Infrastructural power: discretion and the dynamics of infrastructure in action

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ABSTRACT
This article analyses how a pair of nineteenth century commodity exchanges—in Chicago and New Orleans—shaped the sociotechnical infrastructures underlying two key types of market information—price quotations and crop statistics. Specifically, the paper investigates why these exchanges saw divergent outcomes, each successfully developing one information infrastructure but not the other. Prior scholarship has understood infrastructural development as the result of idiosyncratic, social structural alignments in actors’ resources and desires. This paper, by contrast, examines how such structural elements interacted with practical resources available to exchanges based on their roles within infrastructures. Findings demonstrate that the exchanges gained influence in proportion to their discretion over an infrastructure’s everyday operations and the market routines these enabled. This ‘infrastructural power’, or lack thereof, interacted with social structural resources in two distinct forms—‘feedback’ in New Orleans and ‘sacrifice’ in Chicago—providing or denying each exchange the ability to shape infrastructures to its advantage. These findings suggest that analysts should pay closer attention to market dynamics as they relate to ‘infrastructure in action’.

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Introduction
In 1871, the Impressionist painter Edgar Degas traveled from France to visit his uncle, a cotton broker in New Orleans. Degas’s depiction of his uncle’s workplace, A Cotton Office in New Orleans (1873), shows business proceeding at the languid pace of a humid Louisiana afternoon. There is a decided lack of urgency amongst the men in the scene. Only a few appear to be working, inspecting sample cotton, or reviewing an account book. The others seem to be onlookers, visitors, or loafers. In fact, the two central figures of the painting are each seated alone, quite contentedly unengaged in business—one slouches in his chair, smoking, reading the newspaper, while the other unhurriedly cleans his glasses.

Unknowingly, Degas captured in his image the last gasp of this informal, slow-paced version of the cotton trade and agricultural markets more generally. In the coming years, the world’s markets in cotton, wheat, soybeans, corn, and other agricultural goods would be reconfigured within a far more energetic and demanding mode of organization: the commodity exchange (Markham 2002). Exchanges were voluntary associations that brought together actors from across a city’s agricultural trade—merchants, brokers, warehousemen, manufacturers, shipping agents, insurance agents—for the purposes of growing and regulating their business. Exchanges set rules of competition and
cooperation, settled members’ disputes via private arbitration, and promoted uniformity in trade practices such as delivery, giving of margins, and establishing commission or storage rates. Many also established commodity-grading standards, facilitating global trading in cash markets, as well as the growth of speculative ‘futures’ markets. But beyond fostering cooperation among a city’s traders, possibly the most significant effect of the shift to exchange-based markets was the geographic consolidation of economic information (Markham 1987). Exchanges provided a central location for information exchange both informally through gossip and chatter as well as through official posting of information gathered using the pooled resources of its members. No longer would trading occur scattered across the offices, street corners, and saloons of a city, nor would information be passed primarily along private channels. Offices like those depicted by Degas—dislocated from other traders and the latest information—were pushed to the periphery. The real market was to be found on the exchange.

This article studies one facet of that historical shift, tracing the efforts of two major American commodity exchanges—the Chicago Board of Trade (CBOT) and New Orleans Cotton Exchange (NOCE)—to provide valuable information to their members in the decades after the Civil War. Particularly, it analyses these exchanges’ contrasting successes and failures in securing two key types of information: price quotations and crop statistics. Quotations—the prices at which agricultural commodities and futures contracts were bought and sold on other exchanges—offered a rapidly-changing view of the market. This information was becoming increasingly important. Globalization, standardization of goods, and increased speculative trading served to tightly link commodity markets the world over, making price quotations from hundreds or even thousands of miles away critical signals for traders. Crop statistics provided information about the growth, movement, and consumption of agricultural goods. In contrast to price quotations, they arrived weekly or monthly, rather than in minutes or seconds. While quotations offered a glimpse at how other traders were interpreting the market, statistics provided material for traders to make their own judgments on where prices were headed. The CBOT and NOCE diverged in their provision of each type of information to their members. Price quotations were successfully gathered and widely distributed to members of the CBOT, while on the NOCE they were disseminated unevenly and unpredictably. Conversely, the NOCE provided a vast amount of coordinated statistical information, which was used widely by its members, while statistics on the CBOT remained scattershot and unreliable. This informational divergence contributed to the production of markets and traders with distinct characters and orientations (Pinzur 2016).

Why did the exchanges diverge so significantly in the quality of information they offered their members? Answering this question requires recognizing that providing this information was not simply a technical challenge. It necessitated the integration of a range of material technologies (e.g. telegraphic wires and terminals, crop reporting forms), organizational protocols (e.g. rules for collecting, disseminating, and displaying information), state regulations (e.g. regarding who could access what information and for what purposes), and cultural understandings (e.g. what makes a particular type of information valuable, what makes a market fair) into operative wholes. The day-to-day relations and practices of the actors involved (e.g. exchanges, telegraph companies, statisticians, regulators, farmers) had to be coordinated smoothly enough so that exchange members could count upon the presence and worth of the information provided. Following STS scholars, we can refer to these integrated relations and coordinated practices across technical, organizational, and social components as ‘information infrastructures’ (Bowker 2010, Campbell-Verduyn et al. 2019).

Given this, our question is better stated as: Why did the information infrastructures on the CBOT and NOCE diverge so significantly? Previous research has demonstrated that infrastructures are shaped by broad political, economic, cultural, and organizational factors (Edwards 2003, Edwards 2009, MacKenzie 2018a). Actors apply social structural resources possessed by virtue of their positions within overlapping fields (Fligstein 2002, Bourdieu 2005, Fourcade 2007) hoping to shape an infrastructure’s features to their own benefit. Those with structural advantages have
a greater chance to impact the final result (Pardo-Guerra 2015, MacKenzie 2017). The current article builds on this research by claiming that actors’ discretion over their own practical contributions to the operation of an infrastructure constitutes an additional, discrete source of ‘infrastructural power’ (Braun 2020). Insofar as these actors’ contributions are necessary for the smooth functioning of an infrastructure, their ability to enable or disrupt others’ everyday routines constitutes a practical form of influence (Law 1990). While social structural power shapes an infrastructure’s features from without, infrastructural power allows contestation from within.

