that early misunderstandings between scientists and politicians had. While uncertainty is a useful and necessary principle in science, these chapters reveal its limits for policy and regulation.

After a series of chapters that emphasize the miscommunications between scientists and politicians, Andrea Polli's exploration of how art can communicate science and policy to the public is refreshing. Polli, the artist behind *Particle Falls*, a real-time visualization of air quality data that has been displayed in San Jose, California, and Philadelphia, introduces readers to artists and artworks that directly raise questions about the state of the air. The many examples of productive collaborations between artists and scientists might not offer regulatory answers, but they provide hope for bringing public pressure to demand action on air quality and climate change.

As editors, Fleming and Johnson had explicitly interdisciplinary goals of crossing temporal, geographic and disciplinary boundaries. While successful in assembling an interdisciplinary group of scholars, the editors might have done more to bring cohesion to the collection. The essays often operate on different registers—while they speak to similar issues, the authors rarely speak to one another. As a result, readers might pick up this collection for a single essay and fail to see a reason to read further, thereby missing the many valuable perspectives that the editors carefully assembled.

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The American Synthetic Chemicals Industry: War and Politics, 1910–1930, Kathryn Steen, The University of North Carolina Press, Chapel Hill, 2014, 418 pp, ISBN 978-1-4696-1290-4, $39.95 paper.

In 1920, in the wake of World War I, a collective of chemical manufacturers urged the Senate Committee on Finance to maintain rigorous protections established during the war for their industries against potential German resurgence and encroachment (p 195):

> The manufacturers testified that tariffs alone would be inadequate to protect their industry for the next several years. They knew that the German manufacturers still surpassed the Americans in chemical knowledge, research and experience, and they had to make the case that Americans, while not yet equal to the Germans, could catch up in a reasonable time-frame.

The chemistry—and chemical manufacture in question—was the aromatic organic chemistry of synthetic dyes and pharmaceuticals.

A decade later, the situation had changed profoundly. Although continued high tariffs (and wartime confiscation of patents) had insured a modest domestic success of US manufacturers of these products, resurgent German manufacturers "had recovered many of the international markets where Americans had ventured during the war." However, the American synthetic organic chemicals manufacturers had taken the industry in different directions, where "the Germans had little or no head start on American rivals, and the two sides competed with relative parity" (p 237, both quotations).

What Steen styles a "new 'American' industry" (e.g., p 280) consisted of a concatenation of new raw materials, new methods and new synthetic organic chemical products. The spectrum of new raw materials derived from petro-chemicals (among others). Regarding the new chemical products: these were now aliphatic (e.g. ethylene and its compounds) rather than aromatic. They were utilized to make commercial materials such as artificial fabrics, plastics and rubber, and were intended for different industries than the aromatic organic dyes, most notably the rapidly-developing automobile industry. New physical-chemical techniques, employing very high temperatures and pressures were deployed to create the products and they were mass produced. These changes of direction were attended by industrial innovations (or at least enhancements), notably, the development of in-house industrial research, the hiring of American academically trained chemists, the utilization of university chemists as consultants, and the ascendancy of chemical engineering. Particularly in her last chapter (chapter 8: An "American" Industry, 1919–1930), Steen traces these

developments in each of the largest organic chemical producers. In the Conclusion, Steen summarizes these changes:

> The "American" synthetic organic chemicals industry gained its identity by transforming the niche markets of German dyes and pharmaceuticals into mass-produced commodity chemicals, developing the aliphatic branch of chemistry and drawing on the expertise of chemical engineering (p 292).

Implicitly and/or explicitly, a number of very important themes of the historiography of American and international science and industry of the period 1880–1930 are addressed in this book. The most significant is that denominated by my opening scenario: how did American science-based industries move from backwardness and dependency (particularly on Germany) to front-runner positions, independence, and high international competitiveness? Secondly, what role(s) did war, in this era, World War I, play in these developments? Thirdly, what factors in American politics and culture of this period were significant? And finally—this one already mentioned—what changes of industrial organization and outlook ("industrial culture," if you will), were at play in these transformations?

These themes are the ones that dominate the bulk of the book. The opening chapter focuses on German and American synthetic organic chemicals industries; the German industries "dominated the world's production of synthetic organic dyes between 1870 and 1914" (p 23) as well as pharmaceuticals, whereas the contemporaneous American dyes and pharmaceutical industry was "almost negligible" (p 33) but with potential from the inorganic chemicals industry. Chapters two through seven trace out the war-time and post-war industrial and government actions to develop and maintain this industry. Chapter eight focuses on the theme of changes in industrial organization and outlook for five major synthetic organic chemical manufacturers.

Of particular importance is the backdrop of World War I. In chapter two, Steen traces the evolution of the synthetic organic chemicals industry in a number of companies during the war, at the end of which Steen assesses the industry as "precariously built on unsure foundations" (p 76). However, the war itself provided important stimuli and resources for future potential development: expertise in utilizing organic chemicals in high explosives, augmentation of raw materials, and experience in large-scale production, for example. The war also engendered strong nationalistic and anti-German sentiments throughout American society, including the community of chemists, and this helped to foster the impulse to develop "German" synthetic organic chemicals. A dramatic example of this sentiment and its implication was the rhetoric of the chemist, Charles Holmes Herty (President of the American Chemical Society in 1915 and 1916), who wrote of German "enslaving power" over the nascent American industry (p 126). Universities also reoriented towards advanced training in organic chemistry despite shortages in students and laboratory materiel (previously obtained from Germany), and formed consulting liaisons with industry.

