

Transferring the Incubator: Fairs and Freak-Shows as Agents of Change

Expositions are the timekeepers of progress. They record the world's advancement. They stimulate the energy, enterprise, and intellect of the people; and quicken human genius. They go into the home. They broaden and brighten the daily life of the people. They open mighty storehouses of information to the student. Every exposition, great or small, has helped to some onward step. Comparison of ideas is always educational; and as such instructs the brain and hand of man.
President William McKinley, Buffalo, NY, September 5, 1901

In 1901 the Pan-American Exposition was held in Buffalo, New York. This exposition lasted from May 1st to November 1st. On the midway, situated across from the confectionary and the Japanese Village, was Martin Couney's Infant Incubator exhibit. For twenty-five cents, spectators could observe premature infants on display, housed in state-of-the-art incubators. According to the report from *Scientific American* on the exhibit, with the benefit of the incubators 85% of premature infants survived.¹

In the early 21st century, Neonatal Intensive Care Units (NICUs) push the limits of infant endurance, saving ever-smaller babies: one author dubbed the 1990s the "decade of the micropremie."² In these NICUs are enclosed boxes intended which, among other functions, regulate the precarious temperature of the

¹ "Baby Incubators at the Pan-American Exposition," *Scientific American* 85 (August 3, 1901), 68.

² Richard C. Lussky, "A Century of Neonatal Medicine," *Minnesota Medicine* 82 (December 1999), 5.

premature infant. This paper looks to the late 19th century to discover the origins of these incubators, and to follow their diffusion from charity hospitals in France and Germany to their arrival and reception in the United States.

THEORETICAL FRAMEWORK

On the one hand, this is a story about ways of caring for premature infants. But it also addresses a broader topic: technology transfer. There are many different ways of telling stories about technology moving from one context to another. Christopher Freeman argues that the world of innovation should be viewed in the context of national systems, and that by better understanding the national environment wherein innovations are created, we can better grasp how, where, and whether they will develop and flourish. While Freeman is more concerned with the overall effects of NSIs on general levels of innovativeness, his analysis instructs us in a vital point: national systems, and the cultural contexts they create, matter in the development and reception of technology.³ National systems play a role in this story, as the France-born incubator moves to the United States, changing significantly in the process.

Everett M. Rogers, a founding researcher in the field of technology diffusion, has created a wide-reaching descriptive framework to better conceptualize the events and players involved when technology moves from place to place. He

³ Chris Freeman, "The 'National System of Innovation' in Historical Perspective," *Cambridge Journal of Economics* 19 (1995), 5-24.

introduces the role of “change agent,” an individual invested in spreading a given technology. This story largely involves the promotion of the incubator through fairs and expositions, so it is reasonable to look to Martin Couney, the incubator’s showman and champion, as a change agent. However, while Rogers describes the change agent as “an individual who influences clients’ innovation-decisions in a direction deemed desirable by a change agency.”⁴ In the case of Couney, he is for the most part working for himself. While his intention is to promote the incubators, his fair-based approach makes evident that his interest is not in selling incubators but rather in drawing crowds to see those which he owned: he had no interest in what Rogers terms a “terminal relationship,” as he profited from continued interaction.⁵

Couney’s work *did* promote the idea of incubators, in particular *his* incubators, as an effective treatment for premature infants; to use Rogers’ term, he “developed a need for change.”⁶ But his approach did not change the behavior of the medical establishment for long. It captured the attention (and the pocketbooks) of the public, but when his technology proved fallible while in the public spotlight, physicians turned from his work. The presentation of technology at fairs is enough to change the minds of the public, but is vulnerable to public failure as well. Furthermore, without official legitimization, it is difficult to recover from a public failure.

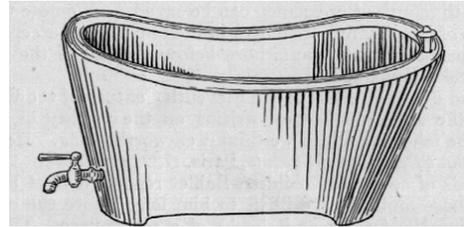
⁴ Everett M. Rogers, *Diffusion of Innovations* (New York: Free Press, 2003), 366.

⁵ *ibid*, 370.

⁶ *ibid*, 369.

ORIGINS OF THE INFANT INCUBATOR

Stories differ regarding the invention of the infant incubator: it seems that the Imperial Foundling Hospital in Moscow had been using a double-walled warming tank invented by Carl Credé since at least 1874⁷, while the first published account of a similar open, double-walled tank came in 1857 from French pediatrician Denucé.⁸ This device, called a



Denucé/Credé *Warmwannen*, from Julius Hess, *Premature and congenitally diseased infants*. Philadelphia: Lea and Febiger, 1922.

warmwannen, consisted of a large metal tub into which was set a smaller metal tub. They were welded at the top edges, with an opening near the top to pour in warm water and a faucet near the bottom to drain it. By filling the space between the tubs with warm water, an infant placed in the inner tub could be kept warm. When Credé published in 1884, he claimed to have been using the tub to treat premature infants at a Moscow hospital for more than twenty years with great success.

