’, and the dried leaves were rubbed over him to give them the necessary colour. No doubt, as you remark in your article, all germs are destroyed by boiling; yet the idea of imbibing the secretions from the skin of an unhygienic Chinaman is repulsive enough to put one off drinking ‘green’ tea (MacLeod, 1908: 421).

MacLeod went on to claim that tannin content also had to do with the age and size of tea leaves. He suggested that the smaller leaves of the highest grades of tea (Orange Pekoe, for example) were richer in tannin. These leaves, collected from ‘the tops of tea bushes’, were more desirable, compared to the Souchoung or Congou grades, which were made from larger leaves collected from lower parts of the bush.

The association of Indian tea with excessive tannin, then, might actually have something to do with the qualities of the leaves available to British consumers and scientists.
'The best China tea', MacLeod hypothesized, would also be ‘collected from the top of the branch’. Presumably, this tea, too, was high in tannin. MacLeod proposed that this finer tea was ‘never exported, but is preserved for the Emperor and highest officials. The adulterated [and less tannic] article is sent abroad!’

While the Sale of Food and Drugs Act of 1875 ensured the inspection of imported tea and other food products to guard against adulteration, MacLeod’s letter highlights how the imperial project that put British Indian tea into competition with Chinese tea continued to provoke racial anxieties that food safety regulations could not fully quell. As a ‘chemosocial’ moment, the early discussion of tea tannins was infused with lingering uncertainties about the impact of an encounter between white metropolitan bodies and the racialized and potentially polluting bodies of Asian field and factory laborers (Shapiro and Kirksey, 2017).

Whereas earlier discussions of the merits of blending focused on variations of MacLeod’s adulteration argument, discussions of tannins turned to the sensory and digestive experience of tea itself – or, rather, the combination of steeping practices, water qualities and plucking patterns that could (but did not always) unleash tea’s bioactive chemical constituents. In their analysis of how omega-3 fatty acids become conferred with the power to transform human bodies, Abrahamsson et al. (2015) explore an interconnected set of ‘doings’ that span from laboratories in the Global North to exploitative and environmentally harmful fish harvests in the Global South. Omega-3’s, they argue, never act alone, nor is their way of mattering innate (Abrahamsson et al., 2015). Like tannins, omega-3’s had to be materialized socially (Shapiro and Kirksey, 2017). Both the early Lancet studies and responses like that of MacLeod underscore that tannins were not an independently active substance, but ‘matter in relation’ (Abrahamsson et al., 2015: 13). Sensory and imaginative experiences of taste, place and race – in relation – were integral to the effort to ‘objectify’, explain, and trace the circulation of tannins, and to determine how different kinds of bodies were able to shape those itineraries (Spackman and Burlingame, 2018: 354; see also Berenstein, 2018; Shapin, 2012).

‘Digestive tea’

After more than three decades of scientific reports and analyses of the safety of Empire-grown Assamica teas, tea planters in India still could not shake the perception of tannins as health threats. By the onset of the Great Depression, notable brands such as Typhoo and Brooke Bond were even marketing ‘digestive’ teas that they claimed were free from tannins. Scholars have linked ideas about the ‘goodness’ of food to historically particular ideas about the quality of biological and social life (see, e.g. Paxson, 2012; Weiss 2016). In nutrition, the shape, size and efficiency of bodies have increasingly been linked to discrete elements, from calories to vitamins. As critical analyses from STS scholars have noted, such reductionism is not a result of some inevitable march of science; rather, these elements are materialized through encounters between science, capital and ‘extra-scientific’ (moral, sensory, racial) social and cultural forces (Biltekoff et al., 2014: 18; Scrinis, 2013; Tompkins, 2009). Colonialism and empire are foundational among these. In a process similar to the ones in which scientific observations in imperial outposts contributed to the ‘discovery’ of dietary fiber and of the developmental value of proteins...
(Biltekoff et al., 2014; Gil-Riaño and Tracy, 2016), a science of the tannin came into being as the British tea industry fought to maintain Indian tea’s market dominance.

