

“Industrial Espionage along the Delaware...and beyond”
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This paper uncovers a largely unknown case of industrial espionage from early 19th-century America that challenges the standard view of technology transfer in the Atlantic world during the early stages of industrialization. Industrialization depended on the acquisition of new technology, which created an environment where naturally, to maintain their competitive advantage, the “haves” guarded their secrets against the “have-nots,” in turn, to close the gap, the “have-nots” resorted to stealing technology from the “haves”. Though not technically illegal until the 1880s when international law protected intellectual property rights, even before then most people viewed industrial espionage as a violation. Still, necessity justified its use as the “premier tool of industrial development.” As Doron Ben-Atar argued in his recent book on technology piracy, industrialization sparked a “worldwide all-out competition for technology” that continues to this day.¹

Scholarship documenting the forbidden exchange of technology in the 18th and 19th centuries has concentrated on schemes to catch up with England, the leader of the industrial revolution, particularly by pirating equipment and stealing workers from the textile industry. As a result, technology transfer appears to run only in one direction- from England to the rest of the Atlantic world. My purpose is not to dispute these scholars’ conclusions about English technological and industrial dominance, but rather to call attention to the often stated fact that technology transfer was “never a one-way street.” The lack of detailed scholarship to support the

claim causes us to forget that all nations participated in the production and transfer of technology during the early stages of industrialization.²

In the race to industrialize all competing nations were simultaneously agents and targets of industrial espionage. Governments and private citizens alike orchestrated covert operations to steal technology from rivals. Through the work of Doron Ben-Atar we know that the United States government and citizens used “technology piracy” to become the world’s industrial leader. I am interested in the United States not as an agent provocateur but as a target of industrial espionage. As it turns out the Prussian government devised and executed a plan to appropriate American flour milling technologies and techniques in the 1820s.³ When it came to flour milling in the early 19th century, “American” meant “better,” and the Prussians knew this. The United States may have been largely an “importer of technology” during the era of the early republic, yet the Prussian case proves that Americans were technology exporters too. In addition to redirecting our view of technology transfer,² the case also brings us into the secret world of industrial spies and provides the opportunity to study the diffusion of stolen knowledge. Finally, the case raises important questions about American attitudes toward industrial espionage before the United States became the world’s industrial giant.⁴

The Plan

Voltaire once said that “Prussia is not a country with an Army but an Army with a country.” Prussia’s military prowess was established during the Seven Years War when it held off a coalition of Austria, France and Russia. Despite suffering a humiliating defeat at the hands of Napoleon at Jena in 1807, Prussia emerged from the Napoleonic wars the dominant power in Germany over their long-time rival, Austria. Still, the war exposed Prussia’s backwardness. When peace came liberal bureaucrats, schooled on the likes of Adam Smith, called for reform.

They sought nothing less than the total modernization of the Prussian state, society, and economy.

Discussions about economic development focused on two things: industrialization and trade. Despite their new ideas the Prussian leaders maintained a mercantilist perspective on international politics. They believed that industrialization was the key to improving Prussia's import-export ratio, "the traditional measure of state power." In other words, sell more, buy less. But to do that the Prussians needed first to develop a manufacturing sector and second to find markets for its new products. In contrast to the United States, the Prussian government took a hands-on approach to economic development. The *Seehandlung* (Overseas Trading Company) stimulated financial and commercial growth, while the Department of Industry & Trade encouraged manufacturing by any means necessary.⁵

As head of the Department of Industry & Trade from 1818 to 1845, Peter Beuth earned the title, "father of Prussian industry." Beuth fully embraced the technology doctrine of the machine age. For example, he once argued that to support craftwork over factory production made as much sense as replacing gunpowder with bows and arrows. To encourage the rapid industrialization of Prussia Beuth drew on methods well-established in the Atlantic world during the 18th century. First, to promote innovation and technological development Beuth reorganized the Technical Commission originally created in 1810. The Commission's most important new duty was to administer the patent law. Patents had long been the European, and by extension American, tool of choice to encourage invention and industrialization. In exchange for exclusive rights for a set period of time, five years in Prussia, inventors disclosed their secrets to the government.⁶ Second, to foster the exchange of technical information between public officials, army officers, university professors, industrialists, scientists and artists, Beuth established the

Association for the Promotion of Industrial Knowledge in 1820. Of the 367 founding members, there were 100 civil servants (including university professors), 66 merchants, 66 bankers and 6 mechanics. They met on Sunday afternoons in Berlin at the House of Industry, where the Association also maintained a library of books, periodicals, engravings and collection of full-sized machines as well as models. The published transactions show how thoroughly members monitored technological advances both at home and abroad. Improvement societies like the Association were products of the Enlightenment and existed across the Atlantic world.⁷

Finally, to develop homegrown talent to supply industries with skilled technicians Beuth formed the Technical Institute in 1821. Located in Berlin, boys 12-16 years old enrolled in a two-year program, eventually extended to three years in 1842, which taught the basic subjects required by civil engineers and builders including mathematics, chemistry and mineralogy. The school was free and the government covered the annual cost of room and board (300 Thalers). The number of students rose from 13 the first year to 101 in 1845. Beuth evidently weeded out the weaker students sometimes losing as much as 50% of an entering class after the first term. Many of Prussia's leading engineers of the 19th century were graduates of the Institute, including August Borsig, the builder of Prussia's first locomotive. Beuth also pushed for the construction of "junior technical institutes" in the provinces. After reviewing a syllabus from one of the provincial schools Goethe commented: "We are now assured of the comprehensive care with which the Prussian State is endeavoring to keep pace with the incessant advances in technical methods effected by our neighbors."⁸

Industrial espionage played a central role in Beuth's plan to industrialize Prussia. He recruited industrial spies from the Technical Commission, Association for the Promotion of Industrial Knowledge, and Technical Institute. The two most popular forms of industrial

espionage at the time were technology piracy (stealing machinery) and labor piracy (stealing skilled labor). The Prussians engaged in both strategies to foster industrial progress, but to acquire America's flour milling secrets they selected technology piracy as the best method to get what they wanted. Rather than entice American millwrights and millers to emigrate, the Prussian government decided to train their own men undercover in America.⁹