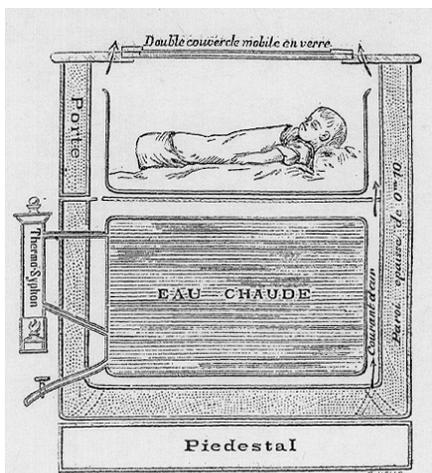
In 1883, Pierre-Victor-Adolph Auvard published an account of another incubator, developed by Etienne Stéphane Tarnier for use in the enormous Paris Maternité.⁹ As the story goes, Tarnier was visiting a poultry exhibit at the Paris zoo when struck with the idea to have a poultry incubator built with the purpose of

⁷ Carl Siegmund Franz Credé, “Ueber Erwärmungsgeräthe für frühgeborene und schwächliche kleine Kinder,” *Archiv für Gynäkologie* 24 (1894), 128-147.

⁸ Jean-Louis-Paul Denucé, “Berceau incubateur por les enfants nés avant terme,” *Journal de Médecine de Bordeaux* (December, 1857), 723-724.

⁹ Pierre-Victor-Adolph Auvard, “De La Couveuse Pour Enfants,” *Archives de Tocologie des Maladies des Femmes et des Enfants Nouveau-nés* 14 (October 1883), 577-609.

warming premature infants. It seems that he came to this idea with little knowledge of the less-sophisticated Denucé/Credé device. Tarnier's device, the *couveuse*, consisted of a double-walled wooden box, the space between the walls filled with sawdust for insulation. To prevent fumes from a gas or alcohol heater reaching the infant, Tarnier used a thermosiphon with a gas burner to heat a reservoir of water in the lower compartment of the box. The infant was placed in the upper compartment. Air would enter the box at the bottom, be warmed by the



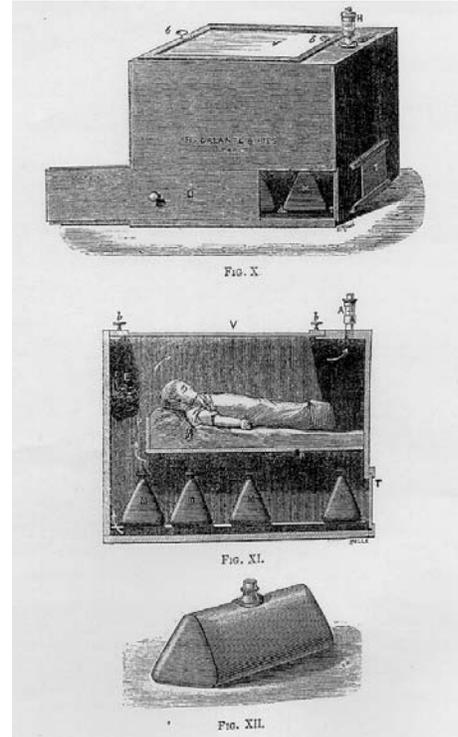
Tarnier *Couveuse*, from Pierre-Victor-Adolph Auvard, "De La Couveuse Pour Enfants," *Archives de Tocologie des Maladies des Femmes et des Enfants Nouveau-nés*, 14, October 1883.

reservoir, and then pass upwards through vents to reach the baby above. It would then pass out the top of the incubator through vents in the double-thick glass lid. A thermometer placed next to the baby allowed caretakers to monitor the incubator's temperature without opening the box. Tarnier recommended that the thermosiphon burner be lit three times a day for an hour at a time in winter,

and twice a day in summer, with adjustments to be made as needed.

Incubators based on the Tarnier design, constructed by scientific instrument maker Odile Martin, were used at the Materinité from 1880. The Auvard paper gives statistics showing that for infants under two thousand grams, use of the *couveuse* cut mortality by half. However, the device was large, expensive, and conducted heat so efficiently that it risked cooking the infant! Two solutions were engineered to respond to these problems. One, designed by Tarnier's student

Budin, incorporated a mercury thermostat and a battery-operated alarm to alert caregivers if the temperature rose too high or dropped too low. But the more popular design was in response to nurse behavior in the wards: viewing the thermosiphon as too risky, nurses began periodically filling the reservoir with hot water by hand two or three times daily. Tarnier and his intern Auvard developed a low-tech version of the incubator in response: a two-tiered, sawdust-insulated box heated by removable clay hot water bottles. It was this device that was produced on a large scale, and was the most popular model until the late 1890s. In fact, soon Budin abandoned his own thermostat model for variants of this one.¹⁰



Tarnier-Auvard incubator, with cross section and hot-water bottle, from Pierre-Victor-Adolph Auvard, "De La Couveuse Pour Enfants," *Archives de Tocologie des Maladies des Femmes et des Enfants Nouveau-nés*, 14, October 1883.