But it was the federal government's support of the nascent and instable synthetic organics industry that made a critical difference. Before the US entry into the war in 1917, the government took steps to aid the industry largely through market information supplied by the Department of Commerce. Although the Democratic administration was ideologically against protection through high tariffs (and the textile industry was not in favor), lobbying by chemists such as Herty and the chemical industry did result in a tariff bill being enacted in 1916 although one not completely satisfactory to the industry. Once the US entered the war, far more draconian measures against the German industry and its property and patents in the US were enacted, such as the "Trading with the Enemy Act" of October 1917, with its attendant Office of Alien Property and Alien Property Custodian. A. Mitchell Palmer, the Alien Property Custodian and Francis P. Garvan, head of the Office's Bureau of Investigation, steered the Office of Alien Property towards confiscation and sale of the property and sequestering of the patents of the German synthetic organic chemicals industry. These latter were deposited in and administered by a "Chemical Foundation," founded by the Alien Property Custodian in 1919, with Garvan as its first head. More generally, a protracted "economic war" was waged against German industry for the four years after the armistice augmented by industrial self-interest and reflective of the persistence in the United States of anti-German sentiment and intense isolationism. This climaxed in the Fordney-McCumber Tariff Act of 1922, placing "the steepest tariffs ever on [imported] dyes and intermediates derived from coal tar" (p 199). Throughout the rest of the decade, the US synthetic organics industry continued to benefit from governmental support and judicial decisions against German patent compensation claims.

If this were a literary work—a play or a novel—this narrative might build up to the satisfying dénouement that the US had come up to parity with Germany in the manufacture of the traditional dyes and pharmaceuticals

by the book's terminal date, 1930. But history is not literary narrative and, as was mentioned near the start of this review, the American synthetic organic chemicals industry in fact veered off in a different direction towards aliphatic rather than aromatic organic chemicals during the 1920s.

How this came about—and, indeed, how the major US chemical manufacturers were transformed—in this decade is the subject of the eighth and final chapter, aptly titled "An 'American' Industry, 1919–1930." After detailing mergers and changes in I.G. Farben in Germany (e.g. high pressure organic synthesis under the leadership of Carl Bosch) and the recapturing of a portion of the American market for dyes, Steen turns to analyzing changes in the major US synthetic organic chemicals producers: National Aniline & Chemical Company/Allied Dye & Chemical Corporation, E. I. du Pont de Nemours & Company, Dow Chemical Company, Union Carbide and Chemical Company, and Bakelite Corporation.

In fact, there is something of a literary "moral fable" contained in this chapter: The first of the companies, National Aniline & Chemical Company, was "the largest American manufacturer of chemical dyes" at the end of the war (p 250) and its merger with other firms to form the Allied Dye & Chemical Corporation in 1921 resulted in a chemical concern that was second only to Du Pont. But National Aniline, which continued to specialize in synthetic dyes, fell on hard times due both to insufficient technical ability and decisions at the top by Orlando F. Weber, former president of National Aniline who became president of the merger company, to downplay synthetic dyes in favor of nitrogen-based products perhaps because he came to realize that "the profitability of dyes, which depended heavily on the tariff, was too uncertain in the face of steep international and domestic competition" (p 254).

In contrast, the other companies discussed in this chapter all focused or came to focus on aliphatic chemical products. Moreover, they all participated in the changes that produced the industrial physiognomy of Steen's "new 'American' industry" as detailed earlier in this review. Her account of Du Pont is the most elaborate and depends in part on the magisterial study of Du Pont by David Hounshell and John Kenly Smith.

The American Synthetic Chemicals Industry: War and Politics, 1910–1930 is an important book. Its narratives and arguments are rich and intricate. With such an accomplishment before me, I hate to ask for more from the author but this is, after all, the function of a reviewer's critique. One addition that would have enriched Steen's narrative is more background context on the general economic ups and downs of the period, particularly the post-World War I period (domestic and international). As I was organizing my thoughts, I came upon a review of a book on the depression of 1921 (1). I can hardly expect Steen to refer to this book, which was just published, but she does in fact make passing reference to this episode several times. It would have been valuable to have some sustained background narrative about economic change.

My second "wish" is for more industrial context for Steen's critical eighth chapter on the development and change-of-direction of the synthetic organic chemicals industry in the 1920s. The obvious context here is the mutually reinforcing developments of petrochemical and automobile industries. In her Conclusion, Steen raises a counterfactual argument about what might have transpired with the synthetic organic chemical industry had World War I not occurred. One could raise the same kind of counterfactual regarding these contextual industries: how might/might not the American synthetic organic chemicals industry have been sustained and developed in the 1920s had these industries not been developing so vigorously? But these are desires engendered by the stimulus of a rich and highly informative book.

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References and Notes

1. J. Grant, *The Forgotten Depression: 1921: The Crash That Cured Itself*, Simon & Schuster, NY, 2014. Reviewed in *The Economist*, Nov. 8-14, 2014, pp 84-85.