In 1931, GH Harden, a principal in the company that marketed the most famous of the ‘tannin-free’ teas, Doctor’s China Tea, published a Treatise from a Medical Point of View on Various Facts Relating to Tea. Harden clarified in the introduction to the Treatise that while he was not himself a doctor,

My primary object has been to draw attention to the extraordinary extent to which indigestion due to tea-drinking has increased in this country within the past fifty years, and to put forward what I believe to be the cause of this increase and the methods by which it may most effectively be counteracted. (Harden, 1931: 5)

Harden traced this mass indigestion to what he called a ‘speeding up’ process that had taken hold in Europe and North America during the previous century. ‘[F]or this pace to be maintained with comfort’, he wrote,

some sort of stimulant was increasingly necessary. Alcohol, except in most moderate quantities, had already been discouraged by all the leading diecticians of the day; and tea – previously restricted to China tea, and therefore, rightly regarded as non-harmful – was welcomed everywhere as the only suitable substitute. Unaware of the lurking danger, the consuming public felt that here, at last, was exactly the beverage that it required. (Harden, 1931: 7)

During this speeding up process, ‘as China tea “went out”, so indigestion and nervous affections “came in.”’ The difference lay in the tannins. ‘As is well known’, Harden wrote,

... tannic acid forms with the ... contents in the stomach ... a leathery insoluble compound upon which the digestive ferments cannot easily act, and hence excessive tea-drinking becomes a primary cause of indigestion. The human system is capable, under favorable circumstances, of coping with a small amount of tannic acid without ill effects; but the cumulative effect of habitually exceeding this ‘small amount’, to say nothing of the inveterate habit of large doses, is little less than disastrous. (Harden, 1931: 11)

Because of its effects on the ‘muscular coating of the intestines’, tannic acid ‘arrests their normal gradual movements and so induces constipation’. According to Harden, tannic acid’s ‘astringent effect’ also caused gastritis, various ulcers, dyspepsia and even stomach cancer (Harden, 1931: 11).

China tea, Harden argued, was free from these risks because of the way it was produced. As he explained,

The conservative habits of the Chinese have prevented them from adopting modern methods of extensive cultivation, and their tea is almost entirely grown by the small farmer. ... In many cases only a very small area – perhaps the corner of his farm – is planted with tea. ... Large plantations of a thousand acres or more, such as are common elsewhere, are practically unknown in China, as are also even the most rudimentary forms of tea-making machinery. It is no doubt partly due to these old-fashioned methods of cultivation and manufacture, as well as
to the differences in the soil and in the nature of the plant itself, that China teas should vary so greatly from those produced in any country. (Harden, 1931: 14)

What Harden presented was a more redemptive (if also differently racialized and essentialized) way of perceiving of tea production in China.

For Harden, the problem of tannin-induced indigestion was not just an outcome of the mechanized plantation processes that had replaced ‘old fashioned methods of cultivation and manufacture’. The industrial organization of factories in England and Scotland also played a role in the epidemic. Harden tells the story of ‘a young girl suffering from chronic ulceration of the stomach’. The London factory in which she worked had a custom whereby

each girl [would] bring a teaspoon full of tea wrapped in a piece of paper. These papers were emptied in the morning into a gallon pot, which was then filled with boiling water. During the day the pot was constantly refilled as the contents were exhausted, and each girl in the factory consumed at least six cups of this astringent concoction during working hours. (Harden, 1931: 17)

The longer tea steeped, the more ‘astringent’ (or ‘tannic’) it got, and the greater the chance for ulcers.

Advertisements for Doctor’s China Tea appeared in medical journals and popular media outlets. These were accompanied by testimonials from ‘medical men’, including doctors who themselves suffered from indigestion before making the switch to this new brand. In one of these vivid testimonials, a woman who was a devotee of Doctor’s China Tea describes being on holiday and being given another tea, whereupon she immediately started vomiting.

Doctor’s China Tea and Harden’s Treatise might seem like typical, if extreme, examples of aggressive, ‘extra-scientific’ direct marketing in the key of nutrition (Biltekoff et al., 2014: 18), but the Indian Tea Association (ITA), the trade organization that represented British planters, and other proponents of Indian tea, saw Doctor’s China Tea and similar products as serious threats. In most respects, Harden’s claims were both hyperbolic and anachronistic. In numerous scientific studies over the preceding decade, the theory that tea tannins caused the kinds of digestive problems he described had been largely discredited. And in all likelihood, products marketed as tannin-free probably contained at least some Empire-grown tea, given both its market saturation and the nature of blending. Nevertheless, the ITA considered marketing pitches for tannin-free tea to be harmful, unscientific propaganda.

