Kolthoff of Minnesota
Paul D. Nelson

On 5 August 1927 Dr. Samuel Lind, dean of the Institute of Technology at the University of Minnesota, sent this cablegram:

University of Minnesota Minneapolis desires full professor analytical chemistry. Kruyt recommends you. Would you accept visiting professorship for coming year October to June for $4500 with permanent position in view?

These few lines yielded riches for the university, in honors, in teaching, in scientific achievement and, yes, in money, beyond anyone’s imagining.

The recipient was a 33-year-old lecturer at the University of Utrecht, in the Netherlands, Izaak Maurits Kolthoff. Kolthoff did not know Lind, had never been to Minnesota, and may have been surprised to learn that a university somewhere bore that peculiar name. Three days later Kolthoff cabled back his acceptance. So began a relationship that lasted sixty-six years.¹

The Chemist

“Don’t worry, mama, I will restore your chicken soup to its optimal pH.” Such is the gist of a story that Piet (his nickname from childhood, pronounced Pete) Kolthoff liked to tell, and told often. He was fifteen years old and had converted part of the family kitchen into a makeshift chemistry lab.

One day I got in the kitchen and found my mother desolate. By mistake Mother had put in the chicken soup . . . several large spoonfuls of sodium carbonate [baking soda] instead of sodium chloride [table salt.] She was just ready to throw everything into the sink when I told her that it was child’s play to transform the carbonate into sodium chloride. Thus, I made my first titration, adding hydrochloric acid until -- at a pH of 7 -- litmus paper turned violet. This, in my experience, is still the optimum pH of chicken soup.²

Whether this story is entirely true may be doubted,³ but no matter -- it tells a truth about young Piet Kolthoff. He loved chemistry and, very young, dove in deep.

Kolthoff was fortunate then to be both bookish and Dutch. The elite public high school in Almelo, his home town, demanded a commitment to studies that even today’s over-stressed American high school achievers would find exhausting: plane and solid geometry; algebra; economics, world and national geography and history; three years of organic and inorganic

Kolthoff Papers, University of Minnesota Archives [hereafter, Kolthoff Papers.]
² I.M. Kolthoff. “Autobiography.” Kolthoff Notebooks, University of Minnesota Department of Chemistry [hereafter, Kolthoff Notebooks.]
³ It does not hold up. No cook in her own kitchen would long confuse the powdery baking soda with the chunky, crystalline table salt. And no cook would put “several large spoonfuls” of salt into a soup, unless it were in a vat prepared for an army.
chemistry; four years of English, five of German, and eight of French. It suited him. Completing the coursework marked a good start, but only a start. Then came two and a half weeks of written tests, followed by oral exams. “For the oral exams we submitted a lists of 20 books . . . we had been required to read in English, German, and French (not to speak of Dutch.) The two examiners could choose any one or more of these books and in addition to giving a summary of the contents by the candidate they would interrupt with questions.” The language exam consisted of questions about the same books, but in the language of the book. Fifty-five students started in Kolthoff’s class; he and ten others made it through.

This achievement still did not qualify him for a regular Dutch university because he lacked Greek and Latin. So in 1911 he enrolled in the pharmacy program at the University of Utrecht. He chose it because he could get in, because the pharmacy program differed not much from the chemistry program, and to study under Nicolaas Schoorl, professor of pharmaceutical and analytical chemistry.

As a second-year student at Utrecht Kolthoff had come upon a book by Wilhelm Ostwald -- and what youth could resist this title? -- *The Scientific Foundations of Analytical Chemistry*. There he read that analytical chemistry, “the art of recognising different substances and determining their constituents,” had been one of “supreme importance” for centuries. But -- and this is what most arrested Kolthoff -- “analytical chemistry is content with fashions of theory which have long been discarded elsewhere and sees no harm in presenting its results in a shape which has really been antiquated for the last half-century.”

There it was: opportunity. A “supremely important” branch of chemistry had fallen far behind the rest of the field. Here lay an open field for an ambitious young man. At Utrecht Schoorl and Kolthoff shared a wavelength. “Confining myself only to analytical chemistry, we spent one year in carrying out gravimetric and volumetric analysis, one year in organic analysis . . . one and a half years in pharmaceutical analysis, one quarter in food and water analysis, one quarter in toxicology, and one quarter in clinical analysis.” All the rest of his long life, Piet Kolthoff praised Wilhelm Ostwald and Nicolaas Schoorl.

In 1915, at age twenty-one, Kolthoff published his first paper, “Phosphoric Acid as a Mono- and Dibasic Acid.” He got his Ph.D. in analytical chemistry in 1918. Over the next five years Kolthoff published his first book, on pH, in 1920, and more than 150 scientific papers, a number impressive to everyone except, it seems, the grandees of the Dutch academy. Employed by the University of Utrecht as a chemist, he was permitted to begin teaching only in 1923,

Young Kolthoff in the mountains, somewhere in Europe, probably around 1920. Kolthoff Notebooks.

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and then as a *privat docent*, not a professor, for no additional pay.

But Kolthoff's reputation had slipped the noose of the Dutch academy, and in 1924 he received an invitation for a summer lecture tour in the United States. He accepted, though nervously -- he had just four years of classroom English. The journey took him first to Toronto, then to Rochester, New York. There, on a free day, young colleagues responded to his request to see something "typically American" by taking him to a burlesque house. Though he could not understand what the performers said, "visually speaking, I did not miss anything of the show."

In New York City, after a lecture to some pharmacists, came "beer, beer, and more beer," followed by a solo walk through Central Park enlivened by an attempted mugging. "I was scared stiff, but I had a fortunate inspiration. . . . I had learned a simple trick to break someone's leg. So I started taking my jacket off and asked [the mugger] 'Do you know Jiu Jitsu?'" When the mugger hesitated, Kolthoff sprinted away. His New York stay also featured a homosexual come-on, a three-card monte scam, and "more crazy experiences . . . with pickpockets, crooks, etc, than I have ever had since."

