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"The Public Image of Chemistry", Part II

Abraham Cressy Morrison in the Agora: Bringing Chemistry to the Public

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Abstract: This paper looks at the visual and textual images of chemists in A. Cressy Morrison's *Man in a Chemical World*. It argues that Morrison was attempting to create a public image of an American chemist different from European chemists. Morrison and the illustrator Leon Söderston, working on behalf of the American Chemical Society, attempted to associate chemists and chemical industry with American prosperity by linking the 'man in the white lab coat' to religious and secular themes. This approach is analyzed using the concept of metonyms. Metonyms are a way of encapsulating complex ideas and associations within simple, often iconic, images in text and illustrations.

Keywords: *images of chemists, popularization of chemistry, chemical industry, Abraham Cressy Morrison, Leon Söderston*.

1. Introduction

When Abraham Cressy Morrison published *Man in a Chemical World* in 1937, it joined a growing tradition of books that tried to make science better known to the public. What makes it different from most of the other popular works was its polemical style and the illustrations, which were some of the most interesting representations of scientists ever presented to the general public. Morrison was attempting to present a new and American image of chemistry. A key component in this effort to present a new public image for the American chemist was to recast the 'man in the white lab coat' as American and linked to beneficial (and even divine) activity. By examining the images and strategies used in Morrison's book, we can gain a better understanding of the complex nature of image creation, especially the way that images encapsulate wider concepts.

All the popularizers of the era had to bring their work to the 'agora' of print media and influence the public through texts and images in magazines and books aimed at a general audience. As a topic, chemistry needed popularization in both the sense of making it better known and making the study of chemistry more attractive. Through the post-war years, American chemists were battered by public antipathy to chemical warfare.[1] The extent of this image problem can be seen in the results of a 1922 *New York Times* poll. When asked if chemical warfare should be abolished by international treaty, 366,795 respondents voted for abolition, while only 19 supported its continued

use (Anonymous 1922). The subject was also kept in the public eye by a host of popular books such as Will Irwin's *The Next War* (1921), M. Dalton's *The Black Death* (1934), and most significantly H.G. Wells' *The Shape of Thing to Come* (1935) and its movie version *Things to Come* (1936). Wells' work started with a world ravaged by war and devastated by chemical weapons. The ongoing debate over the existence of the U.S. Chemical Warfare Service also affected public perception. This continued into the 1930s particularly because the United States helped to created and then refused to ratify the 1921 Geneva Gas Protocol (Ede 2002, p. 131).

Although the public concern about chemical warfare was significant, the story was not completely negative. The dramatic rise in the number of American-born and educated chemists attested to the increasing acceptance of chemistry as an academic subject and career choice.[2] The appetite among publishers for popular science titles such as Morrison's also reflected a growing public interest in science. *Man in a Chemical World* joined a substantial list of other popular books on chemistry from the era that tried to make clear the importance of chemistry. These included multiple editions of Floyd L. Darrow's *The Story of Chemistry* (1927, 1930) and Alexander Findlay's *A Hundred Years of Chemistry* (1937, 1948, 1955, 1965). H.E. Howe's two volume *Chemistry in Industry* (1924-5) was widely distributed, with a print run of 10,000 copies (Howe 1924-5, front apparatus). One of the most prolific popularizers of the period was Williams Haynes, who published many chemical titles, including *Chemical Economics* (1933), *Our Chemical Heritage* (1935), *Men, Money and Molecules* (1936) and *Chemical Pioneers: The Founders of the American Chemical Industry* (1939).

2. The American Context and the Origin of the Text

The issue facing science popularizers was how to make the public understand the importance of a topic that was not recognized as a part of daily life. Although there had been a number of notable Americans such as Benjamin Franklin and Thomas Jefferson interested in science, it was not a subject that had garnered wide public interest. There were several reasons for the lack of interest. Until World War I, science education in America was not very advanced at any level, and the number of scientists in the population was quite small. American competition in international trade was relatively limited, focusing mostly on raw materials, as were the demands to meet or surpass the technical standards of countries like Germany, England, and France. The majority of scientists in the U.S. working before the war were either foreign born or trained for their higher degrees at European universities (Thackray *et al*. 1985). Although the United States was slowly rising in scientific and industrial power before the war, there was an explosion of growth because of the war. While certain aspects of science might be seen a dangerous, after the war it was clear that a strong scientific community was increasingly desirable.