The ITA’s response to these pitches consumed much of its work over the 1930s. Whereas critical nutrition studies have often identified a trend toward ‘simplification’ in industry-driven science, the ITA’s campaign did anything but simplify the relationship between tannins and health (Biltekoff et al., 2014). In fact, in an effort that was part scientific, part legal, and part commercial, the ITA set out to push back against the simplified causal connection that Harden and others made between tea drinking and the ‘epidemic’ of indigestion. The ITA did not dispute that such an epidemic existed, but it did maintain that claims of such a connection, as a letter sent to Harden from the ITA Secretary shortly after the publication of the Treatise asserted, ‘[ignore] the vital changes
in the whole habits of the people that have occurred in the past half century’. More importantly for the ITA, it was not valid to compare Doctor’s China Tea to what Harden called ‘strong coarse growths of other countries’. The ITA did not limit its opposition to Doctor’s China Tea to scolding private correspondence. In fact, it considered taking Harden to court. In October 1931, however, the ITA’s lawyers informed the organization that it had little standing to bring a libel suit.9 Instead, the ITA set out to produce an alternative, health-oriented pamphlet. For this, the association turned to scientists working at its Tocklai Experimental Station in Jorhat, Assam.

The ITA responds

Tocklai was the center of the ITA’s Scientific Department, which spanned from British universities to offices in London and Calcutta. Experimentation at Tocklai was initially oriented towards maximizing yields and increasing overall efficiency on plantations, but by the turn of the 20th century, tea science was reoriented towards maximizing quality. Before the onset of the Great Depression, the ITA had resolved to limit total production, seeking to reduce what it termed ‘coarse’ plucking and other plantation practices that might increase output but compromise taste and texture (Dey, 2018; Rappaport, 2017: 244). A central task of a tea science that held quality as its object of analysis and intervention was to materialize tannins as benign flavor-producing substances. That tannins were active compounds could not be debated. The question was what relationships and material contexts would catalyze that activity, and what the sensory results would be.

The objective of the ITA scientists was not to prove that the coarser, hardier *Camellia sinensis, var. assamica* tea was somehow intrinsically superior to China tea. Nor was it to deny that tannic black teas could leave stains on tablecloths, cups, and saucers. Instead, starting in the 1930s, their aim was to recast tannins as palatable and even valuable constituents of plantation-grown tea. Their audience was not consumers but the ‘medical men’ who were also the targets of aggressive marketing by the likes of Doctor’s China Tea.

A 1932 handwritten response to Harden’s treatise explained that ‘[d]uring the rolling process of black tea manufacture, the oxidized tannin is mixed with the leaf proteins and is largely precipitated. The result is the removal of much soluble oxidized tea tannin from the tea leaf.’10 Reminding readers that the tea they were drinking was the product of industrial machine manufacture, however, did not prove to be the most effective way of validating tea’s health and safety. Changing course, the ITA enrolled PH Carpenter, Tocklai’s Chief Scientific Officer, and senior scientist CR Harler to draft a scientific article that would refute the claims in Harden’s *Treatise*. Early drafts of Carpenter and Harler’s ‘The Chemistry and Pharmacology of a Cup of Tea’ began with a belabored discussion of the technicalities of tea manufacturing, describing the different processes that yielded green and black tea. The bulk of the article, however, traced tea tannin in its journey from steeping through mixture with milk, to ingestion by mouth, into the intestines, and out of the body.

As Carpenter advised in a January 1932 letter to the Assistant Secretary of the ITA, ‘since medical men appear generally to have a misunderstanding of tea’, the article should be submitted for publication in the *Lancet*. Carpenter wanted the findings
published in the leading medical journal of the day because he and Harler believed that they had identified a fundamental chemical difference between 'tea tannin' and the tannic acid associated with leatherwork and other dyeing processes. Carpenter emphasized that this finding would be a corrective to an often-cited 1911 *Lancet* study, which had treated the two substances as one and the same. Carpenter and Harler were not just defending tannic tea from allegations of toxicity, they were suggesting that tea tannin was a chemically distinct entity.

With the ITA’s support, Carpenter and Harler submitted ‘The chemistry and pharmacology of a cup of tea’ to the *Lancet* later that year. The article went through multiple rounds of peer review by scientists and industry professionals. Ultimately, however, the *Lancet* rejected the submission. A version of the manuscript was eventually published in the *Quarterly Journal* of the ITA, which had a far more limited reach. Many of the same findings were also published in Harler’s (1933) book, *The Culture and Marketing of Tea*. Even though Harler’s book proved to be quite popular (three editions – 1933, 1956, and 1964 – were eventually published), the ITA remained concerned that its message was not yet reaching the correct group: ‘medical men’. So-called ‘digestive teas’ continued to claim a considerable share of the market, and their manufacturers continued to promote these teas as medically preferable to conventional black teas.