The most important part of the visit was still to come. He went next to Ohio State University, then Northwestern, and then University of Michigan, where he lectured at their departments of chemistry. These visits set the stage for Dean Lind's telegram three years later.\(^5\)

We can guess what Lind had in mind with his offer to Kolthoff. Samuel Colville Lind was a chemist himself, and a distinguished one. He had studied languages at Washington and Lee, chemistry at MIT, and gotten his Ph.D. at the University of Leipzig. He studied a year in Paris under Marie Curie, the discoverer of radium, and then more radiation studies in Vienna. After seven years teaching at the University of Michigan he joined the U.S. Bureau of Mines as its radium expert. In 1926 he received the Nichols Medal, one of chemistry's highest honors. The same year, Lind got faculty offers from both Michigan and Minnesota; he chose Minnesota in part for its (then) greater prestige.\(^6\) Lind had never met Kolthoff, but he had heard of him and read some of his papers. (Like Kolthoff, he was multilingual.) As his August 5 cablegram reveals, he had inquired about Kolthoff with H.R. Kruyt, a professor of physical chemistry at Utrecht who knew Kolthoff well; the two had spent many hours arguing. Kruyt had visited American universities and liked the closer relations he observed between universities and society.\(^7\) Lind probably saw Kolthoff as a rising star; Kolthoff recalled decades later that Lind "was anxious to develop the scope of research at the University of Minnesota."\(^8\)

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\(^5\)*Autobiography.* Kolthoff Notebooks. According to Peter Carr, who knew Kolthoff well, this story is "pure B.S."


\(^8\) Brasted, Robert C. "Interview with I.M. Kolthoff." *Journal of Chemical Education* 50, October 1973, p. 663.
Lind’s cable came to Kolthoff “out of a blue sky,” but it took him just three days to accept — why? There are hints in Kolthoff’s writings. Despite his academic productivity he was still earning so little, about $1200 a year, that he had to supplement his income writing for a Dutch newspaper. Kolthoff had found the Dutch universities tightly bound by tradition, “concerned with the education of scholars and isolated from society.” By contrast, he had seen, at Ohio State, Northwestern, and Michigan, big, young, well-funded universities free from European traditions. “[I]n American universities education toward a bachelor’s degree was directed to provide society with useful citizens.” Lind’s telegram also offered Kolthoff a good salary ($4500 — about $60,000 in 2017 dollars) and the implied promise of creating his own analytical chemistry program. This was an opportunity Europe would never offer. Kolthoff arrived in Minneapolis eight weeks later.9

Professor
He took an office in the chemistry building, later named Smith Hall, on the west side of Northrup Mall, and set about building an empire. He taught. He researched. He wrote. He traveled. He built networks. Today we might apply the cliché word “workaholic,” but the suggestion of a compulsion would get Kolthoff wrong. Work is what he wanted; it wasn’t all he wanted, but it was what he wanted more than anything else. There were not enough hours in the day.

Kolthoff’s teaching duties, as Professor of Analytical Chemistry, and administrative duties as section chairman, were relatively light. The main thing that had attracted him to Minnesota was the opportunity for research; he called the university his “El Dorado,” for its laboratory facilities, talented graduate students, and the freedom he enjoyed.

He put on the lab coat. Between 1928 and the end of 1941 Kolthoff published 232 scientific papers, in nineteen journals, and three languages, with forty-four co-authors. The titles of these papers are mostly incomprehensible to anyone but chemists: “Effect of Dilution on the pH of Buffer Mixtures,” from 1928, is one of the simpler examples. They are mostly short, five to fifteen pages (one, though, measured 94), variations on this theme: We went to the lab and tried this approach to solving a problem. Here is what we did, and these are the results. Studies like these, and countless others, published in journals, comprised the way chemists communicated with other chemists. Thus, little by little, Kolthoff pushed the growth of his discipline. And thus, little by little, Kolthoff expanded his own knowledge and reach. Here was Kolthoff relentlessly expanding the boundaries of analytical chemistry.10

The man and the hour had met. Twentieth century science and industry demanded more and more precise and sophisticated chemical analysis. This could only be done by chemists with sufficient mastery of chemical theory to take on new problems. At Minnesota Kolthoff established new standards for teaching graduate students -- making sure they were solidly grounded in physical chemistry theory -- and in writing, for the clarity of description of the problems to be solved, the application of theory, and the succinctness of his experimentation.

He published more than articles. In this period, 1928 through 1941, Kolthoff also published three books, starting with a translation of his 1927 Die Massanalyse (Volumetric Analysis); Textbook of Quantitative Inorganic Analysis, with his former graduate student Ernest B. Sandell; and Polarography, with


another former graduate student, James Lingane, in 1941.

The arithmetic: In his first fourteen years at Minnesota, on the average, Kolthoff published a scientific paper every three weeks, supervised a PhD thesis every six months, and wrote or co-wrote a major scientific book every five years. He produced not a flow, not a river, not a flood, but a tide of scholarship, all in the service of his big plan, the modernization and elevation of analytical chemistry.\(^{11}\)

Kolthoff excelled at attracting talent. The first was Ernest B. Sandell, later a co-author of *Polarography*, and many years a professor at Minnesota (and, with Kolthoff, creator of the Sandell-Kolthoff test, still used for the measure of iodine in human blood). James Lingane went on to a long career as professor and department chair at Harvard. Herbert Laitinen, a Finn from Ottertail, Minnesota, taught chemistry -- and trained his own cohort of graduate students -- at Illinois, then the University of Florida, and served many years as editor of *Analytical Chemistry*, the first academic journal devoted to the subject. David Hume taught analytical chemistry for thirty-three years at MIT. Joseph Jordan taught analytical chemistry for thirty years at Penn State. Stanley Bruckenstein served more than forty years a professor at SUNY Buffalo. Johannes Coetzee taught for many years at Pitt. Every one of these teachers and scholars -- and many others -- extended the web of Kolthoff’s influence in space and in time, to later generations.\(^{12}\)

In his campaign to modernize and elevate analytical chemistry Kolthoff was recruiter, drill sergeant, quartermaster, and chaplain: he found the young chemists, trained them, inspired them, and kept the resources flowing. He was the field marshal, master of strategy and tactics. He was a foot soldier too, working side by side with his recruits in the laboratory. Piet Kolthoff was not a man; he was an army.