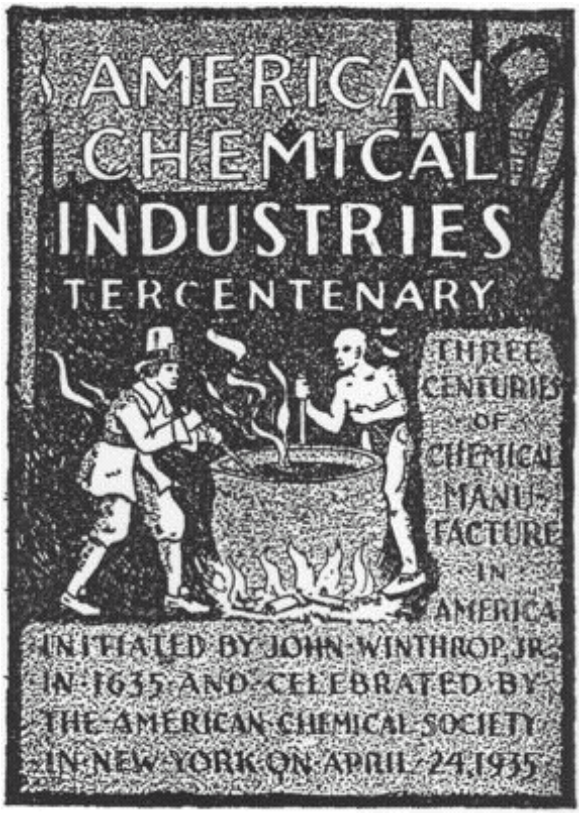


Figure 1. Poster for the American Chemical Industries Tercentenary used by the American Chemical Association 1935 meeting in New York (from Morrison 1937, p. 1).

It is against this mixed image of chemistry that Morrison's book must be read. The genesis of *Man in a Chemical World* started with one of the most significant attempts to promote and 'Americanize' chemistry undertaken by the American Chemical Society (ACS). For the 1935 conference, the ACS chose as their theme the tercentenary of chemical industries in America. (Morrison 1937, p. x) This offered an excellent platform to promote chemistry as an important American industry. The official poster (Figure 1) for the tercentenary showed a native in loincloth and feathered headband working with a Pilgrim stirring a giant steaming caldron.

Although there was chemical activity in the New World in the 17th century, the tiny number of European settlers in 1635 made the claim for three hundred years of chemical 'industry' a bit of a historical exaggeration. Regardless of whether the claim was historically justified, the association of chemistry with the founding of America was a direct argument that chemistry was a national enterprise and part of American history from the beginning, not a recent and foreign import. The scientific audience for this message was significant; when the annual meeting opened on 24 April 1935, more than 10,000 delegates from around the world had traveled to New York to attend (Anonymous 1935).

The conference was front-page news in New York and across the country, and all the published reports suggested that the conference was a rousing success. However, the executives of the ACS also wanted to present a more substantial view of the importance of chemistry than could be obtained from brief newspaper articles, even if those reports were positive. During the planning stages of the conference, the ACS had established the Executive Committee of the American Chemical Industries Tercentenary, with Francis P. Garvan as the honorary chairman and Arthur W. Hixson, a chemist at Columbia University, as the general chairman. The Committee in turn asked Morrison to write a companion book about the importance of chemistry and chemical industries (Morrison 1937, 'Acknowledgment').

Morrison's book may have been modeled in part on E.F. Armstrong's *Chemistry in the Twentieth Century* (1924). Armstrong was the chair of the Committee of Scientific Societies and coordinated the participation of British scientific organizations including the Royal Society in the 1924 British Empire Exhibition.[3] His book was "offered as a contribution made by British men of science to the work of building up the Empire" (Armstrong 1924, preface). Just as Armstrong had linked the importance of chemistry to the success of the Empire, so too did Morrison attempt to show how integral the role of chemists and chemistry was to American life.

3. Morrison and the ‘Agora’ of Popular Writing

Morrison was a good choice to write the companion book. He had a strong interest in popularizing science, having written articles for *Scientific American* and *Science Digest*, as well as *Reader’s Digest*. He was also the author/compiler of *The Baking Powder Controversy*, a massive two-volume work that compiled all the important documents and explained the convoluted legal, political, and business history of the fight to control the production of baking powder in the U.S. (Morrison 1904-7). He had been the President of the New York Academy of Sciences, which named a prize in his honor. The A. Cressy Morrison Award for Natural Sciences was conceived to acknowledge not only important scientific work, but also the best communication of that work.

What is less clear is the degree to which Morrison’s work was directed or overseen by the ACS. It is likely that Morrison worked with Hixson, and the plan for the book originated with the Tercentenary Committee, but beyond that there is no direct evidence of ‘writing by committee’.[4] There were numerous sub-committees for the conference (including ‘Golf’ and ‘Plant Visits’) but nothing specific about this project. Publishing records do not appear to exist, but the print run may have been as large as 10,000 copies, a substantial number, but in keeping with other books of the period.[5] According to copies bearing company stamps or labels, the book was purchased by at least two chemical companies and given away to libraries, and both Hixson and Morrison gave out copies.[6]

Although *Man in a Chemical World* was Morrison’s most significant work of science popularization, his most widely circulated work was an article cum pamphlet entitled ‘Seven Reasons Why a Scientist Believes in God’.[7] Morrison further explored the issue of religion and science in his 1944 book *Man Does Not Stand Alone* (Morrison 1944). It is important to see the material in *Man in a Chemical World* as part of Morrison’s larger conception of science and religion. Chemistry, and science more generally, was linked to the divine.

It is easy to see Morrison and the other popularizers simply as promoters of science and their books as boosterism, but there is a deeper layer to their work that is about the struggle to create a public voice for a discipline that had grown increasingly private (Shapin 1988). The extent of the concern among the chemical community, particularly among the leadership of the ACS, about public awareness can be seen in Arthur W. Hixson’s ‘Foreword’ to Morrison’s book. It is a good example of the enthusiasm, verging on hyperbole, common to many of the promotional books of the time.