This article argues that the interaction of social structural and infrastructural resources shaped information infrastructures on the CBOT and NOCE. On the NOCE, initial social structural strengths and weaknesses were amplified through the exercise of infrastructural power in a process I call ‘feedback’. On one hand, the NOCE leveraged its organizational and cultural stature to shape a crop statistic infrastructure in which it became technically indispensable to the routines of traders; on the other, the Exchange’s economic and political weaknesses within the price quotation infrastructure led directly to a lack of discretion in everyday action and an inability to contest prejudicial elements. By contrast, the CBOT began negotiations over both price quotation and crop statistic infrastructures with sizeable organizational and economic resources. It successfully combined these resources with its own infrastructural power to force beneficial changes to the price quotation infrastructure. In the process, however, it assumed positions within the cultural and legal environment such that building a viable crop statistic infrastructure became far more difficult. This process, which I label ‘sacrifice’, was key to the infrastructural divergence on the CBOT.

The article proceeds in six parts. The next section reviews the main approaches to market infrastructures in order to highlight the distinctiveness of the concept of infrastructural power and the analysis of infrastructure in action. I then introduce the two exchanges and describe the materially-mediated relations and practices involved in price quotation and crop statistic infrastructures. The fourth section presents findings demonstrating the ongoing, intertwined exercise of infrastructural and social structural power as each exchange sought to shape and re-shape their information infrastructures. Section five discusses implications of these findings, including the need for increased theoretical attention to the dynamics of infrastructure in action across multiple infrastructures. Finally, section six briefly restates the value of the research for scholarship on market infrastructures.

Politics and power in infrastructure

This article conceptualizes price quotations and crop statistics as products of infrastructures—‘collections of technological devices, standards, classifications, protocols and material arrangements’ that support action locally while enabling global coordination (Pardo-Guerra 2015, p. 6). Infrastructures draw together a wide range of actors, devices, and practices across technical, organizational, and social environments into (more or less cohesively) attuned wholes that transparently underlie higher-order behaviors (Edwards 2003, Bowker 2010). Infrastructures, in addition to providing information, enable market activities such as price setting (Muniesa 2007), delivery (Pinzur 2016), settlement (Jeffs 2008, Krarup 2019), clearing (Millo 2005), order matching (Pardo-Guerra 2015), risk assessment (Poon 2009), and payment processing (Guseva and Rona-Tas 2014). Providing market infrastructures has become an increasingly important component of global exchanges’ business practices (Petry 2020).

Infrastructures remain below the visible surface of transactions, yet produce ‘world-ordering arrangements’ (Carse 2012, p. 543) with wide-ranging—and potentially unequal—consequences (Jeffs 2008, Lampland and Star 2009). As a result, their construction is often marked by contestation among multiple stakeholders. Technical components may be contested by engineers holding contrasting goals for a system (Pardo-Guerra 2019, 2015) or users seeking a material advantage over competitors (MacKenzie 2012, MacKenzie 2018b); managers and workers clash over infrastructures with an eye toward their impact on work routines and cultures (Bowker and Star 2000, Muniesa
legislators and regulatory agencies fight to define infrastructures and their legitimate forms in ways that appease vested interests or broaden their own ambit (Millo 2007, MacKenzie 2018a). In short, market infrastructures are not neutral, efficient outcomes, but contested reflections of the perspectives and desires of those with the power to shape them.

Actors involved in these struggles to shape infrastructures draw upon whatever organizational, cultural, economic, political, or material resources they can access from their position within multiple, overlapping fields (Fligstein 2002, Bourdieu 2005, Fourcade 2007). Meso- and macro-level elites utilize their political and economic power to ensure infrastructural advantages, exemplified in the ability of financial firms and lobbyists to mold market infrastructures (Mirowski and Nik-Khah 2007, Erturk 2013, Hardin and Rottinghaus 2015). Regulators, rating agencies, and economists draw upon their expert status to assert legitimate domain over infrastructural issues (Guala 2001, Millo 2007, MacKenzie 2018a). Micro-level actors, though often unable to intervene in the initial creation of an infrastructure, creatively repurpose the new material and cultural resources it produces in service of local goals, preferences, and commitments (MacKenzie 2003, Erturk et al. 2013, MacKenzie and Pardo-Guerra 2014, MacKenzie and Spears 2014). Coming full circle, this creativity at the micro level can lead to new, unforeseen connections among an infrastructure’s components, forming ‘long chains’ (Campbell-Verduyn et al. 2019) that become critical sites for meso- and macro-level intervention (MacKenzie 2017).

This work, which broadly represents a ‘material political economy’ (MacKenzie 2017) approach, shows how the social environment across multiple scales and fields impacts infrastructures. Yet, I argue that this literature’s attention to instances where social structure and infrastructure come together has meant overlooking their ongoing connection via mundane, infrastructural relations and practices. These everyday elements are, though, central to STS approaches to infrastructure (Bowker 1994, Star and Ruhleder 1996). The analytical strategy of ‘infrastructural inversion’ (Bowker 1994) demonstrates that any infrastructure that remains invisible, automatic, and taken for granted by one group must remain a highly visible, complex, source of constant engagement for another. Scholars must reckon with the dynamics produced in this ‘situated practical work of developing and using’ an infrastructure (Karasti et al. 2016, p. 4, emphasis added). Such an analysis is needed particularly because everyday, infrastructural work is itself a contingent, distributed process: not only is infrastructure constantly made, ‘but at the same time, it is - as a resistant and lively socio-material assemblage - part of this making process’ (Silvast and Virtanen 2019, p. 464, emphasis added). The dynamics of an ‘infrastructure in action’ will vary according to the ongoing sociotechnical relations it entails and have consequences for its connection to the broader social structural environment.

One valuable concept with which to consider these everyday relations is that of ‘infrastructural power’ (Braun 2020). Actors hold infrastructural power insofar as they have discretion to engage in or withdraw from labour that is critical to the functioning of an infrastructure itself (Law 1990). Braun (2020), for instance, demonstrates how financial actors’ infrastructurally critical positions as conduits for central banks’ monetary policies afford them sizeable influence. Policymakers become loath to restrict the financial sector due to their expectation that this ‘would blunt their own policy instruments and thus diminish their control over the economy’ (Braun 2020, p. 400). In a similar vein, Mitchell (2013) demonstrates that nineteenth century British coal miners’ ability to withhold the labour needed to produce the nation’s energy gave them an infrastructural power that they successfully converted into political influence. Finally, Besky’s (2016) analysis of the Indian tea market shows how brokers leveraged their centrality to the market’s ‘communicative infrastructure’ to resist efforts at financialization. In these situations, infrastructures were not only momentary subjects of contestation, but also ongoing means of exerting power through discretion over indispensable, everyday labour. (Features of structural and infrastructural power are summarized in Table 1.)