In a 1933 letter to the Secretary of the Indian Tea Cess Committee, the ITA’s London Secretary, WH Pease, complained about this. The major problem from the ITA’s perspective was that

by stating that ‘DIGESTIVE TEA’ is free from excess tannin and consequently does little harm to people who suffer from indigestion and such like troubles, [advertisements] infer that all other tea is harmful. This idea is being steadily cultivated by the proprietors of Doctor’s China Tea, Typhoo Tips and Messrs. Brooke Bond & Co. Ltd. and the impression is, it is believed, steadily gaining ground that ordinary tea is harmful because of its tannin content.

Pease suggested that the ITA should do something to counter this impression: fund a new scientific investigation into the effects of tea on the human body. He solicited funding by the Tea Cess Committee in the amount of £500 to £1000 to pay for it. In 1933, the ITA contacted the *Lancet*, asking its editors to help identify scientists who might carry out new research on the effects of tea on human health. The *Lancet* agreed, and it found scientists at the University of Leeds who were willing to participate. The ITA responded with appreciation, but it then insisted that it must be able to block the publication of the Leeds study if it did not agree with the findings. The *Lancet* refused, and the study did not move forward.

Though it failed to seize editorial power over the *Lancet*’s studies of tea’s pharmacology, in 1936, the ITA did finally succeed in publishing a pamphlet aimed at the medical profession, under the auspices of the Empire Tea Bureau. *A New Essay Upon Tea: Addressed to the Medical Profession* (Indian Tea Association, 1936) began with a short history of the tea trade, from the East India Company’s exchanges with Chinese merchants, to the founding of tea plantations in India, to the entrance of Dutch tea into the market and the rise of packet teas. The core of the *New Essay* was Part II, which outlined tea’s ‘effect on the human frame’. The section began by stating that in the recent
controversies over the relative merits of Indian, Ceylon, China, and Javan and Sumatran tea, and of the relative safety of various blends, ‘minute and unimportant differences in the composition of teas came to be exaggerated’. Aiming to set the record straight ‘in light of modern knowledge’, the New Essay (p. 19) zeroed in on ‘the nature of tea tannin, about which so much misunderstanding seems to exist’. ‘Tea tannin’, the essay states, was primarily a force not in coloration or staining but in flavoring. It conferred ‘pungency and [gave] taste to the tea’. While it was true that Indian and Ceylon teas were richer in tannin (as well as caffeine and oils) than China teas, what was of most importance was not tea in isolation but tea in combination, or the blend. ‘The composition of the infusion’, wrote the essay’s anonymous authors, ‘is of much greater practical importance than that of the leaves from which it is made’ (Indian Tea Association, 1936: 23–24).

There was no effort here to distinguish Empire teas as preferable on their own. Instead, the New Essay (p. 25) recounted evidence from clinical studies of the health effects of ordinary, regular mass-consumer tea: ‘the cup of tea, as usually drunk with milk and sugar’. These clinical studies were carried out by analytical chemists, and their results had been published and disseminated in trade journals such as the Spice Mill and at meetings of the American and British Chemical Societies. While the ITA made use of the results of several studies, the New Essay cited no scholarly sources. Indeed, at least one of the scientists whose work was indirectly referenced in the essay, a Dr Bach, refused to have his name associated with it. In human subjects, Bach’s studies found that while a ‘10-minute infusion’ of tea drunk without milk caused ‘marked discomfort’, ‘the discomfort was less … with good quality tea than with poor quality’. The addition of milk and sugar to the infusion reduced reported ‘discomfort’ to zero (Indian Tea Association, 1936: 27). Subsequent laboratory studies confirmed that while tea-tannin ‘had a definite effect in reducing peptic digestion’, ‘milk is found to be a completely satisfactory antidote’ (p. 29). The New Essay’s scientific review ended with the definitive statement that ‘the cup of tea as normally drunk has no ill effects on the human body’ (p. 31).

The conclusion to The New Essay’s scientific section listed four summary points:

(1) Good tea, properly made, is in every way harmless.
(2) Poor tea, badly made, may have slightly unpleasant effects.
(3) Good India, Ceylon or Java-Sumatra tea produces no other symptoms and signs and no more harmful effects than does good China tea.
(4) If milk is added to the cup of tea, even the effects of excessive consumption and bad preparation are counteracted (Indian Tea Association, 1936: 32).