While the decision to favor the lower-tech model may seem strange, it makes sense when considered in cultural context. In the late nineteenth century, France was plagued by worries about its plunging birthrate, which was blamed on a number of factors: prematurity, maternal neglect, a longstanding tradition of sending children to a country wet nurse, and increasing child abandonment. There was debate as to whether institutions intended to support abandoned children,

¹⁰ Jeffrey P. Baker. *The Machine in the Nursery: Incubator Technology and the Origins of Newborn Intensive Care*. (Baltimore: The Johns Hopkins University Press, 1996), 28.

such as the Maternité, didn't actually encourage the abandonment of children. Similarly, many children of wealthy families were sent to the country for nursing, and either died there or were never recovered by their parents. These factors, combined with increased work among lower-class women and increased use of contraception, led the French government to fear that the next generation of soldiers would be insufficient to defend the nation.¹¹

Although the initial incubators were developed for crowded wards filled with abandoned children or the sickest children of the poor, they were soon modified for a plan wherein each mother was placed in a bed, beside which was her infant in an incubator. High-maintenance incubators were acceptable, as tending the infant was thought to foster maternal feeling otherwise absent from poor mothers with sick children, thus encouraging nursing and preventing abandonment. This scheme of neonatal care, which required many inexpensive incubators but did not demand great technical sophistication, made the Tarnier/Auvar model a good fit for the needs of the Paris maternity wards.¹²

EARLY INCUBATOR TRANSFER

Word of Tarnier's work spread quickly. Even before Auvar's 1883 article announcing the various devices and the statistical results from the Materinité, a piece appeared in the *Lancet* describing the device. The article, entitled "The

¹¹ For an excellent treatment of the nineteenth-century context in France, see Alisa Kraus, *Every Child a Lion: The Origins of Maternal and Infant Health Policy in the United States and France, 1890-1920*. (Ithaca: Cornell University Press, 1993).

¹² Baker, 58-60.

Couvreuse, or Mechanical Nurse,” begins: “After two years' trial, the *couvreuse* has proved so decided a success that a brief description of this ingenious contrivance may be desirable.”¹³ It goes on to describe the original Tarnier device as well as the modified Tarnier-Auvard design, with rough measurements and indications regarding appropriate temperatures.

The first report of the use of an incubator in an American journal came in 1887. As he reported to the Chicago Medical Society, John Bartlett, a physician and Professor of Diseases of Women and Children at the Chicago Polyclinic, found himself with “urgent occasion to use one of these warming cribs”¹⁴ and so set out to build one. Bartlett writes that, after reviewing the literature on the Denucé/Credé model as well as that used by Tarnier, he found them all either overly complicated to build or to maintain, and set out to create one that was “simple, efficient, safe and, perfectly easy of management.”¹⁵ The incubator he created was made of inset metal tubs, like the *warmwannen*, it also used a boiler attached to the side, like Tarnier’s original *couvreuse* plan. It had a complicated thermosiphon arrangement intended to keep the water at a regular temperature throughout. It had no provisions for ventilation but also had no solid top: Bartlett recommended that a blanket big enough to cover the device be draped over it, “except about the face of the infant.”¹⁶

¹³ “The Couvruse, or Mechanical Nurse.” *The Lancet* 2 (August 11, 1883), 241.

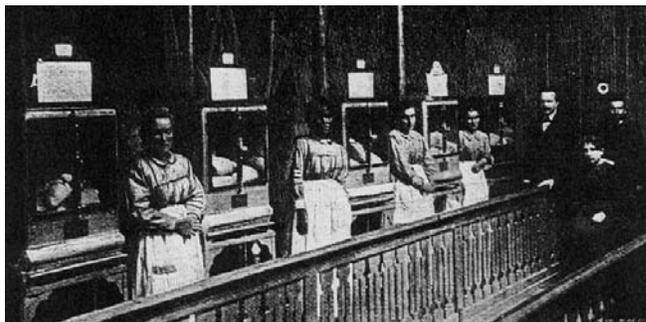
¹⁴ John Bartlett, “The Warming Crib.” *The Chicago Medical Journal and Examiner* 54 (May, 1887), 449-454

¹⁵ *ibid.*

¹⁶ *ibid.*

In 1891 reports came of a new incubator design in France, designed by Alexander Lion of Nice. The Lion incubator was made all of iron, with glass doors in the front and hot water circulating through a spiral pipe in the bottom, warming the air within. It was ventilated by pipes which drew air from the outside, filtering it before delivering it to the base of the incubator. A fan at the top indicated the rate of air circulation. The infant was placed on a mattress in a basket which was suspended from the sides of the apparatus by springs. Lion indicated that the boiler, placed to the side of the device, “could be heated with gas, oil, electricity, methylated spirits, or any other fuel”¹⁷ Temperature was automatically regulated via a thermostat. The device was large, heavy, complex, and expensive, requiring installation into buildings for proper use.