This article’s main theoretical goal is to untangle the distinct ways in which infrastructural and social structural power come together to shape market infrastructures. The development and use of
price quotation and crop statistic infrastructures on New Orleans and Chicago’s post-bellum exchanges provide contrasting cases for analysis.

Cases & methods

The Chicago Board of Trade (CBOT) and New Orleans Cotton Exchange (NOCE) were leading representatives of the new commodity exchanges gaining prominence in the latter half of the nineteenth century. The CBOT was established in 1848 to help bring order to Chicago’s rapidly growing agricultural marketing business (Taylor 1917). After the Civil War, the Board was home to several of the world’s largest agricultural markets, making it a critical player in global trade, a position it would retain well into the twentieth century (Cronon 1992). The NOCE was established in 1871 primarily as a means to revive New Orleans’s flagging spot trade in cotton, which had declined precipitously from its antebellum peak (Bouilly 1975). While it was unable to fully reverse changes wrought by the growth of railroad transport and loss of river-based commerce (Shannon 1945, Woodman 1963, Rothstein 1966), the Exchange did re-establish New Orleans’s position as the country’s premier market for spot cotton sales domestically and internationally, as well as introduce a sizeable futures market (Ellis 1973, Bouilly 1975). Both exchanges during this period operated under comparable legal and regulatory systems (Pinzur 2016).

Both exchanges sought to provide pertinent information on the state of world markets as a service to their members. The two types of information analysed in this article—price quotations and crop statistics—were particularly important. But gathering these required infrastructures composed of distinct actors, relations, materials, and practices.

Quotations—the prices at which commodities and futures were bought and sold on other markets—relied upon telegraphic transmission as their main technological component. Exchanges most commonly judged this technology by its ability to deliver speedy, reliable service. Delays of even a minute could prove costly to exchange members who would be open to predation from those with faster, private connections. Organizationally, the day-to-day operation of the infrastructure was negotiated between individual exchanges and the telegraph companies that served them. Each exchange would contract with a telegraph company both to send out quotations of sales from their own market and bring in the same from other exchanges. The NOCE and CBOT each secured their quotations through Western Union. In reality, they had little choice in the matter. During the 1860s and 1870s, Western Union took full advantage of weak anti-trust enforcement in the telegraph industry, acquiring major competitors and assuming control of a commanding share of the market. With the public’s desire for a state-owned telegraph service dwindling Western Union wielded their near-monopoly power mercilessly, raising prices, ignoring complaints, and delaying technical upgrades (Chandler 1977, John 2010).

The infrastructure required to produce and disseminate crop reports—statistics about the growth, movement, and consumption of agricultural goods—was quite different. The core challenge was not technological, but organizational. A crop statistic infrastructure required gathering data from myriad, widely-dispersed individuals and organizations—farmers, processors, railroad agents, shippers—as well as compiling this dispersed data at a ‘center of calculation’ (Latour 1988). Creating and maintaining crop reports required collaboration between informants with

| Table 1. Features of social structural and infrastructural power. |
|---------------------------------------------------------------|
| **Social structural** | **Infrastructural** |
| Drawn from broader political, economic, cultural, or organizational position | Emerges from discretion to engage in relations and practices that enable or disrupt routines |
| Externally imposed | Internally generated |
| Structural | Relational |
| Part of a general social environment | Specific to a particular infrastructure |
| Focused on construction | Grounded in ongoing use |
local knowledge, statisticians with mathematical expertise, and a publishing organization with regional, if not national, reach. State and federal governments attempted to organize this infrastructure beginning in the 1860s, but the statistics they produced were notoriously inaccurate (Pietruska 2012). If exchanges wanted more useful crop statistics, they would need to secure them through private infrastructures.

This article asks how the CBOT and NOCE fit into these networks of actors, practices, and relations, what sorts of infrastructural and social structural power they exerted from these positions, and how the interaction of these contributed to the observed divergence in information they brought to their members. The answer draws on multiple sources of data: the CBOT and NOCE archives, which contained annual reports, organizational records, published books and pamphlets, correspondence and meeting minutes, as well as relevant committee records; newspaper data from the Chicago Tribune and New Orleans Daily-Picayune; and secondary sources on the histories of each exchange. Materials range from the earliest sustained debates over these infrastructures, in the 1870s, up until 1914 when the US government temporarily assumed control of agricultural marketing in response to the destabilizing effects of World War I. Data were analysed using an inductively-formed, recursively-refined set of thematic codes.

As noted previously, the goal of the article is to detail the combined influence of infrastructural and social structural power in producing divergent informational outcomes on the two exchanges. The findings that follow reveal two different modes of interaction, which I label ‘feedback’ and ‘sacrifice.’ In a situation of feedback—seen on the NOCE—actors’ initial positions of strength or weakness in one area (social structural or infrastructural) were subsequently amplified in the other. In the situation of sacrifice—seen on the CBOT—efforts to align infrastructural and social structural power in one infrastructure undermined like efforts in the other. These dynamics demonstrate the multi-faceted, bi-directional relation between infrastructural and social structural power, as well as the complex interactions between infrastructural context and practice. To highlight the cases’ contrasts, the findings are organized by infrastructure, reviewing first both exchanges’ efforts to provide price quotations, then their work on crop statistics. The intra-exchange dynamics of ‘feedback’ on the NOCE and ‘sacrifice’ on the CBOT are noted when appropriate, to be explicated at length in the article’s discussion section.

**Price quotations**

**Chicago**

In 1848, the introduction of the telegraph served as a catalyst for Chicago’s evolution into the country’s grain marketing hub. But by the 1880s, the Board had developed entrenched conflicts over the day-to-day operation of the telegraph with service provider Western Union. Two aspects were critical. First, the CBOT, like most other exchanges, wanted faster service and lower rates. The Board’s motives were purely economic: faster provisioning of quotations made it a more attractive trading venue, while lower prices meant more money for the association to use elsewhere (Taylor 1917, see also, Preda 2006, on connection to ticker tape). The second, more significant, desired change was not (primarily) economic in origin, but political. From the time of its founding, the Board had been accused of promoting gambling under the guise of trade, particularly via speculation on its agricultural futures markets (Cronon 1992, de Goede 2005). Rebutting these claims and defending the legitimacy of its practices against public opprobrium were ongoing efforts (Lurie 1979). This work became more difficult beginning in the late 1880s thanks to the growing presence of ‘bucket shops’—local gambling shops where patrons could, for a small fee, place bets on the fluctuations of the CBOT’s price quotations (Fabian 1999, Hochfelder 2006). These quotations were supplied to the shops directly by Western Union and other telegraph operators. The increase in bucket shop activities reinforced the public’s association of the Board with gambling and reinvigorated state and federal efforts to regulate trading (Lurie 1979). To quash this
harmful association with gambling, the CBOT asked Western Union to cease disseminating their price quotations to bucket shops. But Western Union fought hard against any changes in service. The outcome of this clash would depend on which organization could muster the structural and infrastructural resources necessary to shape the price quotation infrastructure over the coming decades.