> This book is intended to be educational, from the cultural as well as the utilitarian point of view. Its object is to impress the man in the street with the fact that the chemical industries of the United States render a service that touches practically every activity in which he engages. In fact, it is the main purpose of the book to awaken him to the realization that he is utterly dependent upon these industries not only for the necessity and luxuries of life, but also for his very existence. [Hixson, in Morrison 1937, p. ix]

That the ‘man in the street’ owed his life to chemistry was an extravagant claim, but one that Hixson and Morrison felt justified in making, based on the vast number of applications they identified as being within the realm of chemical industries. This covered everything from the pharmaceutical industry to farming and the conduct of war. The extent to which the ‘man in the street’ was aware of this assessment might be summarized by the brief book review in the *New York Times* (reprinted in the *Times Literary Supplement*). The anonymous reviewer commented that "Mr. Morrison has acceptably pointed out the practical universality of chemistry in or behind the activities of industry and programs of ordinary life".[8] This tepid acknowledgement of Morrison’s thesis can be contrasted with the positive comment of C.C. Furnas, writing in *Industrial and Engineering Chemistry*, who said, "An astonishingly good job which the intelligent portion of the public will appreciate", and he encouraged chemical engineers and their "non-technical friends" to read it (Furnas 1937).

Framing Morrison’s work in the tradition of the agora offers a useful way of discussing the rhetorical and iconic strategies of *Man in a Chemical World*. In the ancient world, the agora was more than the early version of the supermarket; it was also the public forum, the center of political debate, the source of gossip, and the market place

of ideas. Philosophers and physicians, magicians and barbers, adventurers and charlatans shared the public space with wine merchants and fruit sellers. The very idea that there is a 'public' comes to us because the agora, or its various equivalents throughout history, existed as meeting place that was not private space. Although natural philosophy and later science has always had a level of public presence, whether it was Socrates in the actual agora or Benjamin Franklin at fashionable French salons (*e.g.* Tucker 2003, Isaacson 2004), the practice of modern science does not lend itself well to the culture of the agora. As science became dominated by experiment, the locus of investigation became increasingly private. For Robert Boyle and his assistant Robert Hooke, the gentlemanly enterprise of experimentation took place in a laboratory that was part of a private residence (Shapin & Schaffer 1985). Admission was by personal invitation or referral by a close associate. Even the 'public' demonstrations of the Royal Society were largely restricted to members. By the 20th century, the physical place of scientific activity was not just private, but often carefully separated from other activities and hidden behind locked doors. The private world of science was partly a matter of utility, since scientists had to contend with safety issues, such as the control of toxic chemicals, and to protect sensitive and expensive equipment. Equally, science became increasingly private as more scientists began to work on secret military projects.

While the necessity for such security was perfectly reasonable, it was nonetheless the case that the practice of science took place far from the public gaze. The potential problems of the isolation of science was part of the motivation to create the British Association for the Advancement of Science in 1831 and the American Association for the Advancement of Science (AAAS) in 1848.[9] These two organizations have expended a great deal of effort to keep science in the public forum. To reach a wider audience, the AAAS began publishing the journal *Science* (partly financed by Thomas Alva Edison) in 1880. It joined the magazine *Scientific American*, which had first appeared in 1845, as conduits between the scientific community and the American public. Another important venue for public exposure were the natural history museums and the later creation of science museums and interactive science centers.

It is against this background of concern about the place of science in the public domain that we must see Morrison's work. *Man in a Chemical World* employs two strategies to present a positive image of chemistry: polemic and iconography. Morrison's text was frequently polemical, particularly using statistics to demonstrate just how important chemistry was to the individual and the nation. In addition to telling the reader how dependent they were on chemistry, the text was reinforced by the powerful and provocative illustrations done by Leon Söderston. Rather than follow the more common practice of the period of illustrating the book with photographs or diagrams of chemical experiments or apparatus, the majority of the drawings in *Man in a Chemical World* were metaphorical representations of chemistry and the spirit of science more generally.

4. Leon Söderston, the Illustrator

Information about the illustrator is scarce. Only one reference to Leon Söderston of Yonkers, New York appears in standard dictionaries of illustrators and artists (Mallett 1948, p. 412). His name does not appear in the National Archives' searchable database, but it is possible that he worked for the Federal Art Project during the Depression. Although his work likely appeared in magazines or advertising copy, he is known to have illustrated only one other book, *The Congressional Library* (1922) by the poet Amy Lowell. Söderston was mentioned in the author's acknowledgement, but it is not clear what degree of interaction there was between the author and the artist. Typically, illustrators worked from the text, or at least from detailed outlines. Authors would see the illustrations and have some say in approving them, but often the illustrator would only deal directly with the editor. In this case, the images are too closely linked to the text to have been created without access to the text prior to creating the illustrations. We can therefore read the text and the illustrations as a unified whole, while still acknowledging the two hands at work.