Just as innovative as his incubator design, was the institutional structure in which Lion used his devices. He created a number of “Incubator Charities,” places where his incubators were available without cost to the poor, or to the wealthy for a



Incubators and Nurses, with Lion in background, at an Incubator Charity in France. From James Walter Smith, “Baby Incubators,” *The Strand Magazine* (London, 12, 1896), 771.

fee. To fund these charities, he invited spectators and charged at the door. For a time, he received assistance from the state as well. By 1896 Lion had opened storefront charities in Paris, Bordeaux,

Marseilles, and Lyons. Separated from the stigma of the lower classes and

¹⁷ James Walter Smith, “Baby Incubators,” *The Strand Magazine* 12 (London, 1896), 770-776.

abandonment that was associated with Tarnier's Maternité, Lion served all classes, and even rented some of his machines into private homes.¹⁸

It is significant to note that while, on the one hand, Lion's device entered the same population-panicked French context as the Tarnier model, its presentation was much different. An expensive device, it was designed to be used for either by wealthy private patrons or by the poor, who in lieu of payment allowed their babies to be publicly exhibited. Its design is ideal for exhibition purposes, with the large glass windows placed at eye-level and the tiny infant's bed suspended in the center. It is precisely these design specifications, relevant not to health care but to health care funding, which shape the path of the Lion incubator.

It is interesting to note that these radically different innovations spring from the same national context. On the one hand, it leads me to question whether a national system has any strong bearing on the path of innovations, as Freeman so strongly suggests. However, in France the Lion incubator remained primarily in the limited context of the Charities, while other models were used in other contexts. In the U.S., as I will show, the Lion became the primary form of incubator technology used, which can perhaps be attributed to a turn-of-the-century American enthusiasm for things technical and automatic.

THE INCUBATOR EXHIBITIONS

¹⁸ *ibid.*

The first Infant Incubator show was at the 1896 Berlin Exposition, billed as the *Kinderbrutanstalt* (“child hatchery”). It featured six premature babies from the Berlin charity hospital, on loan with the excuse that they had little chance of survival in any case. In its two-month run, the exhibit drew over a hundred thousand visitors – reports indicate that all of the infants survived.¹⁹

While its success in drawing popular attention to the incubators as treatment for premature infants is unquestioned, its impetus is unclear. In a 1939 interview with the *New Yorker*, physician/showman Martin Couney claimed that he was responsible for the Berlin show. Born in Alsace, Couney claimed to have studied under Budin (Tarnier’s successor) at the Maternité in Paris, and to have started the incubator shows at Budin’s request.²⁰ While the Berlin exhibit coincided with a push from Budin for greater publicity, it is also clear from drawings of the site that the incubators used were Lion’s design, and sources indicate that Lion provided financial backing for the show as well.²¹ Furthermore, only Lion was mentioned in contemporary accounts of the show: nothing was said of either Couney or Budin. It seems most likely that, if Couney was involved in the Berlin show, it was under the direction of Lion in the tradition of the successful Incubator Charities. While Couney may have practiced medicine under Budin, the exhibition show was far from his style of infant



¹⁹ Baker, 90.

²⁰ A. J. Liebling, “Patron of the Premies,” *New Yorker* 15 (3 June 1939), 20-24.

²¹ Baker, 91.

Cartoon of the *Kinderbrutanstalt*, showing Lion incubators in use. From “Neonatology on the Web,” <http://www.neonatology.org/pinups/berlin.html>

care—Couney most likely invoked Budin’s name for the purposes of building his own credibility.

Although Couney’s participation in the Berlin exhibit is in doubt, he was certainly the coordinator of the next incubator show: the 1897 Victorian Era Exhibition at Earl’s Court. As in Berlin, Lion incubators were in use, called “Altmann” incubators by some after their German manufacturer Paul Altmann. In Couney’s account, no London hospitals were willing to entrust premature babies to the show, so Couney was forced to return to Paris and retrieve “three washbaskets full of premature foundlings” from Budin’s care.²² *Lancet* announced the show with enthusiasm, reporting the project underway: the nursery was “ready to take in their charge any prematurely born child” and employed three physicians, as well as trained nurses, to tend to their needs. While refraining from explicitly condoning the show, the article admiringly notes that Couney and his associates “invite the criticism of the medical profession, and will supply every possible facility for the fullest investigation.”²³

The *Lancet* editors also noticed another incubator, without interned child, on display at the show:

It so happens that among the exhibits of the London Hospital to be seen in the main building there is an old-fashioned incubator which serves to illustrate the progress accomplished in modern days. This old incubator is not aseptic, for it is simply a wooden box with a glass lid, nor can the temperature within be

²² Ibid, 90.