The CBOT first attempted to exert control over the price quotation infrastructure by creating their own alternative telegraph networks. In 1880, several CBOT members joined with a group of Milwaukee businessmen to form a telegraph company that directly linked the grain exchanges in both cities, circumventing Western Union’s wires (“Cheap Telegraphing Pays”). The company was a success. The cost of constructing the line was recouped within two years of operation and the increased competition drove down Western Union’s prices on that section by 80% in just a few years (“New Line of Telegraph”). In 1883, seeking to replicate this success, the CBOT attempted to construct and operate a direct telegraphic connection with the Merchants’ Exchange in St. Louis. But Western Union, having learned their lesson in Milwaukee, squashed the project by pressuring local landowners to engage the Board in a tangle of litigation and, for good measure, sending armed gangs to tear down recently erected poles and segments of wire (“Judge Wall Hearing the Case of the Board of Trade vs. Western Union at East St. Louis”). After more than two years of costly struggle against this obstruction, the CBOT called off the project. The experience soured the Board on the circumvention strategy more broadly, leading them to withdraw from a contemporaneous plan to build an independent telegraph line on the critically important Chicago-New York route. It simply did not have the resources to fend off the legal, economic, and political challenges that Western Union was sure to mount in response.1

Lacking the resources to circumvent Western Union entirely, the CBOT then sought to use its infrastructural power to increase pressure on the company. Key to their strategy was the fact that the price quotation infrastructure operated through inter-dependency: exchanges needed telegraphic delivery of information on the status of other world markets, but telegraph companies could only meet this need if exchanges supplied them with quotations. CBOT directors calculated that withholding their own quotations would so disturb trading on other exchanges and hurt Western Union’s income that the company would be forced to negotiate on issues of infrastructure. So, in 1890, the CBOT took the drastic step of removing itself from the price quotation infrastructure altogether, expelling all telegraph operators from the floor of the exchange in an effort to force Western Union to the bargaining table.

The effort backfired. Many CBOT brokers lost clients, who chose to execute their trades on exchanges that still received public quotations.2 Members who had grown reliant on public provision of price quotations left the Board to trade in places that still had a telegraphic connection—ironically, often the very bucket shops the policy was meant to eliminate.3 Furthermore, quotations were regularly smuggled off the exchange floor and disseminated around the country (Taylor 1917). As one angry Board member pointed out more than a year into the policy: ‘It is well known that in New York, in Minneapolis, in St. Louis, in Chicago, any man who wishes to pay $1.00 a week can get every shade of quotation that is made on the Board of Trade.’4 Faced with the failure to achieve any pressure through its actions, the Board rescinded the policy the very next year.

By the end of the century, having failed to materially circumvent or overpower Western Union, the CBOT redoubled its efforts to establish control over the price infrastructure through legal means (Lurie 1979). As it happened, the pivotal case came in February 1900 when a prominent bucket shop, the Christie-Street Commission Company, filed an injunction against the Board to prevent any cessation of its market quotations. In arguing the case, the Board’s lawyers drew on the legally and culturally significant distinction between productive contracts and destructive wagers (Hochfelder 2006, Levy 2006). Price quotations on the Board, they argued, served legitimate commercial purposes, while in bucket shops they were purely fodder for illegal gambling (Sager 1908).5 In June 1900, reversing the trend of previous trials, the Illinois Supreme Court affirmed these claims, ruling that the Board could legally withhold its quotations from bucket shops.
The day after the decision was handed down, the Board contacted Western Union, demanding that it cease supplying quotations to bucket shops. But Western Union made no immediate response to either the court’s ruling or the CBOT’s demand. Believing in the power of its position, it appealed the case to the U.S. Supreme Court and continued supplying quotations to bucket shops as usual (Lurie 1979, de Goede 2005). The state court’s decision did, however, alter the institutional environment enough that the CBOT could re-adopt older, infrastructural power-based tactics, which now hit with increased force. The first such tactic was withholding price quotations, albeit more adroitly than previously. Aware now of their own reliance on the telegraph, the CBOT did not disconnect themselves from the infrastructure entirely, but simply cut back on the frequency with which Western Union could gather quotations from the floor (“Plan Lines For Their Own Use”). This struck the right balance, hurting Western Union and the exchanges that were its customers more than it hurt CBOT members. The second tactic was to resurrect the old, discarded plan to circumvent Western Union on the key Chicago-New York route by building an independent telegraph line with the New York Produce Exchange. Though it had dismissed the possibility two decades prior, the CBOT now projected that wires could be up and running in just over four years (“Vote For a New Telegraph Line,” “Enters Telegraphic Field”). Western Union, already losing money from the slowdown in quotations, confronting the possibility of further pro-CBOT court rulings, and now facing the specter of a serious competitor for telegraphic traffic, recognized that it had lost control over the price quotation infrastructure. In March 1901—four years before the Christie case was finally settled by the U.S. Supreme Court—it agreed not only to limit dissemination of quotations to Board-approved recipients, but also to increase its payment for collecting CBOT quotations from $6,000 to $30,000 per year (“Quotation War May Be Ended,” “Quotation War to Continue”).

New Orleans

In New Orleans, the NOCE did not face the problem of bucket shops to anywhere near the same degree as the CBOT. It did, however, face significant technological challenges posed by the South’s degraded, post-war telegraphic infrastructure (John 2010). At the onset of the Civil War, Union forces had cut many telegraph lines extending from north to south across the Mason-Dixon line. During the war much telegraphic property was destroyed. Companies serving the South barely had enough business to stay afloat, let alone to repair damaged lines or expand coverage. After the war, the American Telegraph Company, which operated the main route to the north, planned to invest half a million dollars repairing its lines. The plans were scrapped, however, in 1866, when the company was absorbed by Western Union (Thompson 1947). At the founding of the Exchange five years later, little had been done to rebuild or expand southern lines (John 2010).