By the end of 1941 Kolthoff had built an unshakeable reputation as teacher, scholar, and innovator. The coming of World War II to the United States was about to take his career in a new direction.

**War**

From 1928 until 1940, Kolthoff took time every summer to visit his home town, Almelo. He had family there. His father, Mozes Kolthoff, died in 1936, but his mother still lived, along with his sister Elisabeth; her husband Jacob Wijler and their two daughters Martha and Rose; brother Abraham, and a host of uncles and aunts. As the 1930s went on he felt the growing tensions of war in Western Europe. Almelo, in the northeast corner of the Netherlands, lay ten miles from the German border.

\(^{11}\) Author’s compilation of Kolthoff publications in the University of Minnesota libraries.

\(^{12}\) The web site Chemistry Tree provides an excellent, though not complete, listing of chemists tracing their academic lineage to Kolthoff.
The Kolthoffs were Jewish. After his last pre-war visit, in 1939, Kolthoff told a reporter, “I had a horrible feeling of premonition and there were tears in my eyes.” Though Dutch Jews, among the most assimilated in Europe, had mostly remained relatively calm in this period, with few trying to leave the country, the Kolthoffs looked into it, moving money around in the hope of acquiring tourist visas to Uruguay. Nothing came of that. The Nazi army invaded Holland on May 9, 1940. The so-called Battle of the Netherlands lasted seven days. Piet Kolthoff heard nothing from his family -- Jews trapped in the Nazi occupation -- until after Holland’s liberation five years later.  

Mid-twentieth century war ran on rubber: jeeps, trucks, armored personnel carriers, landing gear, plus trucking transport on the home front. The British had controlled most of the world’s rubber supply through its Southeast Asian colonies until they were conquered by Japan in the early 1940s. Synthetic rubber had been invented, but played a small part in global supply. After Pearl Harbor, synthetic rubber became a crucial war material for the Allies, as Japan now controlled 90% of world supply. The United States began the war with less than a year’s peacetime inventory. For the first year of the war, 1942, the country relied to an alarming degree on recycled rubber from a tire drive.

Synthetic rubbers of limited usefulness had been developed in the early 1920s. German scientists working for I.G. Farben in the late 1920s and the 1930s produced a tire-quality synthetic rubber, praised by Hitler and produced in modest quantities during the war. The I.G. Farben scientists had gotten U.S. patents in 1933, so their work was public knowledge.

In late 1942 the U.S. Defense Rubber Committee selected Izaak Kolthoff as one of a dozen academic chemists to join chemists from Firestone, Goodyear, Goodrich, and, later Phillips Petroleum, to take on what was sometimes called a Second Manhattan Project -- to find a recipe for synthetic rubber with two essential qualities: 1) durability comparable to that of natural rubber; 2) capability of mass production.

The accounts of the project’s experiments provoke an image of chefs gathered around a giant cauldron, each with a big wooden paddle, stirring the mixture and arguing. There was a good deal of trial and error because, according to Kolthoff, the participants so incompletely understood the chemistry. Also, they were in a hurry.

This was Kolthoff’s first encounter with government-funded research, and he hated the bureaucratic nuisances -- the meetings, the squabbles, the red tape. On one occasion he requisitioned a particular part, with precise specifications and available from just one vendor. When weeks passed without receiving it he found that his request had been sent out for


16 Morris, Peter J. The American Synthetic Rubber Research Program. Philadelphia: University of Pennsylvania, 1989, pp. 13-38. Still working on rubber in 1956, Kolthoff applied for a National Science Foundation grant to further study emulsion polymerization. He wrote, “It must be admitted that our understanding of the kinetics and mechanism of any emulsion polymerization system is most inadequate. The recipes now used by the American Rubber Industry [and largely produced by Kolthoff and his colleagues] have been developed almost entirely on an empirical basis . . . .” Grant application, folder marked “Grant Papers,” Kolthoff Papers.
bid; the winning bidder produced an item only approximately the right size -- that is, useless. He fumed.

He learned to bite his tongue working with the oil industry representatives, who disliked collaborating with academics and tried to keep credit for themselves. “This lack of cooperation is disgusting,” he wrote to the program’s director.\(^\text{17}\)

He also had to wrestle with the government over his researchers. Most of them were draft-age young men. Every time one of them got drafted Kolthoff traveled to Washington DC to get the unlucky soldier un-drafted so that he could serve the war effort in the lab. Kolthoff claimed that he never lost one.\(^\text{18}\)

Rubber research brought a lot of activity and money to the University of Minnesota. During the war years Kolthoff’s project employed up to fourteen people (eight of whom, he wrote were working 50 hours a week), including Kolthoff and his assistant. Edward J. Meehan, and paid three-fourths of Kolthoff’s $5500 salary. In the years 1942-1946 the project brought in $231,000, about three million in 2017 dollars.\(^\text{19}\)

Kolthoff’s rubber work defies easy description. The manufacture of artificial rubber involves polymers, strings of molecules. If the strings are too short (not ‘poly’ enough) or too long, the resulting rubber does not work well. So one of the keys to the project was finding a recipe that halted the polymerization process at the right moment. In the words of the historian of this project, Peter Morris, “Kolthoff was drawn into the investigation of how the various parameters -- temperature, soap, acidity, and modifier -- influenced the rate or outcome of the polymerization.” He and Herbert Laitinen, now at Illinois, developed new analytical techniques for the purpose.