What did the Prussian government plan to do with America's flour milling secrets? Well, the Prussians wanted to expand their domination of Europe's grain trade into flour production. Danzig was the greatest grain port in Europe because the city had easy access to Poland's fertile Vistula River basin as well as to Europe's finest and whitest wheat grown in the Russian Volhynian valley. Hundreds of thousands of bushels of grain passed through the city each year, stored temporarily in hundreds of warehouses on an island in the middle of the Vistula River where light was forbidden to prevent fire. The grain was purchased from large landholders in the interior by middlemen, mostly Polish Jews, who then sold the grain to export merchants in Danzig who in turn shipped it to England, Spain and other markets.¹⁰ Prussian leaders saw in flour the chance to improve their balance of trade with other European nations, especially England. Because the German states lacked colonies in the new world they were dependent on foreign nations for tropical goods, which usually came at a high price. The independence of many of Spain's colonies during this period gave Prussia direct access to markets for coffee, sugar and other tropical goods for the first time. But in order to capitalize on the situation and by-pass English and Dutch merchants, the Prussians needed to sell their own merchandise to Caribbean and South American consumers. One of the commodities they selected was flour.¹¹

The flour scheme would not be easy to pull off. Investigations undertaken by Beuth and the Department of Industry & Trade in the mid-1820s revealed the backwardness and inferiority

of Prussian flour milling. First, most Prussian mills were small in size and scale, serving the needs of a single neighborhood rather than long-distance markets. That German consumers preferred rye over wheat and grist (a courser grind) over flour meant millers lacked the expertise needed to meet the desires of foreign consumers who favored finely ground wheat flour. Second, the all important technology deficit, English and American milling methods and the use of superior machinery produced higher yields of flour. Beuth observed that Prussia could “only compete when our prices for grain are low enough to cover [our] lack of technology.” Third, though the customs union, the *Zollverein*, lifted many trade restrictions between the German states, new legislative restrictions in the grain trade continued to hamper free trade and the construction of large, technologically advanced mills. Beuth concluded that only by acquiring the flour milling secrets of the industry’s leaders could Prussia overcome these obstacles and catch up.¹²

The Prussians turned to England first, as the world’s leading industrial power, the small island nation was the target of most efforts at industrial espionage in the 18th and 19th centuries. England built one of the first steam-powered flour mills in the late 18th century at Black Friar’s Bridge in London. Prussia’s industrial spies sent to snoop around in the 1820s admired the large-scale of English flour mills and noted that cleaning and sifting machines allowed the English to maximize the ratio of flour produced per bushel of grain ground. Someone even succeeded in enticing an English millwright to migrate to Prussia and build an English-style flour mill at Magdeburg. The design was later copied by German millwrights at mills in Berlin, Guben and Hamburg. Beuth also explored a modern mill in France in 1826.¹³

The Prussians appeared most interested in American flour milling techniques, however. Recognizing that the United States, not England or France, was their greatest rival in the flour

industry, Beuth concluded that the scheme depended on acquiring a “complete knowledge of not only the mechanical equipment of the North Americans, but also their miller’s trade.”¹⁴

American innovation and expertise in this field reminds us that the entire Atlantic world was involved in the production and transfer of technology. Though the English dominated most industries at the time, when it came to flour milling the United States set the standard. As the leading flour exporter in the Atlantic world, including Prussia’s target markets in the Caribbean and South America, the United States had led the way in flour milling improvements since the 1780s.

It was then that American inventor Oliver Evans advanced the milling industry by automating flour mills through the introduction of a series of new machines, for which he received the third United States’ patent in December of 1790. In 1795 Evans went public with his designs in the publication of *The Young Mill-Wright and Miller’s Guide*.¹⁵ Evans’ guidebook was the first to make mill blueprints directly available to millwrights. Printed descriptions of flour mills existed, along with line drawings before this time, but they catered mostly to gentlemen and not the mechanics who actually built mills. Also, of the published building guides on the market in the late-18th century, most provided plans for small-scale domestic mills and not large-scale commercial mills.¹⁶ *The Young Mill-Wright and Miller’s Guide* was an original how-to manual divided into four main sections complete with twenty-six illustrations. “The Young Mill-Wright’s Guide” introduced Evans’ new machinery. The new mill allowed one worker to do the work of five. Evans designed elevators to move grain vertically, conveyers to push grain horizontally, and hoppers to sift and dry the flour. The final product was finer, drier, and longer-lasting flour. “The Practical Mill-wright,” written by Baltimore miller Thomas Ellicott, provided comprehensive directions for building a mill from start to finish including a list of materials. *The*

Young Mill-Wright and Miller's Guide reached audiences beyond America. Thomas Ellicott's chapter was reprinted in technical journals in England by 1796 and France by 1802.¹⁷ Evans went on to open the Mars Works in Philadelphia, where he constructed steam engines and boilers for mills, steamboats, and factories.

Given that Evans broadcasted America's flour milling secrets to the world why did the Prussians resort to industrial espionage? I suppose it is possible that the guide never reached a German audience, yet highly unlikely given the well-documented diffusion of technology and scientific information across Europe through intellectual circles and improvement societies. It is more likely that they only had the English or French reprint of Ellicott's chapter, which lacked most of Evans' contributions. However, direct evidence from one of the spies indicates that the Germans were well acquainted with Evans and his inventions. In fact, the Prussians had good reason to opt for industrial espionage. First, though Evans' book described machinery and processes in greater detail than most, perhaps the descriptions and drawings were still too general for the Prussian craftsmen so new to commercial milling to emulate. Second, Evans' printed guide provided an out-dated look at the state of American flour milling. To be competitive they had to catch up to where the Americans were now (1820s) and not where they were then (1790s). Third, the Prussian government was after trade secrets that *The Young Mill-Wright and Miller's Guide* did not discuss.