The main problem facing the Exchange was speed. The delivery of quotations was simply too slow. Delays were particularly pronounced at busy times such as the opening of the market or periods of large price fluctuations—the precise moments when traders most needed timely updates. The slow service on the Exchange’s public wire led to a persistent problem with ‘beats,’ i.e. instances where price quotations reached commission houses along private wires faster than the same information came to the Exchange over public lines. As a result of this time differential, members associated with private houses had a chance to act on information before it became common knowledge. The slow telegraphic connection also deprived the NOCE of business from merchants looking to place orders in the futures market. Even Southern merchants who wished to patronize a Southern exchange simply could not take on the risk entailed by the slow telegraph connection and sent their business to New York instead. For these reasons, increasing the speed at which price quotations moved through its market was at the forefront of the NOCE’s concerns.

But the NOCE, unlike the CBOT, had few social structural resources it could marshal to alter the state of the quotation infrastructure. It lacked the capital to circumvent Western Union, as a brief, failed exploration of a direct line to New York made clear. Even more significantly, the NOCE had
no natural allies who would also benefit from altering the telegraphic infrastructure. Critical in this regard was the Exchange’s position as the second-largest American cotton futures market, behind the New York Cotton Exchange (NYCE). This small difference in trading volume led to a spiraling loss of influence. Since prices on global markets were becoming more closely linked—its own consequence of telegraphic infrastructures—European markets could increasingly take the price in New York to represent the US market as a whole. The investment effects of the NYCE’s premier position further hastened the NOCE’s irrelevance: New York attracted more capital, which made its markets more liquid, which made them even more attractive trading sites (Markham 1987).

In its powerlessness, the NOCE’s only recourse for poor service was haranguing Western Union for improvements, a strategy that, predictably, saw little success. Writing in 1908, after two decades of pleas had fallen on deaf ears, the NOCE’s Committee on Information and Statistics admitted that its arguments had, ‘been gone over so often with the telegraph officials with no appreciable result, that [it was] at loss what further to do.’

Its secondary position meant that the NOCE also was at a disadvantage in negotiations over the organizational protocols governing the day-to-day operation of the price quotation infrastructure. One such protocol was the NYCE’s so-called ‘ten-minute rule.’ This rule allowed a member to withhold reporting a trade in futures to the Exchange for ten minutes. During this time, they could privately wire news of the trade to their partners in New Orleans, who would have the jump on members relying on the public wire. A second prejudicial arrangement was that the NYCE publicly transmitted to the NOCE only quotations of finalized sales, while commission houses often privately received news not just of sales, but also of offers and bids. This let them suss out market trends early. A trader who relied on the public wire in New Orleans, gave the following example:

Some days since [a futures contract for delivery in] a certain month was quoted at 10:30 AM in New York, 11 cents; by 10:31, it was offered at 10.99; then at ’98, ’97, ’96, and ’95 successively; but because there were no sales we did not get a quotation until 10:33, when a transaction was made at 10.95. The successive offers of ’99 to ’95 were known through private resources, but the Exchange was without information because it had to wait until an actual sale.

Both rules put NOCE traders taking quotations from the public wire at a disadvantage. New York’s economic advantage allowed them to slow-pedal their response to the Exchange’s complaints for years. In this way, the NOCE’s disadvantages at the field level extended to, and were reinforced in, the everyday relations and practices of the infrastructure in action.

These cases demonstrate the interaction of structural and infrastructural power in the CBOT and NOCE’s efforts to reshape price quotation infrastructures. The history on the CBOT illustrates a back-and-forth movement between the two forms. Following initial success using organizational resources to create its own telegraphic line, the CBOT encountered the limits of its structural power in the face of Western Union’s superior legal and economic resources. While its initial turn to infrastructural power—removing the telegraph from the floor of the exchange—was a failure, the CBOT eventually skillfully combined its discretion within the operation of the price quotation infrastructure with a more favourable legal landscape. From its initial, middling levels of both structural and infrastructural power, the CBOT effectively leveraged incremental gains in one with increased pressure in the other. By contrast, the NOCE’s structural and infrastructural weaknesses exacerbated one another. Its economic and organizational importance to Western Union and other exchanges was weakened by its secondary position vis-à-vis New York, the largest and best-connected cotton market, which became the American representative. This disadvantaged structural position was reinforced infrastructurally by Western Union’s intransigence and New York’s prejudicial rules. In total, these left the NOCE with few tools to fight against further depredations, let alone to seek improvements in the day-to-day operation of the price quotation infrastructure.

However, as the next sections will show, the combination of structural and infrastructural power regarding crop statistic infrastructures led to precisely opposite outcomes.
Crop statistics

New Orleans

Prior to the founding of the NOCE in 1871, New Orleans tradesmen made no effort to produce their own statistics on the growth and movement of the cotton crop. Instead, they relied on piecemeal information from travelers, statistical bulletins from the federal government, and private crop reports from companies based in New York and Liverpool (Sherman 1934). Prior to the War, with business booming and New Orleans the leading American cotton port, this arrangement met traders’ needs. But following the War, the habit of ‘patiently waiting for [others] to tell [them] what they knew’ about the state of cotton was deemed to be both insulting and bad business (Frost 1926, np). As a business strategy, it kept New Orleans ‘in leading strings,’ further cementing its status as subordinate to New York.16 Additionally, the NOCE feared that these reports, coming from markets largely representing manufacturers’ interests, might be manipulated so as to depress cotton prices (Bouilly 1976). Finally, after the experiences of the Civil War, occupation by Union forces, and Reconstruction, the indignity of relying on northern sources for information about the South’s staple crop increasingly grated on traders’ sense of pride.17 In response to this dissatisfaction, the NOCE’s young secretary, Henry Hester, set out from the earliest days of the Exchange to construct a network for gathering statistics on the growth and movement of the U.S. cotton crop.18 His goal, in his own words, was to ‘make the South the authority for facts concerning the growth and distribution of its great staple, cotton’ (Frost 1926, np).