²³ “The Victorian Era Exhibition at Earl’s Court,” *Lancet* 2 (1897), 161.

automatically maintained. It is warmed by placing underneath three stone bottles containing hot water. Of course, the water becomes cold and the temperature falls unless the attendant is very careful. Nor is there any system for filtering and moistening the air. Instead of breathing pure outside air the infant must breathe the air of the ward or room in which he or she is placed. How all these inconveniences can be avoided will be made manifest to those persons who visit the special exhibit of the Altmann incubators.

Of course, this “old-fashioned” incubator was of the Tarnier/Auvar model, and was exhibited not as an exemplar of obsolete technology but rather because it was still in frequent use in Paris, and, presumably, in London as well. Tarnier and Auvar specifically rejected more complex models for the simpler, “old-fashioned” incubator. In spite of this, they continued to successfully treat thousands of children each year, it appears that more was going on than simple “improvement” of the incubator.

Little is known of the first American exhibition. The show was at the Trans-Mississippi and International Exposition in Omaha, held in 1898. It was run by Couney, but photographs indicate that it was on a much smaller scale than the London or Berlin shows. The exhibit was held in a small, two-level house. An archway over the garden gate read: “Infant Incubators with Living Infants” while the sides of the house were passed with signs reading “A Wonderful Invention:

Infant Incubators... Live Babies” and “Visited by 407,000 people at Queen Victoria’s Diamond Jubilee Exposition London 1897.”²⁴

While the small Omaha show did not appear to garner much attention in the public press, it coincided with the publication of a few more articles on incubators in the American medical press. In *Pediatrics*, Minnesota doctor S.W. Ransom indicates that incubators are the best way to keep premature infants alive in large urban hospitals, but in rural settings where large incubating devices were not available, other means must be used to care for these babies. He describes a makeshift warming technique in which a child is placed into a pair of nested washtubs, the larger tub being filled with warm water: essentially an improvised *warmwannen*. Although Ransom states that “[i]n some of our large metropolitan cities there are wards connected with maternity hospitals where there are incubators heated by steam,” it seems likely that this “we” refers to European, not American cities: in 1898 there had not yet been any organized incubator stations in the U.S. outside of the Omaha fair.²⁵ Ransom does not mention any incubator shows in his article.

Also in 1898, a notable article appeared in the British journal *Pediatrics* by G.H. Blacker of University College Hospital. In this article, Blacker uses the statistics from the Paris Maternité to illustrate his point that “[t]he first indication, therefore, in the treatment [of premature infants] is the careful maintenance of the body temperature. This can only be done really efficiently by the use of a *couveuse*

²⁴ Photos available online at “Neonatology on the Web,” <http://www.neonatology.org/pinups/omaha.html>.

²⁵ S. W. Ransom, “The Care and Feeding of Premature and Feeble Infants,” *Pediatrics* 9 (1898), 322-326.

or incubator.” Blacker goes on to review the available incubators, concluding in accordance with the *Lancet* that the Lion is most advanced because it provides a thermostat and is ventilated from the outside. Blacker only briefly referenced the exhibitions, stating that “It is difficult to say what is the earliest age at which a premature baby has survived, and in these days, when, unhappily, incubators appear to form an essential part of any popular show, there are... many rival candidates for the honour of being the youngest baby successfully reared.”²⁶ Blacker’s distain for the incubator shows is complicated by the fact that his preferred model of incubator, the Lion, was popularized by and used primarily at sites where admission was charged. Because the shows were the primary method of developing and promoting the Lion device, it is difficult to see how Blacker could have developed an admiration for the device in the absence of the shows.

A jarring example of the minimal state of diffusion of incubators in the U.S. in 1898 comes from L. Emmett Holt’s Presidential Address to the American Pediatric Society regarding “a subject which has for me the deepest interest and which must be of vital importance to every pediatricist, viz: The Scope and Limitation of Hospitals for Infants.”²⁷ Holt’s lengthy address, given at the tenth annual meeting of the young society, encouraged the establishment of infant hospitals and infant wards in general hospitals. Although the talk was addressed to pediatricians and was specifically on the subject of infant care, it did not once

²⁶ G.F. Blacker, “The Care and Feeding of Premature Infants,” *Pediatrics* 61 (1898) 28-37.

²⁷ L. Emmett Holt, “The Scope and Limitation of Hospitals for Infants,” *Transactions of the American Pediatric Society* 10 (1898), 147-160.

mention the acquisition or use of incubators. The sole mention of prematurity comes in a discussion of heating wards to temperatures appropriate to the cases treated. Neither the incubator shows nor the success of the French, German and British use of the devices was noted.