Historians and philosophers have frequently attempted to deconstruct the meaning of scientific images ranging from the insects in Robert Hooke's *Micrographia* to particle trails in cloud chambers (e.g. Adams 1994, Hankins 1995, Lightman 1997). Some images, such as the double helix and the Bohr-Rutherford atom have become so well-known that they are iconic, and even the simplest doodle is all that is needed to call to mind the larger subject

matter they represent. More recently, there has been growing interest in images of science and scientists. In particular, LaFollette (1990) explores this topic, looking at the impact of public images of science on science itself. [10]

5. The Use of Metonyms

One of the problems with attempting to decode images is that the interpretation is subjective. Different viewers see different things and can trace different roots. There is also the Derridian problem of endless reinterpretation.[11] In terms of setting images before the public, Norman M. Klein provides a way to interpret the link between image and public perception. According to Klein (2002), powerful images such as the picture of Einstein or the double helix create metonyms. A term borrowed from literature, a metonym is the use of one name (often a short form) for another, often more complex, concept. This kind of coding is very common, such as a reporter saying 'the White House' to represent the president or the executive branch more generally. Morrison and Söderston employed visual metonyms in both a direct and an exoteric manner. To understand what direct and exoteric metonyms are, consider the mass media image of Albert Einstein. Although Einstein was not the only wild-haired eccentric genius from whom this image was drawn – recall Charles Darwin's or Dimtri Mendeleev's magnificent bramble of beard, for example –, his image has really taken over the category. Einstein's picture appears on everything from coffee mugs to boxer shorts. As a direct metonym, a picture of Einstein in a biography of Einstein attempts to capture a small slice of time, placing an image of the man in the mind of the reader in the context of the story of the great scientist. Just as the use of the term 'White House' brings to mind the executive branch of the American government, so is the picture of Einstein a direct visual metonym that when viewed brings to mind the life of Einstein, especially at the time of the image. Put the same picture of Einstein on a T-shirt and it continues to convey the first aspect of the metonym, but it also suggests that the wearer admires Einstein and has a high regard for a certain approach to science and rationalism. The T-shirt image is an exoteric metonym: a public or outward declaration of the worldview of the wearer encapsulated in a picture.

The direct metonyms in *Man in a Chemical World* are relatively mundane; the Söderston images attempt to encapsulate the thematic material of the text. For example, in chapter eight 'Serving Industry', Söderston illustrates the pouring of molten metal (most likely steel) in an industrial plant. While the illustration can evoke the concept of all heavy industry, it does not carry the same complex package of meaning as other images.

The exoteric use of the images, on the other hand, created in the mind of the viewer a link between the image and a larger concept. In particular, Söderston's illustrations become a statement about the place of the scientist in society. Morrison was not looking to promote chemistry as the domain of geniuses, but as a field and industry essential to the prosperity of America. Thus, the textual and visual images of the chemist had to be work-oriented without making the chemist appear as a technician. This was a difficult set of requirements, but the image of the man in the white lab coat fit those requirements. It suggested both hands-on work and a higher calling, since the lab coat was transformed into a uniform with strong religious overtones in Söderston's illustrations.

6. The Evolving Image of the Scientist in the White Lab Coat as Scientific Icon

There is some debate about when scientists were first shown in lab coats. Their appearance in *Man in a Chemical World* does not represent a new image, but rather an important interpretation of the image that contributed to the creation of a powerful visual metonym in the public sphere. The use of the lab-coated scientist as a metonym does not have a single source of origin. In part, it evolved from images of chemists and other scientists at work, where they often wore aprons or light overcoats to protect their suits. As photography improved, candid pictures of scientists at the lab bench became more common by the 1920s, so the wearing of the lab coat came to be associated with a scientist at work. The other source of the image came from physicians, who started wearing white overcoats and aprons in the late 19th century and were far more likely in this period to be pictured in their white

overcoats than most scientists.[12]

Morrison's iconographic efforts were shaped by the necessity of creating an 'American' scientist. In both the text and the images, *Man in a Chemical World* repeatedly returns to the 'American-ness' of the chemistry. In the chapter 'All the Comforts of Home', chemistry was both American and domestic: "In America, the soft soaps of our ancestors were made in every home by boiling fat with the lye extracted from the wood ashes from the hearth" (Morrison 1937, p. 161). In the second chapter, 'Chemistry in Overalls', Morrison makes clear the distinction between the European intellectual and the New World researcher while pointing out that the industry was run by Americans. "These developments [chemical industry] are characteristically American and fully illustrate the ramifications of chemical industry, both as showing the high type of Yankee ingenuity behind them and as typifying industrial chemical progress." (Ibid., p. 30) Nothing foreign in soap, and the chemical industries were the product of the same Yankee creativity that made heroes of people like Thomas Edison and Alexander Graham Bell.