By war’s end in 1945, US production of synthetic rubber had risen from 231 tons a year in 1941, to 920,000 tons in 1945. After the war Kolthoff and his team moved past analysis and onto the big prize, improving the recipe. They played a part in making “cold rubber,” a higher quality product produced, literally, in the cold, about 20 degrees Fahrenheit, that forever replaced natural rubber for tires. One of Kolthoff got two 1947 rubber patents provides a glimpse of him at work. The rubber recipe that the war group chose was called emulsion polymerization. To work well it required the emulsion to be kept consistent, which was done by either shaking or stirring. Kolthoff, with colleague Charles Carr, devised a better way -- ultrasonic waves.\(^\text{20}\)

Though Kolthoff sometimes downplayed the importance of his rubber work, he continued at it for another seven years, and near the end of his life, in a 1992 survey for Who’s Who in American Science, he cited only one achievement: the “recipe for emulsion polymerization of rubber, 1942-54.”\(^\text{21}\)

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\(^{17}\) Kolthoff to Dr. C.S. Fuller, 8 November 1943. Kolthoff Papers, folder labeled Correspondence 1926-44.

\(^{18}\) Brasted interview.

\(^{19}\) Department of Chemistry records, U of M Archives, folder marked “Dr. Kolthoff’s Rubber Research.” Through June, 1952, the University received $631,214. Only the Universities of Illinois, and Chicago, and Case Institute in Cleveland, got more. Herbert and Bisio, Synthetic Rubber, 149. The University of Illinois program was run by Kolthoff’s former graduate student, Herbert Laitinen.


\(^{21}\) Morris, Peter T. The American Synthetic Rubber Research Program. Philadelphia, University of Pennsylvania, 1989; American Chemical Society, “United States Synthetic Rubber Program, 1939-1945” (pamphlet produced for dedication of a chemical landmark in Akron, 29 August 1998.) Washington DC: American Chemical Society, 1998. Kolthoff is not mentioned in the brochure, but this sentence - - “University laboratories developed better analytical methods to achieve better quality control and performed fundamental research on GR-S polymerization and the
The Canadian Army liberated Almelo from the Nazis on 5 April 1945. Crushing news reached Kolthoff in fragments. Dutch Jews had been murdered at a higher rate than in any other occupied Western European country, almost 75%, compared to 45% in Belgium and 25% in France. Kolthoff’s mother, her brother and her sisters, by now all old, had been murdered at Vught, Netherlands and the Sobibor death camp in Poland in the spring of 1943. His two adult nieces, Martha and Rose, had gone into hiding (as did many Dutch Jews), but been betrayed and killed, 21 January 1943, at Auschwitz. Their parents, Kolthoff’s sister and brother-in-law, Elisabeth and Jacob Wijler, also hid and avoided capture; but when they learned the fate of their daughters, took their own lives six weeks later. Only his brother Abraham, also hidden, survived the war.  

On April 5, 1951, Piet Kolthoff awoke to find his name in the morning Minneapolis Tribune, linked with film stars Judy Holliday and Mel Ferrer. The U.S. House of Representatives Committee on Un-American Activities (HUAC) had issued a report on prominent Americans associated with disloyal and subversive organizations. The Tribune headline featured Holliday and Ferrer; Kolthoff’s name appeared lower, in the text. The HUAC report named him six times.

Kolthoff was neither disloyal nor subversive, but he had done plenty to get himself noticed in that hypervigilant era. He had begun taking public political positions as early as 1930, when he became national president of the Association of Cosmopolitan Clubs, whose motto was “Above all nations, humanity.” In 1931 he had written, “I frankly admit that I am a bad nationalist.” This was innocent then, but in the Cold War “internationalism” fell under suspicion as a synonym for “Communist sympathizer.” Though -- or, perhaps, because -- Kolthoff had become a U.S. citizen in 1940 and a valued defense scientist in 1942, the FBI started investigating him in 1944. Agents quizzed his superiors at the University of Minnesota about his loyalty.

Whether they reported these contacts to Kolthoff we do not know. In 1945 headline from the Minneapolis Tribune could have been ominous -- another turncoat? But it was merely descriptive. Within weeks of the end of World War II in Europe the Soviet

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22 van der Boom, Bart. “Ordinary Dutchmen and the Holocaust: A Summary of Findings,” in The Persecution of the Jews in the Netherlands. Amsterdam: University of Amsterdam Press, 2012 [page?] Information about the fates of Kolthoff’s relatives comes from a variety of sources, the Jewish Historical Museum of Amsterdam and Culemborg (where his mother’s family came from), and the Yad Vashem Central Database of Shoah victims. Personal communications from Ariane Zwiens, Jewish Cultural Quarter, Almelo.  

government invited Kolthoff and fifteen other American scientists on a seventeen-day tour. What the Soviets’ motives may have been we cannot know, but to Kolthoff the trip’s only political element was the promotion of international scientific cooperation. After stops in Casablanca, Cairo, and Teheran, the Soviet tour began in Baku on the Caspian Sea, then Moscow, to a thousand-acre collective farm, and Leningrad, then back to Moscow before undertaking a cross-Siberia air journey to Anchorage, then home.

With the help of Tribune staff writer Kenneth Scholes, Kolthoff published ten articles about his journey, and in them a government disloyalty hound could easily have found grounds for alarm. Kolthoff attended a dinner with Stalin and Marshal Zhukov; he described Stalin as displaying “great strength of character,” praised the Soviet government for support of basic scientific research much better than that of the West, and noted that the escalator he rode in Moscow worked “at a much faster speed than escalators work in America.” He seemed smitten by his U.S.-born Russian translator. In her version of the Soviet state, wages were fair, the necessities of life amply provided, and freedom abundant. “Natasha is enthusiastic about Soviet Russia, but I found her quite objective.” Kolthoff’s description of the collective farm was positive, though without overall judgment.

He wrote in praise of Russian theater and dance, the warmth of the Russian people, and the advancements of Russian science. The traitor-hunter would have noticed Kolthoff’s pleasure at his encounters with chemist A. Frumkin and physicist James Frenkel; both were Jews who had taught in the Midwest, Frumkin at the University of Wisconsin and Frenkel at Minnesota, now living in the Soviet Union. In Moscow he also ran into the French scientist Frederic Joliot-Curie, a Communist (also a Nobel Prize winner and son-in-law of Marie Curie) whose name featured prominently in the 1951 HUAC report.