Also in 1898, the *Lancet* editors, so enthusiastic only a year before, published a scathing indictment of the increasing trend toward incubator shows in England. The piece cites three shows: one at the World's Fair in the Agricultural Hall, Islington, one at the Royal Aquarium, and one at Barnum and Bailey's Show in Olympia. The editors hold up the Earl's Court exhibition of the previous year as an example of an incubator show done properly, and criticizes the new shows (none of which were run by Couney or Lion) as inadequate both because of improper ventilation and disrespectful treatment of the infants. As Jeffrey Baker notes, "It was not clear whether being located next to the bearded lady or having to breathe the same air as the leopards of Wombwell's menagerie represented the greater danger."²⁸ This article set the bar for later incubator shows: those that provided for ventilation were favorably regarded, while those that did not were seen as careless or unprofessional.²⁹

In 1901 Couney returned to the U.S. to present an infant incubator show at the Pan-American Exposition in Buffalo, NY. The Pan-American was an enormous fair, and Couney's exhibit there drew accolades from the popular and medical press

²⁸ Baker, 92.

²⁹ "The Danger of Making a Public Show of Incubators for Babies," *Lancet* 1 (1898), 390-91.

alike. Articles appeared in local and national newspapers, as well as in *Pediatrics*, the *Buffalo Medical Journal*, *Scientific American*, and *Cosmopolitan*. These accounts are remarkable for their lack of criticism, and the degree of similarity among them suggests that most of the information was obtained from the same source: the midway barker for the show, perhaps, or Couney himself. Each account locates the exhibit on the entertainment-based midway but praises its educational and scientific content. Each describes the device in the same way, and reports a survival rate of 85%. All of the articles

praise the cleanliness and bright appearance of the exhibit. The *Cosmopolitan* piece is, unsurprisingly, the most admiring: waxing poetic in a long meditation, it favorably compares the “tiny



brain of an incubator baby” with the “power and beauty” of nearby Niagara Falls.³⁰

The exhibit’s twelve Lion incubators and long duration made an impact on the public imagination. The incubators were ducted into the walls, so that air was drawn from the outside. Several wetnurses were in constant attendance, and the infants were fed and cleaned every two hours. Technically, the exhibit far exceeded

³⁰ “Arthur Brisbane, “The Incubator Baby and Niagara Falls,” *Cosmopolitan* 31 (1901), 509-516; “Some Medical Aspects of the Pan-American Exposition: Infant Incubators,” *Buffalo Medical Journal* 57:1 (1901), 55-56; “Exhibit of Infant Incubators at the Pan-American,” *Pediatrics* 12 (1901), 414-19; “Baby Incubators at the Pan-American Exposition,” *Scientific American* 85 (1901), 68.

anything available in American hospitals of the day. While several incubators from the expo were sold to the Buffalo Children's hospital following the event, the most prolific offspring of the successful Buffalo show was not incubator wards, but instead more incubator shows.³¹

In 1903 Couney permanently emigrated to the U.S. and opened an exhibit of incubators at Coney Island's Luna Park. Several years later he opened another Coney Island show, at Dreamland. Aside from some passing trouble from the New York Society for the Prevention of Cruelty to Children, the incubator shows were quite successful.³² In 1904, the most ambitious exhibit yet was launched, not by Couney but by his imitators.

The Louisiana Purchase Exposition opened in St. Louis in June 1904. The Infant Incubators were in a grand hall, with elaborate decorative columns in the center and the incubators, fully ventilated Lion models, at the edges. There were trained nurses and a head physician in attendance, but in July, catastrophe struck. As recounted by John Zahorsky, a pediatrician and later director of the St. Louis show:

Everything went very well until the hot weather, when, through some error, a very virulent pathogenic micro-organism was introduced and the catastrophe of an epidemic summer diarrhea started among the babies. The losses of very young babies was increased by the death of several "graduates," and the mortality was

³¹ Baker, 99.

³² Ibid, 97.

altogether higher than was desired. On September 1st the death-rate had been about 50 per cent -- the death-rate of infantile hospitalism.³³

The specter of hospitalism, a term used to refer to the tendency of otherwise healthy children to die when kept in a hospital environment, was a long-time concern of the American medical establishment. An 1897 paper on the subject prescribed “care, fare, and air” for hospitalized children, by which he meant frequent and competent handling by mothers or nurses, proper food delivered regularly, and “fresh air, pure air, and plenty of it.”³⁴ Because of the small space and forced ventilation of the incubator, its promoters were particularly vulnerable to charges of hospitalism.

After the diarrhea epidemic, the head physician of the show resigned and Zahorsky took over. Zahorsky, an young and enthusiastic physician just beginning to specialize his general care practice in a pediatric direction, saw the technical sophistication of the site as an opportunity for clinical research. He redesigned the incubator room, placing a glass wall between spectators and incubators to insure that the infants had “fresh air” even when removed from their individually ventilated chambers. He redesigned sanitation and feeding procedures, and managed to reduce mortality rates to acceptable levels. He experimented with incubator temperature and feeding methods, and after the close of the fair published a comprehensive report on his procedures and results. The articles that resulted made up an eleven-part series in the *St. Louis Courier of Medicine*, and

³³ John Zahorsky, “The Baby Incubators on the ‘Pike’: A Study of the Care of Premature Infants in Incubators Hospitals Erected for Show Purposes, Part 1,” *St. Louis Courier of Medicine* 31:6, (December 1904), 345-358.