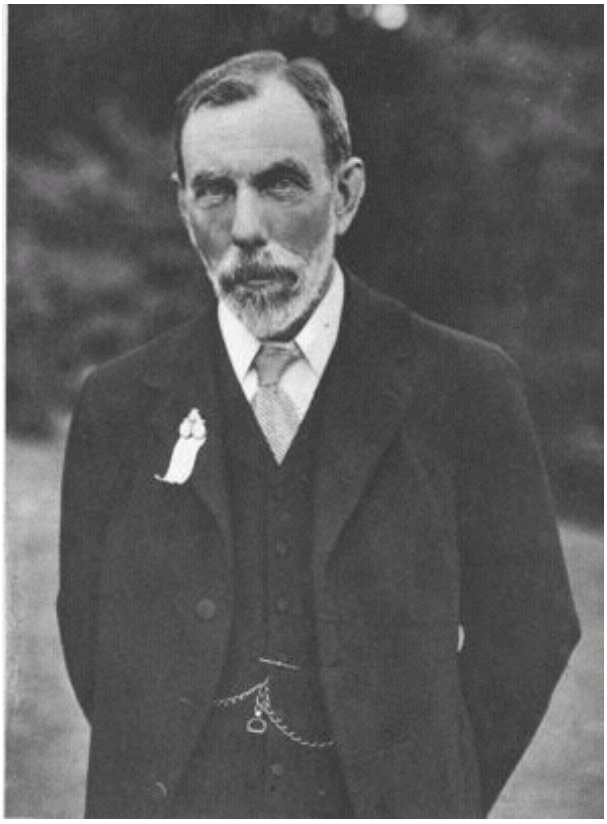


Figure 2. Photograph of Sir William Ramsay (1902) showing the formal image of a chemist of the era (from Picture card 1920).

For Morrison, the American scientist was to be differentiated from his European counterpart in much the same way as Robert Boyle distinguished the gentlemanly chemist from the medieval alchemist. Yet this had to be done without denigrating Europeans or European science, so it was done by emphasizing American work in the text and through the images. The European image of a scientist against which Morrison's portrait was drawn came primarily from the style and fashion of the late 19th-century European professorate. A typical European image of a scientist can be seen in the publicity photograph of Sir William Ramsay (Figure 2), taken shortly after he was knighted in 1902.

The European scientist was a member of the intellectual class, dressed in a three-piece suit, watch chain across the vest and wearing a carefully trimmed beard or goatee. This style remained popular for professional men in the U.S. until the early 1920s, as can be seen in the formal portraits of chemists in the ACS's *A Half-Century of Chemistry in America, 1876-1926* (Browne 1926). This image, however, was completely absent in Morrison and Söderston's depiction of American chemists.

Morrison's American scientist was a leader, economically as well as scientifically, but he was not an outsider, nor an effete scholar or from an upper class. Söderston shows us this Americanized scientist. The American scientist is dressed practically, either in the lab coat or working man's clothes. His clothes carry with them no hint of social

rank, just as the monk's habit abolishes the distinction of class at birth. The new scientist was clean-shaven, with short, slicked down hair. This reflected the new fashion for men of the day, especially in the U.S. and it also made clear that these men were progressive, concerned with the needs of the market, and distinct from the old professors. The new scientist was also pictured, metaphorically and literally, with his sleeves rolled up and getting down to work.[13]

7. The Artistic Style of the Illustrations

Söderston's choice of style was well suited to this new presentation of the scientist. Broadly speaking, the illustrations are in the American realism tradition, which had developed through the 1920s and become popular during the Depression era. Many of the public murals and friezes commissioned by the federal government as part of the Federal Art Project (a division of the larger Works Progress Administration) were in this style. American realism frequently celebrated the struggle of humanity overcoming adversity, but there was also a darker side to the presentation and subject matter. American realist subjects tended to be urban, often focusing on work and industry. Paintings like Victor Arnautoff's 'City Life' (1934) or Thomas Hart Benton's series on different types of dangerous work such 'Coal' and 'Steel' (1930) looked at their eponymous subjects with an eye for detail, but were not romantic. Life was hard and dangerous, and even a stroll on a city street exposed people to potential peril.

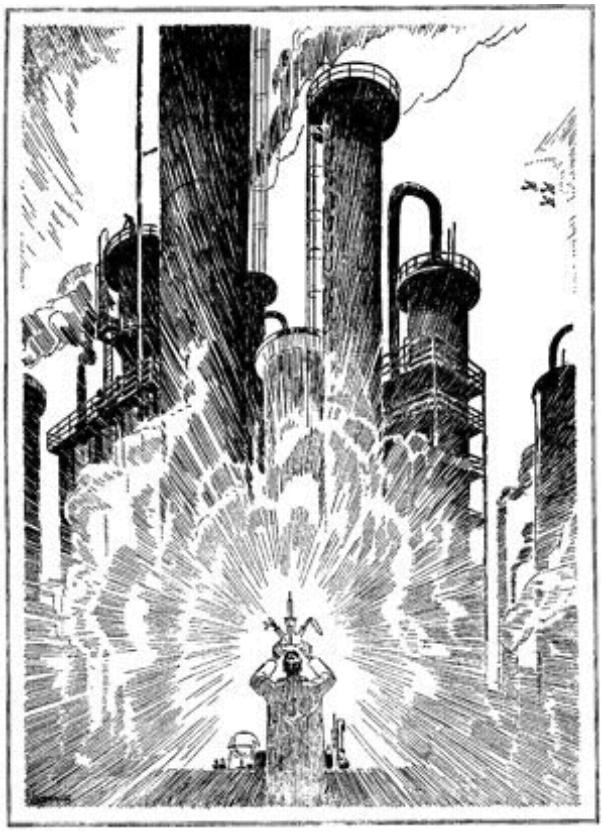
These works also represent a strong interest in art as social commentary, and this often meant the juxtaposition of elements such as poverty and wealth. One of the best and most powerful of these juxtapositions can be seen in Lucienne Bloch's 'Land of Plenty' (1935) that shows a poor family fenced out of a lush farm field growing under electrical power pylons.[14] Söderston was also influenced by futurism. In the era when Flash Gordon was playing on movie screens, futurism's interest in machines, fantastic architecture, and motion made it a logical choice to link chemistry to a bright future. This is particularly true of the cityscape in the chapter 'The Crystal Reveals' (Figure 3) which shows fantastic flying machines zooming between gigantic towers and over sweeping bridges. (Morrison, p. 279)

Figure 3. Futuristic city, from Morrison 1937, p. 279.