This crop statistic infrastructure required procedures for gathering, standardizing, and commensurating information. Compared to the work of a telegraph company, it required little capital, but extensive social coordination. In this regard, the extant organizational connections and cultural solidarity among Southern businessmen helped the NOCE. Hester tapped knowledgeable and well-respected local middlemen known as ‘factors’ to serve as intermediaries in the earliest stages of the infrastructure’s development (Ellis 1973). As the infrastructure grew to be national in scope, the NOCE drew upon the coordination already present among exchanges, mills, cotton dealers, and planters as part of the longstanding, shared system for classifying and judging the quality of cotton (Boyle 1934). While not designed to gather statistics, this network offered a platform from which the statistical infrastructure grew.19 Coordination was aided further by the efforts of the National Cotton Exchange (NCE), which, in 1874, joined Hester’s statistical project, organizing expanded data collection through its member exchanges.20 Over the next few years, this network with Hester in charge grew steadily and implemented a uniform questionnaire for use in obtaining monthly crop information.21

The developments were well-received among members. After its first full year, the NOCE’s Committee on Information and Statistics reported that the system had seen ‘a fair degree of success,’ and the following year’s report noted ‘the increased favor with which the system is received both here and elsewhere.’22 By the system’s third year, the crop reports had become central to the everyday routines of traders, whose ‘thirst for information heretofore considered valueless [was] steadily increasing,’ feeding a growing consensus ‘in favor of obtaining and spreading abroad valuable facts’ regarding the growth and movement of cotton.23

This incorporation of crop statistics into actors’ everyday routines was critical for sustaining Hester’s project through a subsequent, difficult period. Though the crop reporting system was growing, by the end of the decade, data was becoming increasingly inaccurate. One problem was that even with the newly standardized questionnaires correspondents still interpreted questions differently. This problem was compounded by the National Exchange’s requirement that member exchanges merely compile responses as received, exercising no discretion over the acceptance or rejection of answers.25 In addition to commensurability problems, the method of measuring the size of the annual crop by estimating changes year over year meant that inaccuracies multiplied over time. The further it got from 1870—the year of the latest decennial census—the less accurate the estimates became.26 By 1879, even with data from an unprecedented number of respondents,
the NOCE claimed that it could not make any ‘predictions’ about the cotton crop but only present ‘an intelligent general view of the crop prospects.’\textsuperscript{27} In 1882, citing persistent inaccuracies, the NCE ceased compiling monthly reports of crop and acreage.\textsuperscript{28} The NOCE immediately objected. Citing the enthusiastic incorporation of statistics into previous years’ trading routines, they argued that the monthly crop and acreage reports ‘were of too much importance to be omitted.’\textsuperscript{29} Hester and others argued that the solution to current problems was not to abandon, but to improve, the statistical infrastructure. In 1884, after two years of advocacy from the NOCE, the board of the National Exchange was convinced and reinstated the reports.

The resumption of statistical reporting was simultaneously a vote of confidence in Secretary Hester, who assumed an even more central role. Reports were now sent directly to him rather than to committees of the local exchanges, so that he could supervise their compilation and publication. In 1887, after the NCE dissolved, Hester fully consolidated control of the statistical network and additionally incorporated the material resources of Cotton World, a weekly newspaper which he edited.\textsuperscript{30} The centralized control proved beneficial, as the infrastructure continued to grow without loss in accuracy. By 1890, Hester’s statistical infrastructure had grown so massive that his annual statement featured data from every delivery point, point of crossing on the Ohio, Mississippi and Potomac rivers, and all the mills in the South, without a single guess or estimate at any detail of the entire statement.\textsuperscript{31} NOCE crop reports once again ‘bore the stamp of recognized authority on both sides of the Atlantic.’\textsuperscript{32}

With this renewed authority came an even more thoroughgoing incorporation of crop reports into the everyday routines of the market. Members called for ever greater quantities of information, claiming that ‘the trade wants news and facts’ and that ‘if we are to form opinions independent of other centres, it must be by being as well, if not better, posted.’\textsuperscript{33} During periods of market panic, Hester would be enlisted to publish sober quantitative assessments of the market, which would invariably urge traders to spurn rumours in favor of ‘looking facts squarely in the face and dealing with them accordingly’ (Hester, 1926, p.8). The plethora of statistical information provided on the Exchange was widely viewed as one of its leading features. In 1905, Exchange President Abraham Brittin claimed that the recent growth in membership was directly attributable to increased information-gathering efforts.\textsuperscript{34} The same year, the Futures Committee called for the Exchange ‘to enlarge the scope of information from every quarter where cotton is produced or manufactured.’\textsuperscript{35} Through steady development over three decades, Hester’s weekly statistical report became so integral to the routines of trade that no man in the cotton world would think of doing business without it, ‘any more than the captain of a ship would think of sailing from port without chart and compass and sextant’ (Frost 1926, np).

\textit{Chicago}

As in New Orleans, traders in Chicago had no statistical infrastructure of their own at the founding of the Board. Their statistical reports similarly came from a hodge-podge of public and private sources, representing a wide range of values and opinions. Unlike, the NOCE, however, the Board never made a sustained effort to produce their own statistics or even coalesce around a single statistical source. This was not for lack of concern with the inadequacies of the status quo (Taylor 1917, Boyle 1934). Rather, contemporaneous organizational decisions and political factors made efforts to develop a statistical infrastructure complicated and risky.

Organizationally, the CBOT did not have a backdrop of inter-exchange coordination from which to build a statistics-gathering network. The CBOT’s leading wheat and corn markets, in contrast to cotton markets, had long resisted coordinating with other exchanges to produce uniform grading standards.\textsuperscript{36} As late as 1906, the CBOT was begging off efforts at standardization by both the US Department of Agriculture and the Grain Dealers National Association, arguing that national grading standards would be impracticable or hurt market prices.\textsuperscript{37} Further efforts at coordination, such as establishing standard minimum test weights for grades or widespread adoption of new grades,
were also rejected with no explanation other than that they conflicted with current practice. The CBOT was not prepared to weaken its market-leading status for the sake of greater coordination, nor was any state agency or professional association in a position to impose such rules upon it.

The CBOT was also facing politically and legally resonant attacks regarding monopoly control that constrained their options in building a statistical infrastructure. These came from two sources. First, farmers argued that they had no choice but to send their grain to be sold on the CBOT, a necessity that undercut their bargaining power. These claims were of a piece with rural residents’ general suspicion that the Board’s actions were underhanded, parasitic, and benefited middlemen at the expense of farmers (Cronon 1992, Levy 2006). Amplified by populist politicians in state and federal legislatures, this claim of monopoly was a key justification—alongside the charge of gambling—in many of the over 200 bills introduced to Congress between 1880 and 1920 seeking to regulate commodity exchanges (Markham 1987). Second, charges of monopoly came from bucket shops and Western Union. Their claim, frequently made in the court battles discussed previously, was that the CBOT exerted monopoly control not over physical grain, but over information—i.e. price quotations—that ought to have been public. This claim was, in fact, affirmed by judges in several lower court rulings unfavorable to the Board (Lurie 1979).