In 1948 Kolthoff was asked join a “committee of 1,000” prominent citizens (Helen Keller was one of them) calling for the abolition of HUAC. The Committee of 1,000 called HUAC “betrayals of American ideals.” Kolthoff joined gladly: “I am confident that the Un-American activities of the Un-American Activities Committee are of great concern to the majority of the American people.”

In 1949 Kolthoff visited Communist Yugoslavia, and wrote about it for the Minneapolis Star. The country impressed him. “Yugoslavia was a backward and undeveloped country. The people had been exploited. Conditions were favorable for a social revolution. That revolution had brought about great social improvements. . . . Considering the poverty of the country and the recent developments of the socialized system, the results seem to be amazing.”

The 1951 HUAC report accused Kolthoff of association with six organizations that it called subversive: the Civil Rights Congress; Committee for Peaceful Alternatives to the Atlantic Pact [NATO]; Independent Citizens Committee for the Arts, Sciences and Professions; the Joint Anti-Fascist Refugee Committee; and Cultural and Scientific Conference for World Peace. So far as it went, the list was accurate. Accurate, but ham-fisted. These were all international peace organizations, mostly sprung up in reaction to the devastating

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25 IMK to Harlow Shapley, 12 January 1948, Kolthoff Papers. Box 1, Correspondence 1948-49.
26 Minneapolis Star, 19 October 1949, p. 19.
recent European wars, the development of nuclear weapons, and the new threat of war between the West and the Communist bloc. These organizations operated in public (that’s how HUAC got the names) and were supported by hundreds of distinguished citizens. Besides Kolthoff (and his red paramour Judy Holliday -- nee Judith Tuvim, a New York Jew) the report cited an all-star array of American artist and scientists, including:

- Performers: singer and actor Paul Robeson (who really was a Communist), actors Lee J. Cobb, Will Geer, Marlon Brando, Charles Chaplin, Jack Guilford, Gale Sondergaard (a Minnesotan) and Uta Hagen, dancer and choreographer Michael Kidd, composers Leonard Bernstein and Aaron Copland.
- Writers: Thomas Mann, Clifford Odets, Dashiell Hammett, Lillian Hellman, and Ring Lardner
- Scientists: Albert Einstein, Linus Pauling, and Karen Horney

Piet Kolthoff was not even the report’s most-cited Minnesotan. That honor went to former Governor and U.S. Senator Elmer Benson. Kolthoff also came in behind a dangerous character named Charles Turck, president of Macalester College and recently elected president of the U.S. Council of Churches. The presidents of Augsburg College and Carleton College also made the list, along with Arthur Foote, pastor of Unity Unitarian Church in St. Paul.27

Kolthoff was more amused than threatened by the HUAC report, and he responded in typical Kolthoff fashion by writing directly to Congressman John Wood of Georgia, chair of the committee. Only the last of his three letters to Wood survives. On June 6, 1951, he wrote:

I believe there is unanimous agreement that a war would result in a world catastrophe. From the Report of your Committee, one gets the uncomfortable impression that subscription to peace proposals and peaceful solutions makes a person a suspect of being a Communist sympathizer. He then went on to correct the record by naming three more peace organizations he belonged to, not mentioned in the report, and teased the Congressman for relying too much on what he read in a Communist publication, The Daily Worker.28

HUAC apparently did not pursue Kolthoff further, but others did. In May, 1953, the magazine American Mercury published a piece called “Communism and the Colleges.” “In an endeavor to corrupt the teachers of youth,” wrote J.B. Matthews, “the Kremlin has been remarkably successful, especially among professors at our colleges and universities.” Kolthoff fell into the “fellow-traveler” category, not a Red, just a Red-abetter. “[T]hey all serve the purposes of Kremlin treachery.”29

Kolthoff brushed it all off, but the fringe right wingers did not forget. As late as mid-1960s an organization called Christian Research Inc. produced a pamphlet called Communism at the U Today. “HOW MANY PROFESSORS,” it asked students, “...indoctrinate


28 IMK to Congressman John Wood, 6 June 1961. Kolthoff Papers, Box 1, Correspondence 1960-62.

29 Matthews, J.B. “Communism and the Colleges.” The American Mercury, May 1953, pp. 111-146. Only three other Minnesotans were named: Charles Turck, again, and University of Minnesota professors Henry Burr Steinbach (biology) and Joseph Weinberg (physics.) Neither Turck nor Steinbach seem to have been hurt by such accusations -- Steinbach had a long career at the University of Chicago and Woods Hole National Laboratory. New York Times, 24 Dec. 1981. Weinberg, a member of the Manhattan Project, was dismissed by Minnesota in 1953, over suspicions about his loyalty, and returned to the academy only in 1957, at Western Reserve University. He then went on to a long career at the University of Syracuse. http://archives.syr.edu/collections/arc_staff/sua_weinberg_j.htm
STUDENTS WITH MARXISM-SOCIALISM . . . RIGHT IN THE CLASSROOMS!??” Ranked first (despite being retired), “KOLTHOFF, Isaac M.” with thirty-five “Communist front associations.” (His chemical protégé, Cyrus Barnum, ranked fourth, with twelve.)

In fact Piet Kolthoff had no use for Communism or any ideology. Politically he was a conventional liberal (he admired Hubert Humphrey) with a special interest in academic freedom and international cooperation among scholars, without political interference. Kolthoff recognized that science could be put to destructive use. In March 1945 he wrote to former Minnesota governor Harold Stassen:

[B]eware of the criminal nation that wishes to exploit science and its scientists for the ultimate destruction of mankind. Although the scientist should maintain complete freedom in his choice and pursuit of research, I feel that the progress and application of scientific research should be closely supervised by an international board.

He belonged to United World Federalists and in 1949 had written that world government was the only hope for avoiding future wars.