The Mission

The Prussian government chose Friedrich Wulff and Friedrich Ganzel to steal America's industrial secrets. Though their main target was the flour industry, any useful technologies or techniques were to be collected for Prussia's industrial advancement. Their cover was to pose as mechanics looking for work and in that way infiltrate the core of American industry. Who were

these two Friedrichs? So far I have pieced together only that they attended the Technical Institute's two- year program sometime between its opening in 1821 and their secret mission in 1827, placing them among the Institute's early graduates. As principal of the Institute and Director of the Department of Industry & Trade, Beuth probably hand-picked the two engineers for the American assignment. Given the known age range of Institute students, Wulff and Ganzel were most likely in their early twenties when they traveled to the United States. Records document that Wulff came from the Danzig area on the Baltic, long the center of Europe's grain trade. Ganzel settled in the province of Silesia upon his return from America, but whether or not this was a homecoming remains unknown. Silesia was the home of Germany's linen industry and by then the center of German industrialization in the east. It seems likely that they both spoke English. What is certain is that their education at the Technical Institute prepared Ganzel and Wulff to pirate technology for the fatherland. Their age, skill, and immigrant make-up of America gave them every reason to believe they would easily accomplish their mission.¹⁸

The summaries written by Ganzel and Wulff included in the preface of the official report published in 1832 shed light on what would otherwise remain a secret. The summaries make it possible to retrace their steps, documenting the places they went, the people they met, and what technologies they pilfered. The summaries also provide scattered details about the organization of the operation including the use of networks containing co-conspirators, usually Prussian diplomats and merchants, as well as accidental traitors. They left Berlin on August 1, 1827 and after touring European factories in Germany, Holland and France, where perhaps they honed their undercover skills, the two young industrial spies boarded a ship at Havre de Grace on September 15th bound for the new world. Arriving in New York on October 23rd the Prussian government gave them until May 1, 1829 to steal America's industrial secrets.¹⁹ During their 18-

month stay they traveled as far south as Virginia, west to Ohio, and north to Massachusetts, exploring along the way America's world-famous flour mills as well as any other industrial site they could access including paper mills, ironworks, and the Lowell textile mills. On the way home they stopped in Liverpool to check up on the state of English industry. Ganzel and Wulff had been traveling for nearly two years when they reached Berlin on July 1, 1829. The official report documents the success of their mission.

It is worthwhile to reconstruct the American leg of their journey in detail. Ganzel and Wulff stepped off the boat in New York harbor and reported directly to the firm of Hupeden & Meyer. These two men served as important liaisons for the spies and their first service to the Fatherland was to help Ganzel and Wulff get money. The Prussian government evidently provided them with a letter of credit which they redeemed for cash from the firm of Goodhue & Co. located at Number 44 South Street. The firm's founder, Jonathan Goodhue, moved from Salem to New York in 1808 to enter the dry goods trade. When Ganzel and Wulff showed up in 1827 Goodhue & Co. was among the city's most successful firms trading around the world.²⁰ Hupeden and Meyer also coordinated visits to factories around New York. For example, on November 6, 1827 the New York merchants put Ganzel and Wulff on a steamship heading north for Fishkill on the eastern bank of the Hudson River to investigate several textile mills. One mill was managed by the brother of a doctor from Coblenz and the other operated by Schenk & Co. The Schenks were a leading family in Fishkill. Major Henry Schenk had served in the Revolutionary war and even entertained George Washington, the Marquis de Lafayette and Baron Von Steuben at Locust Grove, the family estate. In 1828 both Abraham and Peter Schenk ran manufacturing enterprises in town, one of them directed Ganzel and Wulff to the nearby Newlin flour mill. The miller turned down their request for employment, explaining that he

would soon shut down for the winter. But through their conversation the spies discovered that the Fishkill miller had family and connections to flour milling around Wilmington as his father, Cyrus Newlin, had relocated from Delaware in the 1790s. They persuaded Newlin to write a letter of introduction to grant them access to the Brandywine mills, one of America's great flour milling centers. Thus, Ganzel and Wulff turned Newlin into an unwitting accomplice to their crime. The Fishkill example demonstrates how industrial espionage in the early 19th century depended upon networks comprised of both the guilty and the innocent.²¹

On November 12th they returned to New York and on the following day departed for Philadelphia. There they rendezvoused with co-conspirators including Prussian diplomats, Niederstetter and Sperry, as well as merchant, Hilger Wieht. They visited many of the city's standard tourist attractions including the new prison, which Wulff at least found "remarkable" for its experiment with isolation, and the museum, which he also found "remarkable" for its complete mammoth skeleton. But this was not a pleasure trip and quickly the pair got down to business which meant leaving the city behind. They headed south to Wilmington to investigate America's most famous flour mills located on the Brandywine Creek. The dozen mills built on the banks of the Brandywine during the last quarter of the 18th century comprised America's first flour milling center.²² Despite Newlin's letter of introduction they were unable to find work at any of the Brandywine mills. They did sneak a peak though. In his summary Wulff referred to the Brandywine mills as "little and not so accomplished and comfortable with the arrangement of their machines as those mills built along the Western Canal [Erie Canal] later on." While he admitted the mills produced fine flour, Wulff believed that "the old reputation contributed towards the praised excellence of the flour produced there." Although the Brandywine flour mills proved a let down in retrospect (the mills must have been impressive initially), other industries in

the neighborhood did not disappoint. Wulff documented the presence of several textile mills, described in detail the machinery and process of the DuPont gunpowder works, and noted that Ganzel surreptitiously made a sketch of a patented machine for making sheets of paper at Gilpin's paper mill. After spending nearly a month on the Brandywine they continued southward to Baltimore, America's leading flour town. Though New York would surpass Baltimore in flour exports for the first time in 1827, the city would continue to be the nation's largest flour producer for another decade.²³