7. Key Images of Chemistry and Chemists

The first illustration of *Man in a Chemical World* has become one of the best-known images from chemistry in the era. It was the color frontispiece entitled ‘Chemical Industry, Upheld by Pure Science, Sustains the Production of Man’s Necessities’ (Morrison, frontis).[15] It is a striking image, showing an Atlas figure carrying the modern industrial world above his head. Supporting the elbows of Atlas was a woman (the personification of Pure Science or Athena), clad in a flowing gown. The Athena figure looks directly at the viewer, while the Atlas figure’s head is bowed under his load. Behind the figures are arrayed chemical apparatus and a halo of bright orange and yellow light surrounds them. Although the illustration was based on classical motifs, Söderston connected it to the origin of the book by making the Atlas figure a native American, with tawny skin, loin cloth, and head band, linking it to the aboriginal aspect of the 1935 ACS poster (Figure 1).

a



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c

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Figure 4. (a) Chemist connecting agriculture and industry in the chapter ‘Feeding Millions’; (b) the supplicant chemist from ‘Chemistry in Overalls’; (c) the supplicant chemist in ‘The Crystal Reveals’; (d) the spirit of chemistry in ‘From Papyrus to Television’; (from Morrison 1937, pp. 91, 31, 261, 147).

a

b

Figure 5. (a) A chemist and family from ‘All the Comforts of Home’; (b) Chemist protecting society in ‘Security’; (from Morrison 1937, pp. 159, 231).

The image of science that comes from this is of science as the servant of humanity. Athena and Atlas are powerful exoteric metonyms, evoking the entire history of western philosophy and science. Particularly with the inclusion of the native figure, this linked the glory of Athens with the modern power of the American state. Although this was the most directly classical reference, it set the tone for the visual images of the book. Science as the servant of humanity was the connection between man and Nature as 'the great chemist'. In this schema, scientists interceded on behalf of humanity and were called to the noble enterprise of science. Morrison says of this relationship:

> Although Nature, the great chemist, has provided man with the prototypes and methods by which he has attempted, with considerable success, to conquer his environment, her motives and objectives have seldom been man's […] It is beyond us to fathom the great plan of Creation in which we play at most a very minor role, but obviously the value of natural products to us is wholly fortuitous. [Morrison 1937, p. 13]

Morrison's tone is pious, but this only serves to reinforce the message of the connection between science and the divine. Even more important than reverence for Creation is the idea that the power over nature is granted to those who are capable of using the tools that Nature (or God) has provided for us.

The overt religious symbolism in many of the images reinforces the idea that scientists are a new order of priests. In the chapter 'Feeding Millions' (Figure 4a), the chemist is clad in a lab coat that is distinguishable from priestly raiment only because of the pens in the breast pocket. The lab coat is transformed into a white robe that falls from the shoulder almost to the ground. The mystical aspects of the image are further heightened by having the figure float, spirit-like, above the fields. The chemist makes the land fertile with material falling from one hand while reaping the products of the land with the other. The scientist's head is in the industrial world of trains and factories, but his feet connect him to the earth. The spiritual symbolism can be projected even further, as the scientist replaces the shaman of ancient fertility rites. The difference between the shaman and the scientist was that the shaman was a supplicant before the gods and nature, while the modern, rational scientist controls nature.

There is a temptation to see the illustrations in *Man in a Chemical World* as containing some hint of irony, since the religious references seem so extreme. There was, however, no hint of levity or ironic awareness in Morrison's writing. In Morrison's text, food does literally flow from the work of chemists. It is an actual life and death struggle, and we are reliant upon chemistry for survival:

> numerous agencies are in wait to pounce upon and destroy foodstuffs before they can serve their ultimate purpose. Insect and fungus pests attack growing crops; bacteria and other destructive agencies prey upon the harvested food to render it unsuited or unavailable for human use; and countless other hazards must be avoided or overcome before the farmer's product is set upon the table. In all of these protective measures, the products of chemical industry are potent weapons against the enemies of men. [Ibid., p. 90]

Two other overtly religious images reinforce the exoteric metonym of the man in the white lab coat. The first illustration is in chapter two, 'Chemistry in Overalls' (Figure 4b). The chemist, his back to the viewer, is offering up his chemicals and apparatus as a priest might offer up the host at communion. This offering, made before the work bench/altar, links the chemist/priest to the great power of industrial chemistry represented by the cracking towers in the background (ibid., p. 31). The chemist/priest image is closely replicated in the lead illustration for chapter eleven, 'The Crystal Reveals' (Figure 4c). In this picture, the scientist again appears with his back to the viewer, standing before a work bench/altar, but this time with hands raised in supplication before a glowing globe (ibid., p. 261).