In response to these dangerous charges of monopoly, the Board stressed its non-action and non-control as much as possible. Addressing the farmers’ charge, it claimed to be a purely neutral platform, rather than market participant—witness the very first section of a CBOT pamphlet, Things You Should Know About Chicago Board of Trade, titled, ‘The Exchange Itself Does No Business’ (emphasis added). (Rollins 1920) In response to charges of controlling information, the Board demonstrated its hands-off approach in relation to crop statistic infrastructures. Rather than produce its own information or even curate the information they gathered, the Board disseminated all reports ‘with absolutely no restriction … without prejudice or partiality,’ which they claimed to be ‘for the benefit of all concerned’ (Stone 1911). Even when the CBOT knew information was of dubious quality it chose to publish it and let members use their best judgment. The CBOT declined to join a 1912 effort from the Council of Grain Exchanges aimed at cutting out unreliable sources, stating that ‘there is good work with the bad, and it would be injudicious and fruitless to condemn the whole system … since there is a popular demand for such information.’ Given the political and legal danger, and despite persistent entreaties from members, the CBOT made no effort to curate statistical information until 1918, at which point they took only the small step of certifying legitimate crop reporters.

As a result of their inaction, the Board was flooded with conflicting crop reports from independent statisticians and market prognosticators that mixed slipshod data collection and analysis with a healthy dose of gut feeling and estimation. Unsurprisingly, these analyses varied greatly. The Chicago Tribune, as early as 1887, was denouncing the reports of these ‘private-wire oracles,’ saying that, ‘No two of them ever agree upon a prophecy—indeed they rarely agree upon statements of fact’ (‘Private New York Wires’). The Board’s lack of engagement with this infrastructure meant that statistical information was given little credence. Among members, common knowledge was that ‘the man who trades on statistics is on the highway to ruin’ (‘Article 4 - No Title’).

The development of crop statistic infrastructures on the NOCE and CBOT were shaped by the interaction of social structural and infrastructural power. The NOCE began from a position of organizational strength, able to build upon a history of coordination via the National Exchange and use of shared grading standards. Its cultural stature as the center of the Southern cotton world and the significance of the statistical infrastructure as a means of achieving self-sufficiency further strengthened these organizational bonds and enrolled actors into the infrastructure. The value of the information produced and its widespread incorporation into calculative routines gave the NOCE infrastructural power to develop the system further, even in the face of inaccuracies. As reliance on the infrastructure grew, so too did the cultural authority of its central figure, Henry Hester. Conversely, the CBOT lacked any organizational ties upon which to build its statistical infrastructure, having long resisted coordination out of fear it would negatively impact its economic
position. Further, charges of monopoly in legislatures and courts made the Board wary of any efforts at coordination or control. As a result, the statistical infrastructure remained a disjointed and unreliable source of information for traders.

Theoretical implications of infrastructural power

These findings demonstrate how the CBOT and NOCE gained influence over different information infrastructures via the interaction between social structural and infrastructural power. As prior research would suggest, each exchange drew on the economic, political, cultural, and organizational resources associated with their positions in multiple, overlapping fields to shape infrastructure to their benefit. But these resources became valuable insofar as exchanges could combine them with the ‘infrastructural power’ that came from their position within ongoing relations and practices that supported the routines of multiple actors. This combination happened via distinct dynamics—which I call ‘feedback’ and ‘sacrifice’—across the two cases.

On the NOCE, price quotation and crop statistic infrastructures developed via a process of ‘feedback,’ wherein an initially strong or weak structural position was reinforced over time through the exercise of infrastructural power—or vice versa. For example, in its price quotation infrastructure, the NOCE began with two challenges. Technically, they were unable to send and receive messages quickly; economically and organizationally, they were secondary to New York. Over time, these weaknesses grew deeper in relation to one another. The NOCE’s inability to establish or disrupt routines among a broad set of users through technical means (e.g. by building their own connections to the North) deprived them of any power in ensuing struggles over organizational features of the infrastructure (e.g. the protocols of information sharing). By contrast, the NOCE developed their crop statistic infrastructure from a position of extant organizational coordination and cultural value. These factors made the initial production of a statistical infrastructure simpler and more desirable. Over time, this infrastructure became central to routines of statistical calculation on the cotton exchanges. This widespread reliance then provided an independent resource which helped the NOCE push past early problems with the infrastructure. In the end, their technical competence was the basis for new levels of esteem within the cotton world.

On the CBOT, information infrastructures developed by a different process, which I label ‘sacrifice.’ As opposed to the NOCE, which began building their infrastructures from weak or strong positions, the CBOT developed both of their infrastructures from moderately powerful positions. On price quotations, it possessed some economic and organizational capacity to circumvent Western Union and its price quotations were highly valued by other exchanges; however, Western Union’s quasi-monopoly, the CBOT’s own members’ reliance on telegraphed price quotations, and the Board’s precarious legal position all worked against it. On crop statistics, the Board was weakened by a lack of prior coordination with other exchanges as well as accusations of monopoly control; yet the necessary infrastructural work was well within its capacity, with eager national associations available to be enrolled in the network, as well as state and private statistical reports that could have been harmonized with minimal capital. The CBOT’s divergent outcomes regarding these two infrastructures, then, were not simply continuations of initial conditions. Rather, the CBOT made decisions in pursuing control of its price quotation infrastructure that limited its ability to effectively contest the development of crop statistics. The Board, in its fight over the price quotation infrastructure, was forced to address charges that it controlled, altered, and monopolized information. It prevailed in these political and legal battles, in part, by committing to principles of neutrality, non-action, and non-involvement in agricultural markets. But this commitment—and the costs that would come from breaking it—complicated the Board’s engagement with crop statistics. Rather than take any steps that could be viewed as intervention, the CBOT remained entirely hands-off, letting its statistical infrastructure languish for decades. In short, the CBOT sacrificed the ability to develop a statistical infrastructure in the process of building up control over price quotations.
This distinction points to certain critiques and areas for theoretical development. First, while a ‘feedback’ dynamic occurs over time within a single infrastructure, ‘sacrifice’ happens across the boundaries of multiple infrastructures. Such dynamics across multiple infrastructures within an organization remain largely unstudied. Market infrastructures have generally been analysed in the singular: a grading infrastructure (Cronon 1992), a settlement infrastructure (Krarup 2019, Rella 2020), an execution infrastructure (MacKenzie 2017, Pardo-Guerra 2019). This article demonstrates that market infrastructures, particularly information infrastructures, can usefully be studied in the plural. Researchers should be alert to the new dynamics this multiplicity introduces to the production and maintenance of infrastructures. Beyond ‘sacrifice’, one can easily imagine a technically-focused, path-dependent relationship (Mahoney 2000) where practical elements of one infrastructure demand particular features in other, linked infrastructures (e.g. the relation between commodity grading and contract settlement infrastructures (Pinzur 2016)). Beyond technical connections, one can imagine sets of infrastructures being discursively linked in relation to a particular organizational vision or goal (e.g. efficiency or equity), and thus rising or falling as one in relation to the status of that organizational discourse.