They met their connection J.P. Krafft, a merchant and Prussian consul, living in Baltimore. Diplomats had long been active in the industrial spy game. Monitoring the industrialization of their host country was among their most important duties. In particular, diplomats facilitated national efforts to entice artisans to emigrate and acquire protected machines. Ganzel and Wulff met with Krafft, possibly at his home at 1 Waterloo Row. Krafft introduced them to American artisan George Bannister who would smuggle textile machinery to Prussia later that same year. Bannister, along with another Technical Institute graduate, Johann Gottfried Hoffmann, installed the new machines in a mill in Silesia. Hoffmann reported to Beuth in January 1829 that Bannister was still having trouble with workers incapable of handling the new machinery. Krafft obviously recruited Bannister, which underscores the point that diplomats facilitated technology and labor piracy. However, Krafft was less successful in his efforts to help our technology pirates, Ganzel and Wulff.²⁴

However, Krafft's ties to Baltimore's business community apparently did not help the two find employment at any of the city's flour mills. Even their applications for work in a stonemason's workshop where they hoped to learn the craft of making millstones were rejected. With winter upon them and no prospects for acquiring the information or skills they sought in

Baltimore, the secret agents packed up again and traveled south to the nation's capital. Finding no employment at mills or mill-related businesses in the Washington D.C. area either, the two industrial spies were clearly frustrated. Would they fail to accomplish their mission? Changing tactics they decided to split up as Wulff explained "in the hope to find work at mills more easily." They "agreed that I [Wulff] would go to the west to Pittsburgh and in case that I did not get work there I would move along the western canal, while Ganzel decided to go to Richmond in Virginia." The two parted ways in late January 1828 after scouting out mills in nearby Alexandria.²⁵

Wulff continued to suffer setbacks on his way west facing rejection from millers at both Fredrickstown and Hagerstown. Bad road conditions spoiled his attempt to sneak a peak at gun manufacturing in Harpers Ferry, one of America's most innovative industries. But his luck changed upon crossing the Maryland-Pennsylvania border. In Chambersburg Wulff finally got hired. It was early February. Though the mill was inferior to those he had already seen on the Brandywine and in Baltimore, Wulff took the job because it was his first offer and he also hoped that a letter of reference from this miller would open doors to better equipped mills elsewhere. Wulff remained in Chambersburg for seven weeks during which time he recalled learning mostly what not to do as a miller. Recognizing that continuing in Chambersburg would not help him acquire the technical information or skills he came for, Wulff left the small town for the big city. But not without his reference first.

The letter was addressed to George Evans, identified by Wulff as the "son of the famous miller." In 1828 George Evans owned the steam-powered flour mill built by his father on the Monongahela River in 1809. Evans Sr. had speculated on the rise of Pittsburgh by opening several businesses including the flour mill and a factory to build steam engines, though he

remained living in Philadelphia. Evans Jr. moved to Pittsburgh to oversee his father's business. By the late-1820s George Evans employed a manager to run the mill, a mechanic like his father, he preferred to tinker in his workshop outside of town. The manager rejected Wulff's application for a position but, perhaps because of the letter of introduction, offered instead an all-access tour of the mill including "information about every single machine, their most advantageous installation and use, the processing of grain and the packaging of the flour." Wulff's observations of the Evans mill provided much of the technical know-how included in the official report. During his stay he also examined the machinery and processes used in Pittsburgh's wool and cotton factories, several glass manufactures, and iron works. Above all Pittsburgh impressed Wulff as modern because of its wide use of steam-power. Unlike the other places he had been so far where water drove manufacturing, steam powered Pittsburgh's industries fueled by local coal mines.

Wulff managed to befriend Evans who later suggested that Wulff travel to Cincinnati to see an example of his updated mill design. Though out of his way skipping the Ohio mill was unthinkable because of the opportunity it offered to acquire the latest technology. Unfortunately, the detour proved a waste of time since the mill was out of order. As it turned out the local millwright did not follow Evans' plan, and as a result none of the machinery worked and the whole had to be reconfigured. This case illustrates that intra-national technology diffusion (across the shortest distances) could be as problematic as international transfer. Even with careful plans new methods were clearly difficult to copy. It also supports Beuth's plan to send industrial spies to America rather than rely on printed descriptions and blueprints. In the 1820s, as in the 18th century, technological expertise was limited to a few skilled artisans. Ganzel and Wulff were sent to acquire precisely that rare knowledge and expertise. With nothing to be gained by

hanging around a broken down mill in Porkopolis, Wulff hurried to the nation's emerging flour power along New York's new Erie Canal.²⁶

The Erie Canal, completed only a few years earlier, transformed western New York almost overnight. The area already possessed ample waterpower for milling and plenty of fertile land to grow grain, but lacked easy, affordable market access. The canal solved that problem and the flour boom was on. Rochester earned the title, Flour City USA, in 1836 when it exceeded Baltimore's production. Wulff pulled out all the stops trying to get a position at one of these modern mills. First he took the customary approach: the letter of recommendation. Since Evans had no connections in western New York, Wulff turned to his co-conspirators in New York City, Meyer & Hupeden, for assistance. After they failed to come through, Wulff resorted to a more creative way in. He went to Rochester, selected the largest mill and offered to work for free. Elisha Beach, the owner, probably suspicious of such a strange proposal countered with a proposition of two years without pay. Wulff would have accepted but he would not be in the United States that long. Beach's Aqueduct Mill had been built in 1826 by leading millwright Robert M. Dalzell. There Dalzell installed machinery based on Evans' late 18th-century designs including an impressive bucket elevator system that lifted grain out of boats or wagons at ground level to the sixth floor (top) of the mill. Aqueduct Mill ranked among the nation's most productive flour mills and set the current standard for milling technologies and techniques. Whether or not Beach realized it he had guarded his mill against industrial espionage.²⁷

From Rochester Wulff trekked east along the canal and though he received employment offers at several country mills along the way their traditional-organization and small-scale did not serve his technical purpose. At this point, Wulff decided to give Newlin's mill in Fishkill another try. Newlin welcomed him back and gave him a job. He worked there during July and

August of 1828 learning first to grind corn then wheat before an illness forced him off the job. He recovered after three weeks but refused to return to the mill for fear of a relapse.