Kolthoff was less idealistic than some of the intellectuals who signed the same calls for international peace and cooperation that he sometimes did. In 1948 he met in a small group with Henry Wallace, the most left-leaning man ever to hold the office of Vice-President, and about to run against President Truman in the fall election. He put the question to Wallace, “What assurances are we going to demand from Russia to protect our security?” and was disappointed in a lack of response. “I am not joining the Wallace group,” he wrote a few days later, “until I have assurances that it is not only a matter of giving to but also taking from the Russians.” He had written a similar opinion to Albert Einstein. In 1950 he had been asked to join the World Congress of Defenders of Peace in a call for nuclear disarmament. “Do you really think that outlawing any weapon will contribute to peace? War is immoral, and under desperate circumstances, any nation will use any weapon for self-preservation.” He suggested a different approach: “I would like an appeal to all nations that they submit to international control of elementary human rights.”

The HUAC accusations did not hurt Kolthoff professionally, but they did sting. From the onset of World War II forward he had been an enthusiastic advocate of defense research. In 1951 he had joined the Chemical Advisory Committee of the Air Research and Development Command. But he lost his security clearance in late 1952, and was forced to resign. He got it back in December 1953, but not before having been subjected twice to fingerprinting. This must have galled him; he had long been on record opposing such measures.

30 Kolthoff Notebook no. 16.
31 IMK to Harold Stassen, 9 March 1945. Kolthoff Papers, Box 1, Correspondence 1945-1947.
32 IMK to Frederic Joliot-Curie, 10 May 1950, Kolthoff Papers, Box 1, Correspondence 1950-51. Prof. Joliot-Curie was a scientist whom Kolthoff knew, and an enthusiastic Communist and supporter of the Soviet Union.
33 Amos Horney of Air Research Group to IMK, [date?]; Paul Flory of Cornell University to IMK 22 November 1952; IMK to A.H. Blatt, Chairman of Chemistry Advisory Committee, Air
The accusations had no effect on Kolthoff’s scientific productivity. The demands of wartime research slowed his rate of publication to just eighteen papers, 1942-45, but soon he got back to full production. From 1946 through his retirement year, 1962, he published another 241 papers, about fourteen a year. The rubber research pushed him into a new area of publication, colloidal chemistry. (Emulsions are one variety of colloids, and the cold rubber recipe that Kolthoff had helped develop was called “emulsion polymerization.”) He had first studied colloids with Schoorl in Utrecht.) He also returned to cancer research, an area he had first explored in 1939 (blood analysis) and published articles in The Lancet and the Journal of the National Cancer Institute, two publications normally outside of his already wide scope. 34

In addition to his technical publications, Kolthoff also wrote and spoke regularly about the history of analytical chemistry and the proper way to educate scientists. Above all he advocated liberty of thought and urged his own students not to accept received wisdom or even his own wisdom if they disagreed. He rejected requests from industry to train his students for industry. The qualities that he prized were “imagination, originality, initiative, judgment, and curiosity.” 35

Still not sufficiently busy, in this period Kolthoff also worked part-time as an editor for New York publisher Interscience and its Chemical Analysis series of monographs. This had started in 1942, slowly, then accelerated in the 1950s and ‘60s. Kolthoff may have contributed to as many as fifty of these books. He also became a major shareholder in the company. 36

His own books kept coming too, six monographs based on graduate students’ Ph.D. theses (with Kolthoff as co-author); Emulsion Polymerization (with three co-authors), a description of his rubber work; and another book on pH.

Around 1954 began thinking of something bigger than he had ever done, an encyclopedic treatment of his field. The first volume of Treatise on Analytical Chemistry came out five years later. One sentence in the Forward sums up the size of his ambition:

The aims and objectives of this Treatise are to present a concise, critical, comprehensive, and systematic treatment of all aspects of classical and modern analytical chemistry.

Can we go over that again? “Concise, critical, comprehensive, and systematic . . . all aspects of classical and modern analytical chemistry.” Whew!

In the end it is not clear that he achieved concision. Part One came out in 1959 -- ten volumes, though, to be fair, all are slim, just 400 to 500 pages each. Part Two, sixteen volumes plus index, came out in 1961, and Part Three, four volumes, was issued over a ten-year period, the last in 1977, fifteen years after Kolthoff had “retired.”

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36 Personal communication with Prof. Mark Vitha of Drake University, current (2017) editor of the Chemical Analysis series.
The reader is invited to admire not only the ambition of the task, but the scope. Over eighteen years the Treatise engaged 295 authors, from 60 universities, 55 private companies, eighteen government departments, twelve research institutes, and eight countries; contained 245 articles, and consumed over 17,000 pages. The Treatise on Analytical Chemistry made a fitting culmination to a career that was still not over.37

A non-chemist who paged through the Treatise would discover a vast and unknown world, one where everyone understands the word “titration,” where careers are made observing vanadium, and where industries turn on the precise arrangement of hydrocarbon molecules. It’s a realm where the impenetrable (to almost everyone) is common currency. At the same time, some article titles show where any citizen can understand the everyday application of analytical chemistry: “Testing of Consumer Products,” and “Potable and Sanitary Water.” The people who identified the hazards in the Flint, Michigan water supply in 2016 were practicing analytical chemistry.

The University of Minnesota required Kolthoff to retire in 1962 as he neared age 70. Nothing else changed much. He continued to live on campus, as he had done since 1927; he had a room in the Campus Club on an upper floor of Coffman Memorial Union. He continued to experiment, write, and publish. The Chemistry Department allowed him lab privileges and space for up to three post-doctoral researchers. Kolthoff took that as a starting offer: for the next decade he employed at least ten every year.38

In retirement he published 126 papers, many of these with his devoted laboratory colleague, Dr. Miran K. Chantooni, Jr., who stayed with him for over thirty years. In research there was no looking back; Kolthoff continued to keep up with the literature in his field and explore new areas. A prominent chemist noted that if Kolthoff had started over in 1962, as a fledgling professor, his post-retirement record of research and publication would have qualified him for tenure at almost any university.39

He traveled more, to Florida and the Cayman Islands for fishing, and to Israel, where he had relatives and had taken a great interest in promoting the study of chemistry at Israeli universities. He played bridge; he received a bushels of mail, especially on the occasions of his 80th, 90th, and 95th birthdays. He often

37 Author’s compilation from the first edition of the Treatise, with the assistance of Prof. Mark Vitha of Drake University. Oddly, perhaps, the University of Minnesota libraries do not own a complete set. Prof. Vitha, who got his PhD at Minnesota, owns a set previously owned by I.M. Kolthoff.