Since these two images are in no way based on actual activity in the laboratory, they were meant to convey the role of the chemist as intermediary and conduit between the mundane and the powerful and sacred. These images place in the viewer's mind the association between the scientist's appearance and the larger context. Even if viewers reject the idea of the chemist as a religious figure, viewers have added the metonym to their interpretive framework.

Compare the priest image in Figures 4a and 4b with the scientist in chapter six, 'From Papyrus to Television' (Figure 4d). Here is a different application of the metonym, since in this image, the lab coat is worn by the spirit of chemistry, who floats over an inventor, perhaps representing Guglielmo Marconi. The inventor's sleeves

are rolled up, indicating work, but clearly he is having some trouble, and is sitting, head on hand, struggling to solve some problem. The spirit of chemistry, chemical apparatus cradled in one arm, appears to be dispensing some material, which presumably will solve the inventor's problem (ibid., p. 147).

Although industry was the primary focus of Morrison's argument, he also introduced a more domestic connection between the chemist and the average person in the chapter 'All the Comforts of Home' (Figure 5a). The chemist is presented in his priestly garb, but rather than commanding nature or celebrating a chemical Mass, he is working to make a home for an American family. The beautiful home appears in a burst of radiance and a cloud of smoke that are thrown out by the chemical equipment. The four other figures, father, mother, son, and daughter, hold hands with the chemist, and look up at the house. The large suburban home was presented as the ideal dwelling for the modern, middle class American family. In this case, Söderston was using an existing motif of the middle class home, but the illustration inserts a twist on the structure of the family. Rather than the father being shown as the patriarchal provider for the family, Söderston makes the chemist the source of family comfort. In the context of the Great Depression such a house could only be a dream for many Americans. The book's view of the future was a promise of material wealth for everyone through modern chemistry.

Morrison's text in 'All the Comforts of Home' was primarily didactic, consisting of a long list of consumer goods such as rayon ('better than silk') or aniline dyes ('better than natural dyestuffs') that were the product of chemical industry. Morrison tells the reader that Americans use the most soap in the world, at 27 pounds per person annually. This beats out other 'clean' countries such as Holland, Germany, and England. The Chinese were the least clean people, using only six ounces of soap each per year (ibid., pp. 165-6). This brief passage establishes a clear hierarchy of nationalism, with the United States at the top (clean and industrial) and China at the bottom (dirty and unindustrialized).

Although *Man in a Chemical World* was unrelentingly positive about chemistry, Morrison could not completely ignore the military aspects of chemistry. He included chapter nine, 'Security', to cover the topic of chemicals and warfare (ibid., p. 230-41). Public concern about chemical warfare had been heightened by the rise of fascism in Europe, particularly as Germany rose in power. As late as January 1927, the *New York Times* reported that the Germans were operating a secret phosgene plant called the "Rusko-Germanskaya Fabrika Bersol" in Russia (Anonymous 1927a). This was followed by a report that all the European powers were continuing to manufacture war gasses and train their military forces to use them (Anonymous 1927b). In the same year that *Man in a Chemical World* came out, Augustin Prentiss' *Chemical in War* (1937) appeared. Although it was not aimed at a popular market, it was the most comprehensive evaluation of chemical warfare available in English (Prentiss 1937).

'Security' was quite different from all the other chapters in the book. It was very brief at 12 pages, tied as shortest with the introductory chapter 'Nature Points the Way'. The chapter was also very vague compared to the lists and descriptions that accompanied the other sections. There was no mention of the U.S. Chemical Warfare Service, the main source of chemical weapons for the American forces in World War I. In fact, no specific war chemicals were referred to by name and Morrison did not name a single chemist, unlike the other chapters that list materials and note the work of famous scientists. About a third of the chapter is devoted to fire fighting, police work, and safety at sea rather than warfare. Morrison deals with actual gas warfare in a mere two paragraphs, comparing it to perfume.

> The most important characteristic of effective "poison gases" (using the term with reservation) is that they must penetrate and distribute themselves quickly toward their objective. In this respect, they resemble perfumes. The reservoir of knowledge on which any nation must draw in the event of war is its industries of synthetic perfume. Few "poison gases" are actually lethal poisons. [Ibid., p. 237]

Rather than seeing chemical weapons as the scourge of modern war, Morrison portrayed them as a relatively minor innovation, and went on to argue that other forms of chemistry were responsible for improvements in the lives of soldiers in battle because of better sanitation and medicine. Although Morrison did not go as far as some supporters of chemical warfare in claiming them to be more humane than traditional weapons, he did say that chemical weapons were here to stay.

> Regardless of either the effectiveness or the disastrous consequences of using "poison gases", they will continue to be employed whenever a nation at war feels that its interests will be served by such use. This is a

> situation which has become an acknowledged fact and can never be controlled by international agreement. [Ibid., p. 235]

In addition, according to Morrison, most of the war work was really just a by-product of peaceful chemistry, forced on the nation by the necessities of war.