The final two paragraphs of the scientific section took up the question of ‘tanninless’ tea (p. 33). It cited a report, reproduced in the Lancet (1936a: 387–388), by a Mr HH Bagnall, City Analyst of Birmingham. Bagnall had analyzed a range of supposedly tannin-free ‘digestive’ teas and found that ‘the tannin content was the same as the average tannin content of ordinary teas of the same class’.

The ITA ultimately rested its case for the health of tea produced in large, industrialized, mechanized plantation environments on notions of the ‘goodness’ or ‘quality’ of the product (see also Singerman, 2017). Good quality tea – tea that had a refined, aromatic
flavor (and was also likely more expensive) – was also healthy tea. ‘The better the tea, the better for you’ (Indian Tea Association, 1936: 37). So-called ‘common’ tea could only be saved with a healthy dose of milk. The ITA considered the New Essay to be a success. In December 1936, the Lancet published its own response, confirming the assertions in the pamphlet, including the key findings: first, that ‘poor quality’ tea caused more digestive distress than ‘good’ tea, and second, that tea tannin could even promote digestion in the right circumstances. As the response summarized:

Tea drunk without milk or sugar only caused discomfort when the quality was poor, but the addition of milk and sugar prevented any feeling of discomfort even if the tea had been infused for ten minutes. … It appears from this investigation that tea taken in the ordinary English fashion with milk does not hinder digestion in healthy young people. If tea is taken without milk it should be a high-class tea. If tea is allowed to draw for long the dose of milk added should be proportionally large. (The Lancet 1936b: 1533–1534)

This emphasis on the ‘goodness’ of tea is reflected in ‘Observations on tea’, a pamphlet written by EA Andrews and published by the Empire Tea Bureau in 1939. Andrews writes:

The best quality teas are made from the youngest portions of the young shoots, the bud and the first open leaf, and it is found that the proportion of both tannin and caffeine is highest in these. … Of recent years the plucking of tea has tended to become finer and finer, and existing conditions of regulation of the crop … have emphasized this tendency. Present-day Empire teas are therefore produced from the portions of the shoot that contain the highest proportion of tannin present … [and they] give a refreshing and stimulating liquor. (Andrews, 1939: 7–8)

After over a half-century of debates between scientific and industry actors over the links between tannins and indigestion, British tea interests managed both to equate tannins with quality and to tout the superiority of plantation production. The ITA’s scientific effort to rescue the tannin was at the same time a late colonial doubling down on the indispensability of a bonded labor force that would delicately pluck those ‘two leaves and a bud’ and solidify plantation tea as ‘good tea’ (see also Besky, 2020). The image of the brown fingers of Nepali, Adivasi or Tamil women gently pulling away the tender sprigs of tea – an image that still graces the packages of countless tea brands today – is also a product of imperial technoscience.

By the end of the 1930s, discussions of what tea contained, both as a blended beverage and as a chemical amalgam, had transformed the very idea of quality in the market. The experiments that attended the rise of Empire tea – experiments that began with the carving out of plantations from the forests of Northeast India – yielded two new substances: black tea and tea tannins. Among other things, these experiments provided a medical and scientific rationale for a particular style of (racialized) consumption: that iconic milky, sugary British ‘cuppa’. Uncertainty about tea’s digestibility was momentarily resolved through a diverse but interconnected array of practices, from plucking and processing on plantations, to laboratory experiments, to home brewing. Rather than reducing what counted as ‘good’ tea to a set of quantitative measures, however, this ontological work blended subjective notions of taste with scientific methods of validation.
Conclusion

By the 1940s, the meaning of the term ‘digestive tea’ had changed. The Brooke Bond company began touting a new product: Pre-Gestee Tea. The tannins in this blend, advertising explained, would not harm consumers. They would help them digest their meals. Grocers found the brand name ‘Pre-Gestee’ overly cumbersome, and they soon began calling it by the abbreviated name ‘PG Tea’. In keeping with the new science of quality, Brooke Bond later added ‘Tips’ to the brand name. The message was that this new product contained only the ‘good’, tannic, young sprigs of tea. Today, PG Tips remains among the most popular brands of tea in the world, itself a kind of symbol of contemporary British consumer culture.