The second implication of these findings is that a focus on the ‘idiosyncratic’ alignment of interest and opportunity among actors in different fields (e.g. Kennedy 2017; MacKenzie 2018a) offers only a partial perspective of infrastructural change. This perspective suggests a primary process wherein social structural factors ‘congeal’ (Krippner 2001) in market infrastructures, determining their characteristics and capabilities. But the findings of this article show that infrastructures are not simply ‘[interwoven] with’ and given form by ‘episodes of cooperation and conflict’ (MacKenzie 2018a, p. 1680) at the field level. Additionally, they shape relations between conflicting parties and offer a distinct, interior pathway for forcing re-engagement with the form of an infrastructure. This suggests a more energetic role for infrastructural actors within a material political economy perspective. Scholars, in addition to describing how different fields meet at key moments to influence the development of market infrastructure, should investigate how infrastructural relations and practices cut across fields, extending into and altering social structure. Further research on this topic will promote a greater understanding of infrastructural change, particularly as it relates to dynamics of ‘infrastructure in action’.

**Conclusion**

This article has demonstrated the value of research on actors’ ongoing contributions to the web of relations and practices that comprises an infrastructure in action. To the degree that actors have discretion to enable or disrupt widespread routines they hold a form of infrastructural power, which can be used to force a renegotiation of the very infrastructure to which they contribute. In the cases of the CBOT and NOCE, the combination of their roles within price quotation and crop statistic infrastructures and their distinct social structural resources empowered both exchanges to mold one infrastructure, but not the other, an outcome with long-lasting consequences for their markets. In developing the concepts of ‘infrastructural power’ and ‘infrastructure in action,’ the article draws on the relational character of infrastructure to offer a new reply to the question of ‘who controls [a market] assemblage, and what socio-technical arrangements facilitate the exercise of that control’ (Erturk 2013, p. 339). The answer involves looking beyond the myriad, power-laden struggles that occur around an infrastructure toward the ways that power operates through an infrastructure.

While the cases analysed in this article are historical, the issues surrounding market infrastructure—particularly the politics of its construction, expansion, and alteration—are growing in their contemporary significance. Exchanges’ role as infrastructure providers, examined here in its infancy, has exploded in recent years, becoming a core business feature and source of power (Petry 2020). The trading of new instruments (e.g. cryptocurrencies) has depended on the construction of new infrastructures for recording and accounting for blockchain transactions (Hayes 2019,
Global financial integration is engaging states and private actors in challenging negotiations over cross-border infrastructures (Krarup 2019). The “Cambrian explosion” of fintech products battling for market share necessarily draws in the infrastructures needed to provide interoperability (Nelms 2018). The concepts and methods developed in this article’s historical analysis promise insight into the origins and mechanisms of power in these modern applications as well.

Notes

1. CBOT Board of Directors records, Box 7, Folder 10, Mar. 22, 1881; CBOT Board of Directors records, Box 9, Folder 34, Nov. 10, 1883
2. CBOT Organizational Records, Minutes of the Annual Meeting, Box 6, Folder 2, 1892
3. CBOT Organizational Records, Box 5, Folder 14, Nov. 9, 1891; CBOT Organizational Records, Minutes of the Annual Meeting, Box 6, Folder 2, 1892
4. CBOT Organizational Records, Box 5, Folder 14, Nov. 12, 1891
5. CBOT Organizational Records, Minutes of the Annual Meeting, Box 14, Folder 15, 1918
6. Each approved recipient of quotations had their own set of requirements to meet, which ensured that quotations were not then used for gambling purposes (CBOT Board of Directors records, Box 43, Folder 5, Oct. 23, 1900).
7. CBOT Organizational Records, Minutes of the Annual Meeting, Box 9, Folder 27, 1902
8. The first mention of bucket shops in NOCE Annual Reports comes in the 1903, with the addition of a “Committee on the Suppression of Bucket Shops,” whereas the CBOT formed a Special Committee on the issue back in 1882. The NOCE’s 1907 Annual Report notes that at the highest point there were 32 bucket shops in the state, compared with a high of 80 in the city of Chicago alone in 1895 (CBOT Annual Report, 1899). It is conceivable that Louisiana’s popular state lottery, which ran 1868–1893 may have provided an alternative for wagers from the general public.
9. NOCE Annual Report (AR), 1896; AR, 1911
10. NOCE Annual Report (AR), 1883, 1888, 1889, 1893, 1906, 1910
11. NOCE Volumes, #164, Jan. 12, 1920
12. NOCE Annual Report (AR), 1904
13. NOCE Annual Report (AR), 1908: 31
14. NOCE Annual Report (AR), 1896
15. NOCE Annual Report (AR), 1903: 31–32
16. NOCE Annual Report (AR), 1890: 32
17. NOCE Volumes, #127, January 5, 1875.
18. NOCE Photographs and other records, Box 72, Folder 8, May 24, 1871
19. NOCE Annual Reports, 1872
20. NOCE Annual Reports, 1874
21. NOCE Annual Reports, 1877
22. NOCE Annual Reports, 1872: 4
23. NOCE Annual Reports, 1873: 52
24. NOCE Annual Reports, 1874: 106
25. NOCE Annual Reports, 1881
26. NOCE Annual Reports, 1878
27. NOCE Annual Reports, 1879: 304
28. NOCE Annual Reports, 1882
29. NOCE Annual Reports, 1884: 24
30. NOCE Annual Reports, 1884; AR, 1885
31. NOCE Annual Reports, 1891
32. NOCE Annual Reports, 1890:31
33. NOCE Annual Reports, 1889: 26
34. NOCE Annual Reports, 1905: 11
35. NOCE Annual Reports, 1905: 37
36. CBOT Committee Records, Box 319, Folder 5, various dates, 1905–6
37. CBOT Committee Records, Box 319, Folder 4, Feb. 9, 1906;
38. CBOT Committee Records, Box 319, Folder 10, Mar. 19, 1907
39. CBOT Organizational Records, Minutes of the Annual Meeting (MAM), Box 14, Folder 7, 1915: 4.
40. CBOT Organizational Records, Box 13, Folder 10, Sept. 24, 1912
41. CBOT Board of Directors records, Box 84, Folder 37, Jun. 15, 1918
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