38 Ray Archer, University of Minnesota Department of Insurance and Retirement to IMK, 20 February 1961 (retirement), Kolthoff Papers, Box 1, Correspondence 1960-
worked outside his room at the Campus Club, and had an informal invitation to join any buffet line that appeared nearby.

By 1979 he complained that he could only sustain concentration for a few hours a day, and took leave of his editing duties at Wiley-Interscience. The sports injuries that Kolthoff had suffered over the years -- skiing and horseback riding -- took a predictable toll on his mobility. In 1981, when he had reached 85, the University arranged to move him a few dozen yards to the west, into Comstock Hall, where he lived at the University’s expense. Among his many distinctions: the only male professor at the University to live in a women’s dormitory.

Only at the very end of his life, in is late 90s, did Piet Kolthoff finally leave campus. He moved to the high rise apartments at 740 East River Road near the Ford Bridge, and, ultimately bedridden, to Bethesda Rehabilitation Center, where he died on March 4, 1993.\textsuperscript{40}

The Father of Modern Analytical Chemistry

More than twenty-one years after Piet Kolthoff’s death, in a ceremony held at Smith Hall, the American Chemical Society designated the contributions of Izaak Kolthoff to modern analytical chemistry as a National Historic Chemical Landmark. The Chemical Landmark was Kolthoff’s greatest award, but far, far from the first. In the last half of his life receiving awards became a recurring thing. He got plenty of opportunities to tell his “optimal pH for chicken soup” story.

In 1949 Kolthoff received the Nichols Medal, for original research in chemistry, from the New York division of the American Chemical Society. Previous and future Nichols laureates included Linus Pauling, Irving Langmuir, Glenn Seaborg, Robert Woodward, and Vincent du Vigneaud, all Nobelists in chemistry; and James B. Conant, chemist, U.S. Ambassador to West Germany, and president of Harvard University.\textsuperscript{41}

The next year Kolthoff received the Fischer Award in Analytical Chemistry from the American Chemical Society. The award speech noted that “more research papers have come from the prolific pen of this year’s recipient than from any other living analytical chemist,” and that he had also educated more PhD’s in analytical chemistry than anyone else. He was just the third to win it, and his influence affected this award for years to come. His former graduate students James Lingane, Herbert Laitinen, and David Hume won it in 1958, 1961, and 1963 respectively -- four U of M students or professors in fourteen years. Kolthoff’s co-editor of \textit{Treatise on Analytical Chemistry}, Philip Elving, won it in 1960.\textsuperscript{42}

\textsuperscript{40} \textit{Minnesota Daily}, 8 March 1993.

\textsuperscript{41} Nichols Award web site: https://www.acs.org/content/acs/en/funding-and-awards/awards/acs-local-section-awards/new-york-local-section.html

\textsuperscript{42} Typescript of award remarks, Kolthoff Papers, Box 1, Correspondence 1947-49. Fischer web site. Kolthoff’s chemical grandson (former graduate student of Kolthoff’s former graduate student, Joseph Jordan) and Professor of Chemistry at Minnesota, Peter Carr, also won this award in 2009.) Carr believes Kolthoff’s greatest accomplishment lay in the education of his graduates students.
In 1964 the Chicago Section of the American Chemical Society gave Kolthoff its 53d annual Willard Gibbs Award. This one put him in a company almost as distinguished as the claque of traitors identified with Kolthoff in the HUAC report of 1951: seventeen then and future Gibbs medalists won Nobel Prizes in chemistry, including Linus Pauling, again, and Marie Curie.

Chemists will understand the specifics of Kolthoff’s Gibbs:

In recognition of his unique influence on, and his manifold contributions to the understanding, practice and teaching of analytical chemistry as exemplified by his fundamental studies of classical titrimetry, indicators, pH and buffer solutions, coprecipitation and the aging of precipitates, polarography, the kinetics and mechanisms of emulsion polymerization, and potentiometric, conductiometric and amperometric titrations.

Anyone can understand the award’s general purpose: "To publicly recognize eminent chemists who, through years of application and devotion, have brought to the world developments that enable everyone to live more comfortably and to understand this world better." This fit Kolthoff perfectly, especially the phrase, “years of application and devotion.”

In 1967 the Academy of Pharmaceutical Sciences created a new award, the Kolthoff Gold Medal Award in Analytical Chemistry, “to recognize long-term significant research advancing the science of pharmaceutical analysis.” The medal’s first recipient? Izaak Kolthoff. In his acceptance speech, he told the chicken soup story.

In 1972 the University of Minnesota used the last sliver of buildable land on Northrup Mall, the center of its main campus, to put up a new chemistry center, Kolthoff Hall. At the dedication ceremonies -- and elsewhere again and again -- people honored Kolthoff with the title “father of modern analytical chemistry.”

The key word in that phrase is “modern.” As Wilhelm Ostwald wrote late in the nineteenth century, analytical chemistry then was already hundreds of years old, but its scientific bases were antiquated, obsolete. The “science” was not much more than a compilation of lab techniques.

Kolthoff’s great contribution was to reconnect laboratory practice with theory. The word theory is often misunderstood. In common speech it often means just a guess: “That’s MY theory.” In science theory is not guesswork but an organized body of knowledge that has both analytical and predictive power. The theory of biological evolution, for example, both explains the fossil record and predicts the mutation of, say, the Vika virus.