³⁴ Floyd M. Crandall, “Hospitalism,” *Archives of Pediatrics* 14:6 (June 1897), 448-454.

afterwards were compiled into a book, *Baby Incubators: A Clinical Study of the Premature Infant*. This book was by far the most comprehensive American text on premature infant care. In spite of Zahorsky's scientific work, however, the tragedy of July and August 1904 would mark a turning point in American perceptions of incubators.

In his first article after the fair's close, Zahorsky protests that "[t]he feeling of the medical profession is against the show incubators, of this there can be no doubt."³⁵ While his assertion at first seems sensible, on examination of the literature it becomes clear that prior to 1904, medical opinion was, with the sole exception of the critical 1898 *Lancet* article, overwhelmingly in *favor* of the shows. In fact, even the piece from the *Lancet* condemned only specific practices, not the shows in general. After the infant deaths in 1904, however, American medical opinion turned against not only the shows, but the incubators themselves.

The early American incubator literature shows a fondness for innovation and re-invention: it is no coincidence that most articles by Americans in the years before 1901 included the words "new" or "improved" in describing the recommended device. However, when the Lion incubator was introduced, it caught America's fancy. It is significant when considering the role of the fair that, while most doctors would deny their significance, that Lion himself *never published* a description of his device in medical journals. While it was described in the *Lancet* as well as in the

³⁵ Zahorsky, 450.

popular press, before Zahorsky no statistical studies had been performed to prove the Lion's superiority, while many statistics were available showing the effectiveness of the Tarnier device. And yet, because of its technical sophistication and effective presentation, the Lion incubator quickly became the American model of choice.

LION INCUBATOR ADOPTION AND REJECTION IN HOSPITALS AND CLINICS

Between 1898 and 1901, hospitals and maternity wards were beginning to acquire incubators built on the Lion model. In 1900, James Vorhees described treatment of premature infants at the Sloane Maternity Hospital in New York. He stated that several types of incubators were in use there, but that "best one is probably that of M. Lion, of Nice, first used in 1891."³⁶ In 1901, Francis H. Stuart announced in the *Brooklyn Medical Journal* that a Lion incubator had been donated to the Low Maternity Hospital and could be used in public or private wards. He wrote, "With an apparatus of this careful construction these feeble lives may be carried forward in full development in greater numbers than is otherwise possible."³⁷ Also in 1901, the Chicago Lying-In Hospital announced the acquisition

³⁶ James D. Vorhees, "The Care of Premature Babies in Incubators," *Archives of Pediatrics* 17 (1900), 331-46.

³⁷ Francis H. Stuart, "De Lion Incubator at Low Maternity Hospital," *Brooklyn Medical Journal* 15 (1901), 346-349.

of four incubators build on the Lion model. ³⁸ In a lengthy 1902 treatment of “The Problem of the Premature Infant,” J. W. Ballantyne explains that the best incubator available is “such as was on view at the Buffalo Exposition.”³⁹ Across the board, in the initial exposition years the Lion incubator was acclaimed by medical professionals, and the shows were greeted with enthusiasm.

Following the 1904 fair, the rate of publication on incubators declined rapidly. When incubators were mentioned, it was often with a critical tone. The decline appears to be related to the bad publicity resulting from the 1904 fair, but also from the fact that, as the incubators being purchased were mostly of the costly Lion model, each hospital had only a very few devices. Reserved for the sickest patients, many doctors saw only poor results from the incubators while less sick babies who were placed in warmed, padded baskets tended to survive. The incubator in practice quickly attained a bad name, as it was used only in the most dire cases.⁴⁰

An interesting note is that, by 1905, “incubator” and “Lion incubator” were nearly synonymous in the American medical press. In 1905, John Lovett Morse declared that while the ideal incubator would automatically keep a constant temperature and provide a constant supply of fresh air, he has “never seen one that

³⁸ Joseph B. DeLee, “Infant Incubation, with the Presentation of a New Incubator and a Description of the System at the Chicago Lying-In Hospital,” *Chicago Medical Recorder* 22 (1901), 22-40.

³⁹ J. W. Ballantyne, “The Problem of the Premature Infant,” *British Medical Journal* 1 (May 17, 1902), 1196-1200.