Wulff fled north to escape the fever. He ended up in Troy, a town on the rise since the completion of the Erie Canal in 1823. Made famous as the home of “Uncle Sam” during the War of 1812, Troy supported an impressive manufacturing sector by 1825 including “six grist mills, three saw mills, an oil mill, a fulling mill, a cotton factory, a distillery, a shovel and spade factory, two iron furnaces, three breweries, four tanneries, two shoe factories, a paper mill, a rope manufactory, three carriage factories, a gun factory, and two chair factories, besides many less important manufacturing establishments.” In 1825 the population was 7,859, an increase of nearly fifty per cent in five years. That same year the Rensselaer Polytechnic Institute opened its doors to students. By the time Wulff came to town in September of 1828 the population nearly topped 10,000 inhabitants, a second hotel was under construction, and the project to pave River St. with cobblestones was underway. As a late 19th-century historian put it, Troy was taking on “metropolitan airs.”²⁸

Of Troy’s six flour mills, only two met Wulff’s technology requirements. He handed the millers letters of introduction from Newlin and Schenk which testified to his good character and workmanship, but withheld a third letter written by Jonathan Goodhue for “use only in an emergency” which related his true purpose. He found a job first at Jacob Merritt’s mill. But when it became clear that Merritt hired him only for manual labor, which denied him the chance to acquire the knowledge and skills the Prussian government sent him for, Wulff sought a position at Troy’s other modern mill owned by Townsend McCoun located near the bridge spanning the Poesten Kill. McCoun, a prominent town father active in local government and internal improvement projects for over thirty years, left the business of his mill to an overseer. It was

with this man that Wulff struck a deal. In an interesting twist Wulff was hired only by confessing his real motives. McCoun's mill manager allowed Wulff to get the hands-on technical expertise that had so far eluded him--sharpening millstones, repairing gears, and working on other mill machinery-- in exchange for paying his own board. Wulff later recalled the incident with great relief and a tinge of regret, "Finally I had succeeded to find an appropriate occupation that was suitable for my purposes but only by such means." Wulff took advantage of the mill access granted by working the nightshift to learn more about other parts of the mill. From these observations he made drawings of improvements for the mill based on the more sophisticated mills he had seen in Rochester. He also took samples of wheat, flour and bran ground at the mill, all of which he sent back to Prussia in a preliminary report. He continued working at McCoun's mill until Ganzel arrived in March of 1829 and the two partners in crime took off for New England's industrial sites.²⁹

Ganzel had left Alexandria and Wulff on January 24, 1828 destined for Richmond. Though unable to find a position, Ganzel did get a lead there on a job in Shepherdstown just north of Harpers Ferry on the Potomac River and so turned northward toward Virginia's majestic Shenandoah Valley. Despite his lack of references, the firm of Butler & Reynolds (misspelled by Ganzel as Boeteler & Ronnels) hired Ganzel to help build a new mill in town. Merchants living in rural areas still considered the boondocks had to take more risks to get ahead. Sometimes that meant hiring a complete stranger. In 1828 Shepherdstown was a place on the verge of economic explosion. Construction of the Chesapeake & Ohio Canal would be completed that year, connecting the rich western farmland to eastern markets at Alexandria and Georgetown. This project had been a lifelong dream of George Washington. William Butler, along with several of Washington's relations, tirelessly promoted the C&O Canal during the 1820s helping to bring it

to completion at long last. Butler's business partner George Reynolds had served in the Virginia Assembly from 1813 to 1817. Tax records indicate that both men owned around 20 slaves ranking them among of the wealthiest folks in town. The firm of Butler & Reynolds appeared for the first time on the 1827 tax assessment. Clearly Butler & Reynolds wanted to get their share of America's market revolution.³⁰

Butler & Reynolds finally provided Ganzel with the chance "to gather that knowledge which was intended by this trip." The millwright in charge assigned him the task of preparing the millstones, which he used "to acquire a thorough understanding" of millstone structure and maintenance. Ganzel carefully monitored every aspect of the mill layout and construction process during the day and engaged in discussions about machinery and other topics during the evening. Ganzel recorded that such zealous behavior raised the suspicions of the millwright who "concluded that I must have other intentions than to want to later occupy myself just with milling in America." Although the millwright reported his suspicions to the owners, neither Butler nor Reynolds did anything about it. Apparently they hoped Ganzel would stay on as their head miller. However, when they offered him the job, Ganzel turned them down. He got what he came for. But before leaving the area for good Ganzel stole a peak at the gun factories in nearby Harpers Ferry.

In the meantime, Christian Keller, a flour merchant and miller from Baltimore, had sent word to Ganzel about possible employment at one of the city's modern mills. Upon receiving the good news Ganzel rushed back to Baltimore. It was May 5, 1828. Soon after Keller somehow discovered Ganzel's secret. Rather than turning him off, the truth compelled Keller to give Ganzel a place at his own mill located on Jones Falls. Ganzel recalled later that Keller insisted had he been informed of their real mission from the beginning he would have found jobs for both

Ganzel and Wulff during their stay in Baltimore the previous winter. Stunned Ganzel defended their actions on the grounds that he and Wulff, along with the Prussian government, assumed American millers who controlled advanced techniques and owned more efficient machines than their competitors would guard against theft. Not true claimed Keller, advising Ganzel that only by being direct and open could he achieve his goals. Ganzel followed Keller's advice from then on confessing to his surprise that honesty was the best policy.