Kolthoff did not produce new theories, like Darwin and Einstein did. Instead, he worked to integrate already existing theories in chemistry, especially physical chemistry (the structure and nature of the atom), into chemical analysis. This was, in a way, a harder task than theorizing. Darwin and Einstein caught people’s attention with their spectacular notions. All Kolthoff undertook to do was modernize his science from the ground up, through teaching, writing, publishing, and persuading. The Gibbs award got it exactly: “years of application and devotion.”

His own motto was “theory guides, experiment decides.” We might think of experiments leading to the formation of theory, but Kolthoff put it the other way. Analytical chemists equipped with understanding of modern chemical theory had the tools not just to conduct chemical analysis,
but to understand the why of their results. With the understanding of why came also the ability to imagine new tools and techniques. Einstein’s General Theory of Relativity, 1903, provoked the imagination of the “God particle.” In 2016 experiments confirmed its existence. Theory guides, experiment decides.

When he began at Minnesota analytical chemistry was a technical specialty. By the time Kolthoff retired, the field had achieved full parity with the other branches of chemistry. Two scientific journals, Analytical Chemistry and Talanta, were devoted to it. All major universities employed professors of analytical chemistry, many of them trained by Kolthoff and his disciples. An analytical chemist, and friend of Kolthoff’s, Jaroslav Heyrovsky, won the Nobel Prize in 1959. It was estimated in 1964 that 1100 analytical chemists around the world, in universities and industry, traced their academic pedigrees to Piet Kolthoff, the father, grandfather, and now, in 2016, great-grandfather of modern analytical chemistry.

One of his graduate students, David Hume (who went on to teach analytical chemistry at MIT), tried to sum up Kolthoff’s achievements:

More than any other person, he transformed analytical chemistry from a rather unimaginative, conservative art to a dynamic, innovative science. He swept the profession along with him . . . . So widely is his style of approach now used that . . . . we tend to take it for granted. And we forget, if we ever knew, what the source was.  

In 1994 the American Chemical Society published a book, Landmarks in Analytical Chemistry, a compilation of exemplary papers in the field. For the period 1930s-1940s, the editors chose one Kolthoff paper among the ten exemplars. It bore a typically Kolthoffian title: “Polarographic Determination of Manganese as Tri-dihydrogen Pyrophosphatomanganiate.” Try saying that three times fast.

Alan Bond of LaTrobe University in Australia wrote in appreciation:

This paper represents one of the earliest demonstrations of how an important problem was elegantly solved by using a carefully integrated combination of Classical chemical-based methods, an instrument method [the polarograph], and relevant and recent theory.

An elegant combination of classic methods, new methods, and theory -- what could be better in any profession? “Fifty years later,” Bond continued, “this analytical protocol represents the standard expected in analytical chemistry.”

Kolthoff’s posthumous Chemical Landmark award was his greatest. The National Historical Chemical Landmarks program goes back to 1993 and stands out among scientific awards for its range, from the practical to the erudite. The first award went to Bakelite, a pioneering plastic now prized by collectors. With his award Kolthoff joined a roster that includes pioneering chemists Joseph Priestley and Antoine Lavoisier, the American agronomist George Washington Carver, water-based paint, Scotch tape, Tide detergent, the legacy of Rachel Carson’s The Silent Spring, and, in a kind of double-up for Kolthoff, the U.S. Synthetic Rubber Program in which Kolthoff played so big a part.

Thomas Edison and Piet Kolthoff, alike in their “years of applications and devotion,” were

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43 Typescript, “Professor David M. Hume in an improvised talk discussed Kolthoff’s contributions to science,” upon the dedication of Kolthoff Hall. Kolthoff Notebook 16.

added as “chemical landmarks” in the same year.\textsuperscript{45} One of the reasons Kolthoff left Europe for Minnesota in 1927 was the lure of a university that took an interest not just in pure research (which Kolthoff supported), but also bringing practical benefits to society. For Kolthoff to be placed by chemists who followed him in a pantheon of great theorists (Lavoisier and Priestley), great practical innovators (Edison and Carver), people of conscience (Rachel Carson), and things that made people’s lives better (synthetic rubber, water-based paint), would have pleased him no end.

Epilog

Kolthoff died in 1993. His last paper, written with M. K. Chantooni, was published after his death. The subject was crown ethers, a kind of designer molecule, for Kolthoff, in his nineties, a new area of inquiry. Just as there had not been enough hours in the day to do all he wanted to do, there were not enough years in his life. “I could have accomplished a lot more,” he once said, “if I had worked harder.”\textsuperscript{46}

Author’s Note

I am indebted to several people and institutions for the privilege of writing about Izaak Kolthoff. This project began with a chance meeting with University of Minnesota Department of Chemistry chair Professor William Tolman at the Minnesota State Fair in 2015. That conversation introduced me to Kolthoff.

Kolthoff’s papers are in the University of Minnesota Archives; my thanks to the people there for their professionalism and help.

Professor Peter Carr made available to me the Kolthoff Notebooks, which were compiled by Professor Kolthoff’s longtime secretary, the late Christa Elguther. Without her preservation and organization of Kolthoff’s papers, much of his story would have been lost. According to Pete Carr, Ms. Elguther provided a “serious multiplier” of Kolthoff’s accomplishments, especially in his later years.

Pete Carr and Professor Mark Vitha of Drake University were kind enough to read this manuscript and offer critically helpful corrections and suggestions.

I could not have traced the fates of Kolthoff’s family members killed in the Holocaust without the help of Ariane Zwiers of the Jewish Cultural Center, Almelo, Netherlands. It was she who identified the photo of Kolthoff’s niece, Martha.

Paul Nelson is the author of Fredrick L. McGhee, \textit{A Life on the Color Line}, a biography of Minnesota’s first African-American lawyer, published in 2002 by Minnesota Historical Society Press, and many articles in \textit{Minnesota History} and \textit{Ramsey County History} magazines and other publications. He is a graduate of the University of Minnesota Law School.

\textsuperscript{46} Coetzee, Johannes F. “Biographical Memoirs” . . . 17