> Chemical industry thus stands as a great bulwark of strength for the maintenance of peace, for its beneficent and peaceful activities can, in case of absolute necessity, be quickly turned into the manufacture of materials without which no successful defense of our country could be maintained and no army could withstand attack in modern warfare. [Ibid., p. 232]

The chapter head illustration for 'Security' portrayed the chemist not as a soldier but as a civilian guardian (Figure 5b). The chemist had no weapons, only a collection of instruments, but stood like a colossus between civilization (represented by the factory/city in the background) and barbarism (represented by devices of war in the foreground). Science protected society by intellectual and moral superiority, not by force.

8. Conclusion

There was no doubt in Morrison's work that the U.S. was the greatest nation, and that a large part of its greatness rested on the work of chemists. Morrison concluded his book by saying:

> Many occupations in this world, while profitable, make no contribution to human advancement. Employment in such occupations may be satisfactory to the unthinking, but whoever realizes that employment in the chemical industries is an opportunity to serve in a fundamental occupation, upon which all others rest, without which our country would become a backward nation, and out of which grows civilization itself, glows with justifiable pride in the fact that his life has purpose and that he is serving humanity well. He, individually, feels that he is making a contribution to the industrial and intellectual development of all people everywhere, and especially to our country, the greatest nation in the world. [Ibid., p. 283]

As an argument brought to the agora of American public discourse, *Man in a Chemical World* was extremely bold. Its nationalism fit well with the concerns of many scientists, particularly the leadership of the ACS, that the U.S. needed to establish strong industries and train American scientists and workers for those industries, and potentially for future wars. While it would be difficult to establish the degree to which Morrison 's book independently influenced people, and even more difficult to isolate the effect of Söderston 's illustrations on the image of the chemist, their work was part of the establishment of a powerful metonym. The exoteric visual metonym of the scientist as a man in a white lab coat has been established so strongly that it has moved beyond metonym to stereotype and even the object of humor. For example, F.E. Warburton (1960) playfully suggested that characteristic stains on a lab coat should be used to identify the field of science of the wearer – blackish-brown (mud) for a geologist or greenish yellow and scarlet (sulphuric acid and bichromate) for chemists, and so on.

Although it would be impossible to prove that *Man in a Chemical World* by itself changed the public conception of chemistry or chemists, Morrison and Söderston's work, produced at the behest of the ACS (a large and increasingly powerful organization) represents a significant effort to influence public perception. It attempted to link the image of the chemist to the divine, promote the utility of science, and to redraw chemistry as an American endeavor. To the extent that we continue to associate the white lab coat with the practice and utility of science, this aspect of the project was successful.[16] Morrison's more specific attempt to link chemistry to nationalism and to a solely positive image of science was less successful. The white lab coat is now as likely to be associated with mad scientists in the Hollywood tradition of Frankenstein as it is with Morrison 's benevolent defender of humanity. Further, the lab coat was too widely used to be taken over as a solely American uniform. Even in 1937, the lab coat was international.

Metonyms (both visual and textual) are an innate part of human communication and have been used to attempt to

influence public thinking throughout history, ranging from medieval heraldry and corporate logos to campaign slogans. The metonyms in *Man in a Chemical World* represent one of the more overt attempts to construct a public image of science. Morrison's aim may have been to convince the American public that chemistry and chemical industries were vitally important, but in taking his book to the *agora* he also contributed to the formation of a larger image of science and scientists. Looking at the origins and use of these metonyms offers us a way to understand and discuss the relationship between the public and private spheres in science, both historically and in the present.

Notes

[1] For a brief overview of the history of the public debate about chemical warfare in the U.S., see Ede 2002.

[2] For details of the rise in chemical education, see Thackray *et al*. 1985.

[3] For a history of the exhibition, see Knight & Sabey 1984.

[4] If readers are aware of any information about the production of *Man in a Chemical World*, the author would be grateful for the assistance. Publishing records are often difficult or impossible to find.

[5] Charles Scribner's Sons is now an imprint of Thomson Gale. They have little exact information on this title (personal discussion with the publisher).

[6] Author's collection includes a form letter from Hixson inserted in a copy and Morrison dedication in another copy.

[7] For an expanded version, see Morrison 1962. The basic article is widely available on the Internet.

[8] Brief book reviews, *New York Times*, 4 July, 1937, p. 67. Other reviews were published in the *Journal of Physical Chemistry*, and the *Minnesota Library Journal*, while the *Times* of London reprinted the *New York Times* review. For a complete list of reviews, see the *Book Review Digest*, New York: H.W. Wilson, 1937.

[9] See MacLeod & Collins 1981 and www.the-ba.net; for the AAAS, see Kohlstedt 1999 and www.aaas.org.

[10] For various aspects of the origin of images in science, see Shea 2000.

[11] Or as Lodge (1975) put it "every decoding is another encoding".

[12] For a brief history of the medical lab coat, see Blumhagen 1979.

[13] Rolled up sleeves continue to be a symbol of getting down to work. During the 2005 Katrina hurricane disaster, Michael Brown, the head of the Federal Emergency Management Agency, was advised to roll up his sleeves before appearing on camera. For the email exchange, see Anonymous 2006.

[14] These images are available from various sources including Lucie-Smith 1994. The Lucienne Bloch image is available at www.library.georgetown.edu/dept/speccoll/ prints/jpg/03.jpg.

[15] For a color version, see Schlüpmann 1994.

[16] For examples of modern investigations of the image of scientists, see Barman 2004 and Dalgety & Coll 2004.

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