Ganzel worked at Keller's mill for free after he blew his cover and became like a member of the family. Keller also informed his employees of Ganzel's purpose and ordered them to help him out, which according to Ganzel they did gladly. At Keller's mill Ganzel learned many useful things in particular how to make superfine flour, a product unfamiliar to most Germans, and one of the explicit goals of the entire mission to America. Superfine is the highest grade of flour produced because of its light color, fine texture and keeping qualities. For Prussia to enter the Caribbean and South American grain trade they would have to produce superfine flour not only because it fetched the highest price at market but also because it would weather the transatlantic voyage best. Ganzel used his experience at Keller's mill to write extensively on this subject in the final report.

After several months at Keller's mill Ganzel asked for help finding another position in the city in order to study the differences in American flour milling techniques. Keller approached James Cheston another flour merchant who also owned one of the most technologically advanced mills in Baltimore. After making a full disclosure to Cheston, Ganzel worked at the mill until the end of December 1828. Cheston's mill was located alongside four other mills on Gwynns Falls. The mill burned down a few years after Ganzel's visit. Together the Keller and Cheston mill experiences greatly increased Ganzel's expertise. From Baltimore Ganzel wrote to

Wulff that he would meet him in Troy in mid-March so that they could get to New England before their scheduled departure on May 1, 1829. In the meantime Ganzel went to see the high-tech mills along the Erie Canal for himself.³¹

Just before leaving the United States, Ganzel and Wulff made one final trip to Philadelphia to meet with the Prussian diplomat Niederstetter, who delivered instructions for their next assignment in England. They must have taken a few moments at least to celebrate their American mission completed. It was an unqualified success. With the help of collaborators and unknowing accomplices, Ganzel and Wulff acquired hands-on experience at seven different flour mills, observed the layout and machinery of many more, and stole glimpses at scores of other manufacturing enterprises during their 18-month stay in the United States. Few people probably knew more about the state of American industrialization in 1829 than the Prussian spies Ganzel and Wulff.

The Fatherland

Having completed the first part of their task, pirating American technology, the second and more important step of disseminating that information throughout Prussia began. To meet that goal the Department of Industry & Trade published a report in 1832 documenting the results of Ganzel and Wulff's mission entitled, *Contributions to the knowledge about the nature of American mills and flour production*. The report ran over one hundred pages and included an introduction with a brief background statement by Beuth and travel summaries by both Wulff and Ganzel, the main text was divided into five chapters--The Equipment of American Mills, The Arrangement of the Machines in an American Mill, Application of the Machinery in American Mills during Flour Production, Evaluation and Inspection of the Flour, Types of

Grain--followed by eighteen copperplate engravings based on sketches made by Ganzel and Wulff in America.³²

The report clearly addressed Prussian needs as previously identified by Beuth in 1825. In addition to the vital how-to guide for building and operating American milling machinery, the report also featured discussions of what was identified as America's two most important trade secrets for flour production and marketing. First, to succeed in business the report claimed that Prussians needed to create a flour inspection system along the lines of that in use by the United States to create consumer confidence in their product. Prussian officials needed to be sure that too many rotten barrels would not spoil the trade. In his 1825 report Beuth identified the small-scale of Prussian milling as a problem for export trade. The lack of large commercial flour mills meant that any flour shipped abroad was typically collected from a bunch of small mills usually of varying quality. Beyond the obvious quality-control problems created by such decentralization Beuth indicated that these millers often combined different products in a single barrel, probably whatever grist they had left over from a variety of grains brought in by their neighbors, nailed the header on the barrel and called it flour. The creation of large-scale manufacturing it was hoped would stabilize flour production, reducing the number of millers involved in the export trade in order to ensure uniformity and higher quality. Once in place the inspection system would monitor the quality of flour produced at these more efficient mills and thereby establish the reputation of Prussian flour in the Atlantic world marketplace.

Second, the report explained that all grain was not created equal when it came to flour. The Prussian flour scheme required the production of what they referred to as "permanent" flour or what Americans labeled "superfine." In America Ganzel and Wulff learned that not all wheat made superfine flour. They sent samples of American wheat varieties back to Prussia for

analysis. Beuth's department was apparently criticized for a poor record of technology diffusion, charged with obsessing over machines and ignoring commercial issues. However, Ganzel and Wulff did a good job balancing technical knowledge and the commercial information in their report.³³

So what did the Germans do with the resulting study? Was it used to improve the German milling industry and to what effect? First, the report did lead to the construction of American-style mills in Prussia by Ganzel, Wulff and others. In fact, another Technical Institute graduate built the first American-style mill in Prussia at Dranienburg (Oranienburg located on the banks of the Havel River now part of the growing Berlin metropolitan area). Ganzel received permission from Christian von Rother, director of the government's *Seehandlung* (Overseas Trading Company), to build an American-style mill at Ohlau on the Oder River in the province of Silesia. It was under construction in 1832. Wulff returned to his home on the Baltic where he was hired by a Danzig grain merchant to build a modern mill near Möve.³⁴

Did the Prussian government follow through with the flour scheme? Records from the 1840s indicate that the *Seehandlung* operated two flour mills with new machinery copied from Americans: the one at Thiergarten (Ohlau) built by Ganzel and another on the Vistula River at Bromberg in the province of Posen. Though the *Seehandlung* did ship some flour to South America, ultimately the government plan failed and *Seehandlung* flour was sold at home. Was it a failure to transfer technology effectively? Was it a failure to compete in the Atlantic world marketplace? Was it a failure because of miller-resistance? Was it a failure because farmers focused on traditional grain markets? Why the Prussians failed remains to be worked out.³⁵

America Welcomes Technology Pirates

How do we explain the behavior of men like Christian Keller? It is obvious why the Prussians engaged in industrial espionage. It is less clear why Americans did not safeguard their flour secrets better. A modern reader would be as shocked as Ganzel had been to find Americans evidently so willing to share their technology with rivals. Yet Doron Ben-Atar discovered a “new world of technology exchange” dedicated to free and open communication during the first half of the 19th century.³⁶ Perhaps this golden age explains America’s treatment of Ganzel and Wulff as brothers in an international fraternity of artisans. It could also be that Americans did not see flour milling technology as worth protecting either domestically or internationally. Evans’ patent had long expired, and aside from the use of steam as well as a few minor adjustments milling had not changed much since the 1790s. What was new to the Prussians was old to Americans and that made all the difference.