In his classic study of the place of sugar in contemporary Euro-American life, Mintz (1985) outlines the parallels between the making of the British industrial working class and the formation of the British Empire, both as an idea and as a vast commercial infrastructure. Mintz argues that the taste of that British cuppa, complete with milk and sugar, is as much a matter of global political economy and the racial division of labor as it is of national custom. Behind the seemingly quintessential British practice of drinking strong steeped black tea with plenty of sugar and milk lies a violent history of capital accumulation and dispossession. Milk, as illustrated in the culmination of the tannin debates, seemed not only to counteract any digestive ill-effects but to also further mask this history.

The debates over blending, brewing, the merits or harms of tannins, and the market that I have described in this article underscore that scientific investigation of the chemical components of industrial processes, from field to factory to infused cups, cannot be divorced from that history. The story of how tannins shaped and were shaped by normative understandings of taste and value is indicative of a kind of process that scholars of science, technology, and capital have documented elsewhere: in the determination of acceptable levels of chemical exposure in homes, factory farms and offices (Liboiron et al., 2018; Murphy, 2006; Nash, 2007; Shapiro, 2015), the rise of the calorie as the measure of food’s nutritional impact (Biltekoff, 2013; Guthman, 2011), and the purification of Caribbean sugar through automation (Singerman, 2017). Imperial science thus helped stabilize dominant forms of production and consumption such as the mixing of tannic black tea with milk. To blend Murphy’s (2006) ideas on materialization with those of postcolonial scholarship on foodways, the very ordinariness of the contemporary blended tea bag masks a decades-long effort to answer the ‘alimentary challenge’ presented by the British Empire (Roy, 2010: 10). This ordinariness was achieved once the industry’s desire for standardization and reliability was sutured to consumer desires for health and safety.

The advent of Empire-grown tea on the market in the 1830s promised regularity: a mercantile control over the market, a steady supply chain and a consistency of taste. However, that promise was consistently undermined by the perception of difference: racial, geographical, and olfactory. The story of the rise of blended black tea, then, illustrates the complex relationship between sensory perceptibility, market regularity and the digestive itineraries of people, chemicals and ideas.
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Notes

1. While seventeenth and eighteenth-century writing on tea highlighted its stimulant effect (its ability to ‘cheer but not inebriate’ (see Gray, 1903: ix; Rappaport 2017, 25; Reade, 1884: 36), it was not until the mid-19th century that such claims were subjected to chemical scrutiny.
3. At the same time, MK Bamber, a scientist based in Assam with the Horticultural Society, was conducting experiments on the chemical make-up of tea, with an eye to the relationships between production and chemical constituency (see Bamber, 1893; Indian Tea Association, 1894).
5. University of Oxford Bodleian Library, John Jay Collection, Tea and Coffee 1(88) ‘Copy of a letter received from a Medical Officer of Health testifying to the Digestive Qualities of The Doctor’s China Tea.’
6. University of Oxford Bodleian Library, John Jay Collection, Tea and Coffee 1(88) ‘Copy of a letter from a lady who was previously entirely unknown to us, showing the health value of the Doctor’s China Tea.’
7. See BL Mss Eur F174/1405.
10. BL Mss Eur F174/1405
12. BL Mss Eur F174/1405, Letter from WH Pease to the Indian Tea Cess Committee Secretary, dated January 27, 1933.
13. Later that year, another experimental proposal was floated, this time at a meeting of American and Foreign Markets Sub-Committee on April 7, 1933. Committee members suggested first finding scientists to evaluate the digestive tea claims through an experimental investigation, but this was not supported by most of the members as they believed that nothing would come of proving what they already knew. Then another suggestion was made ‘that the insidious Digestive Tea propaganda might be better countered by advertising that “All Empire tea is digestive tea”’ (BL Mss Eur F174/1407, ‘Extract from minutes of meeting of American and Foreign Markets Sub-Committee held on 7 April 1933’).
14. BL Mss Eur F174/1405, Letter from the Editor of the Lancet to the ITA, dated December 14, 1933.
15. BL Mss Eur F174/1405, Letter from ITA Secretary to the Editor of The Lancet, dated December 19, 1933.
16. BL Mss Eur F174/1405, Letter from the Editor of The Lancet to the ITA, dated December 22, 1933.
18. BL Mss Eur F174/1407, correspondence between Dr Bach’s lawyers (Charles Barker & Sons) and the ITA’s lawyers (Coward and Chance) between June 1935 and July 1935.
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