¹ As befits this topic I borrowed liberally from the work of other scholars, particularly Doron S. Ben-Atar, *Trade Secrets: Intellectual Piracy and the Origins of American Industrial Power* (New Haven: Yale University Press, 2004), xix (definition of technology piracy/international law), 10 (guard against competition), 102 (worldwide competition).

² Ben-Atar, 9, 28, 177, 207 (tech transfer not a one-way street). For an excellent example of the scholarship on the technology transfer and the textile industry see David J. Jeremy, “Transatlantic Industrial Espionage in the Early Nineteenth Century: Barriers and Penetrations,” *Textile History* 26 (1995): 95-122. Other studies of industrial espionage include William H. Thiessen, “Construction of America’s ‘New Navy’ and the Transfer of British Naval Technology to the United States, 1870-1900,” *Mariner’s Mirror* 85 (1999): 428-445. John R. Hensley, “The Brandywine Examples: Case Studies in Industrial Espionage in Early-19th Century Delaware,” *Delaware History* 21 (1984): 73-85.

³ Peter Beuth, Carl Ganzel, and Frederich Wulff, *Beiträge zur Kenntniss des Amerikanischen Mühlenwesens und der Mehlfabrikation* [Contributions to the knowledge about the nature of American mills and flour production] (Berlin, 1832). There are two copies in the U.S., one at the Library of Congress and the other at the University of Chicago. I am grateful to **Stephen Kindig** for bringing this source to my attention. As I lack German language skills, I am indebted to **Birte Pfleger** for translating parts of the document for me.

⁴ Ben-Atar, chapter 6 (government role), 208 (importer), 213-214 (industrial leader).

⁵ On mercantilism, Ben-Atar, 8-9, 11-12. On the state role in Prussia's economic development see W.O. Henderson, *The Rise of German Industrial Power, 1834-1914* (Berkeley: University of California Press, 1975), 71-79. On Beuth and the Seehandlung see W.O. Henderson, *The State and the Industrial Revolution in Prussia, 1740-1870* (Liverpool: Liverpool University Press, 1958), 96-147.

⁶ On German patent law see Henderson, *The Rise of German Industrial Power*, 78. On the widespread use of patents see Ben-Atar, 3-5.

⁷ Henderson, *The State and the Industrial Revolution*, 96-106, 111, factory-gunpowder metaphor is related in note 1 on page 111.

⁸ Henderson, *The State and the Industrial Revolution*, 107-110. Goethe is quoted on p. 109.

⁹ For a discussion of Prussia's industrial espionage activities beyond flour see Henderson, *The State and the Industrial Revolution in Prussia*, 99-102, 112-116.

¹⁰ A contemporary view of Danzig's grain trade is provided by Richard Bryan Smith, *Notes made during a Tour in Denmark, Holstein, Prussia, Poland, Saxony... Interspersed with some Observations on the foreign Corn Trade* (London, 1827), 54-84.

¹¹ Beuth explains the purpose for sending Ganzel and Wulff to America in *Amerikanischen Mühlenwesens und der Mehlfabrikation*, iii-v.

¹² Beuth summarizes the main points of his 1825 report in *Amerikanischen Mühlenwesens und der Mehlfabrikation*, iii.

¹³ Ben-Atar, 14 (target), 37 (London mill). On English-style mills see *Amerikanischen Mühlenwesens und der Mehlfabrikation*, iii. For reference to the French mill see Henderson, *The State and the Industrial Revolution*, 100.

¹⁴ *Amerikanischen Mühlenwesens und der Mehlfabrikation*, iii.

¹⁵ Even if the new federal government had the power or inclination to protect Evans' exclusive knowledge from theft, which it clearly did not during the era of the early republic, the publication of *The Young Mill-Wright and Miller's Guide* five years into his period of exclusivity would have undermined any official effort to safeguard his secrets. Not to mention undercutting the financial rewards to be gained by his patent. (Of course, the fact that Evans filed over fifty patent right infringement lawsuits between 1790 and 1815 proves that civic duty was not his only motivation.) That Evans should have simultaneously sought to protect and to advertise his inventions, while seeming foolish to us today, was quite common in the 18th century. Perhaps Evans shared Benjamin Franklin's dedication to the free exchange of knowledge among an international brotherhood of artisans. However, it seems more likely that patriotism motivated Evans to go public out of fear that technological backwardness would undermine the new nation's peace and prosperity.

¹⁶ The definitive works on Evans are Grenville and Dorothy Bathe, *Oliver Evans: A Chronicle of Early American Engineering* (Philadelphia: The Historical Society of Pennsylvania, 1935) and Eugene S. Ferguson, *Oliver Evans: Inventive Genius of the American Industrial Revolution* (Greenville, Del.: Eleutherian Mills-Hagley Foundation, Inc., 1980). For a concise discussion of mill design see Stephen G. Del Sordo, "Eighteenth-Century Grist Mills: Some Chester County Examples," ed., Camille Wells, *Perspectives in Vernacular Architecture* (Annapolis: Vernacular Architecture Forum, 1982), 65-78.

¹⁷ Ellicott and Evans wrote their treatises separately, but were brought together by a coincidence having sent their work to the same Philadelphia printer, Thomas Dobson, who suggested the two collaborate. For reprinting see Ferguson, *Oliver Evans*, 31.

¹⁸ On ages of Technical Institute see Henderson, *The State and the Industrial Revolution*, 107. For Ganzel and Wulff building mills in Prussia see *Amerikanischen Mühlenwesens und der Mehlfabrikation*, vi. On Silesia see Henderson, 74.

¹⁹ Wulff describes their European travels in *Amerikanischen Mühlenwesens und der Mehlfabrikation*, 1-6.

²⁰ For information on Goodhue & Co. see Walter Barrett, *The Olde Merchants of New York City*, 2nd series (1863), Chapter 11. Available online at <http://www.bklyn-genealogy-info.com/Business/Merchant/Goodhue.html>. From 1808-1811 Jonathan Goodhue operated under the name Goodhue & Sweet, dealing mostly in the foreign dry goods trade and as commission agents for Salem merchants. From 1811-1816 he worked on his own, then he took another partner operating as Goodhue & Ward from 1816-1819. In 1819 he took a new partner, Perit, a Yale graduate, and changed the firm's name to Goodhue & Co. Eventually the firm moved to 64 South Street. Goodhue & Co. lasted 53 years. Jonathan Goodhue was born in 1783 and died in 1848. Henry Bellows wrote a 27-page eulogy for him under the title *The Christian Merchant*.

²¹ *Amerikanischen Mühlenwesens und der Mehlfabrikation*, 7-9. There are two Schenks listed on the 1820 U.S. Census for the division of Fishkill in Dutchess County: Abraham H. (Sheet 63, #9) and Peter A. (Sheet 63, # 18), each owned one manufactory. I accessed the census online at <http://www.rootsweb.com/~cenfiles/ny/dutchess/1820/p060.txt>. Cyrus Newlin, a member of the Society of Friends, moved from Wilmington to settle at Fishkill as a miller, forming a partnership with William Byrnes in the late 18th century. See "Old Dutch Houses on the Hudson," *The New England Magazine* Volume 18, Issue 1 (March 1895), 73-74. Available online from Nineteenth-Century in Print: Periodicals, American Memory, the Library of Congress at [http://rs6.loc.gov/cgi-bin/query/r?ammem/ncps:@field\(DOCID+@lit\(AFJ3026-0018-11\)\)](http://rs6.loc.gov/cgi-bin/query/r?ammem/ncps:@field(DOCID+@lit(AFJ3026-0018-11))) Until 1811 Byrnes and Newlin conducted the mill property together; then Newlin bought Byrnes out. Cyrus Newlin did not live in Fishkill, but his sons, Robert and Isaac, did. Either Robert or Isaac must have owned the mill in the 1820s. Information on Newlins comes from Colette Hook Grower, "Teller Homestead" available online at <http://freepages.genealogy.rootsweb.com/~newyork43/TellerHomestead.html>.

²² Peter Welsh, “The Brandywine Mills,” *Delaware History* 7 (1956-57): 17-36 and “Merchants, Millers, and Ocean Ships: The Components of an Early American Industrial Town,” *Delaware History* 7 (1956-57): 319-336.

²³ For Wulff’s discussion of their visit to Philadelphia and the Brandywine see *Amerikanischen Mühlenwesens und der Mehlfabrikation*, 10-12. On Baltimore see John McGrain, *Grist Mills in Baltimore County, Maryland* (Baltimore: Baltimore County Heritage Publication, 1980), 8.

²⁴ On the spy games played by diplomats see Ben-Atar, 9-10. Krafft is listed in the Baltimore City Directory, see Archives of Maryland Online at <http://www.mdarchives.state.md.us/megafile/msa/speccol/sc2900/sc2908/html/index.html>. Bannister is mentioned in *Amerikanischen Mühlenwesens und der Mehlfabrikation*, 12. See also Henderson, *The State and the Industrial Revolution*, 102, 116.

²⁵ Ganzel and Wulff’s decision to split up, *Amerikanischen Mühlenwesens und der Mehlfabrikation*, 14.

²⁶ Wulff narrates his travels west in *Amerikanischen Mühlenwesens und der Mehlfabrikation*, 14-21. On the challenges of technology transfer see Ben-Atar, 17-18, 87-88.

²⁷ Wulff on the Erie Canal district, *Amerikanischen Mühlenwesens und der Mehlfabrikation*, 21-22. Information about the Beach mill can be found in Blake McKelvey, *Rochester on the Genesee: The Growth of a City* (Syracuse: Syracuse University Press, 1973), 37.

²⁸ George Baker Anderson, *Landmarks of Rensselaer County, New York* (Syracuse, 1897). Available online at <http://history.rays-place.com/ny/ren-troy-ny1.htm>. The information used here comes from Ch. XVI, “Troy as a City.”

²⁹ Wulff’s experiences along the Hudson are described in, *Amerikanischen Mühlenwesens und der Mehlfabrikation*, 23-25.

³⁰ On Shepherdstown see Millard Kessler Bushong, *A History of Jefferson County West Virginia, 1719-1940* (Charlestown: Heritage Books, Inc., 2002), 81, 404. Tax assessment information on Butler and Reynolds was found in Patricia B. Duncan, *Jefferson County Virginia: Personal Property Tax Lists, 1825-1841* (Westminster, MD: Willow Bend Books, 2004), 1, 8, 14, 20, 24, 31, 37, 43, 47, 53, 59, 65.

³¹ Ganzel relates his experience at Shepherdstown and Baltimore in *Amerikanischen Mühlenwesens und der Mehlfabrikation*, 28-32. Keller and Cheston are listed in the Baltimore City Directory, see Archives of Maryland Online at <http://www.mdarchives.state.md.us/megafile/msa/speccol/sc2900/sc2908/html/index.html>. Additional information about the Keller and Cheston mills was related to the author in an email from John McGrain dated June 26, 2006.

³² I have in my possession a photocopy of the preface only. I am grateful to Robert Lundegard for providing a translation of the table of contents.

³³ On permanent flour see *Amerikanischen Mühlenwesens und der Mehlfabrikation*, iii. Henderson, *The State and the Industrial Revolution*, 116.

³⁴ *Amerikanischen Mühlenwesens und der Mehlfabrikation*, vi.

³⁵ Henderson, *The Rise of German Industrial Power*, 74. Henderson, *The State and the Industrial Revolution*, 128-129.

³⁶ Ben-Atar, 207-209.