⁴⁰ For a description of infant triage, see Vorhees, 338. For anecdotal evidence against the incubator, see H. M. McClanahan, “Management of Delicate and Premature Infants in the Home,” *JAMA* 63 (Nov. 12, 1914), 1758-1760.

will do this.”⁴¹ He declares the lack of fresh air created by the incubator environment leaves the baby more prone to infection, both because it leaves them less hardy and because bacteria are more likely to grow at warm temperatures. Therefore, he recommends that babies are kept warm in “incubator substitutes,” such as padded cribs or baskets, which can be surrounded with or placed above hot water bottles or bags, while the baby is covered or nearly covered by a blanket. Other physicians strongly concurred, and soon “fresh air” became the watchword in infant care.⁴² Later, indications for warm boxes even specified that the sides of the box must “not be high enough to exclude air circulation,” stating that “[t]his device has been shown by many pediatricists to be far superior to many of the elaborate incubators.”⁴³

In 1911, a new sort of institute was created in Chicago. To promote the health of infants under one year, “baby fresh-air tents” were established “either on the roofs of buildings or in vacant spaces in the midst of these thickly populated sections, so near the homes that the mother can bring the sick baby ... leave it all day in the care of competent nurses and call for it again at 6 o'clock in the evening.”⁴⁴ The promotion of fresh air and a cleaner home environment for infants, along with a new drive for proper prenatal care and parental education, swiftly

⁴¹ John Lovett Morse, “The Care and Feeding of Premature Infants,” *American Journal of Obstetrics and Diseases of Women and Children* 4 (1905), 589-599.

⁴² Jennings C. Litzberg, “The Care of Premature Infants, with Special Reference to the Use of Home-Made Incubators,” *Journal of the Minnesota State Medical Association* 28:5 (March 1, 1908), 87-91.

⁴³ Roger Durham, “Notes on the Care of Premature Infants,” *Archives of Pediatrics* 29 (1912), 438-441.

⁴⁴ Frank W. Allin, “The Baby-Tents of Chicago,” *Journal of the American Medical Association* 57:27 (December 30, 1911), 2127-2128.

eclipsed the emphasis on incubators in the American medical establishment. In 1908, Edwin E. Graham gave the Chairman's Address at the AMA's Section on Diseases of Children. The talk, entitled "Infant Mortality," concluded with a list of fourteen ways to decrease infant mortality in America. Among these fourteen points, not one referred to the incubator.⁴⁵

MARTIN COUNEY'S INCUBATOR SHOWS AFTER 1904

As noted in the previous section, after 1904 U.S. medical institutions stopped promoting, and likely purchasing, the Lion incubator. Martin Couney suffered a similar setback. Between 1901 and 1933, he presented only two World's Fair events: one at the smaller 1906 Lewis and Clark Exhibition in Portland, Oregon, and one at the 1915 Panama-Pacific International Exposition in San Francisco. It is unclear whether this lack of appearances was due to poor physician cooperation, lack of approval or support from the fairs, or just low interest on Couney's part. In those years he instead established a number of small, permanent exhibits at local amusement parks, including Denver, Atlantic City, Chicago, and South

⁴⁵ Edwin E. Graham, "Infant Mortality," *Journal of the American Medical Association* 51:13 (September 26, 1908),1045-50.

Minneapolis.⁴⁶ In 1917, a physician wrote “incubators are passé, except at country fairs and sideshows.”⁴⁷

In spite of pointed indifference from the medical community, in the years between 1904 and the incubator’s medical revival around 1933, Couney’s shows at Coney Island and elsewhere were the primary site of incubator care. In fact, when in 1914 Couney was in need of a local pediatrician to supervise his show at Chicago’s White City amusement park and was paired with Julius Hess, Hess found in Couney the sole support for his project to build a new incubator. Hess’s model, a double-jacketed warming tub after Credé’s model, was introduced to little enthusiasm in 1915.⁴⁸ In the 1930s the incubator as a means of introducing an artificially high level of oxygen along with warmth to the struggling infant gained again in popularity. In this moment, Hess and Couney joined together to produce two last shows: one at the 1933 Century of Progress Exposition in Chicago, and a final one at the 1939 New York World’s Fair.

In 1939 Couney’s image was rehabilitated, from antiquated sideshow quack to forward-thinking neonatal pioneer. The interview he gave with the *New Yorker* in that year reflected this change. In this article, we find Couney a benevolent old man, ready for a rest: “The New York hospitals are making plans now to centralize

⁴⁶ Baker, 104. A delightful article on what remains of the South Minneapolis show appears here: Joseph Hart, “The Child Hatchery,” *City Pages* 24 (Minneapolis, 9/24/2003)

⁴⁷ Joseph S. Wall, “The Status of the Child in Obstetric Practice,” *Journal of the American Medical Association* 66 (1916), 256, quoted in Baker, 104.

⁴⁸ Julius H. Hess, “An Electric-Heated Water-Jacketed Infant Incubator and Bed For Use in the Care of Premature and Poorly Nourished Infants” *JAMA* 64:13 (March 27, 1915), 1068-9.

their work with prematures at Cornell Medical Center, and probably will have things organized within a year. When they do, Dr. Couney says, he will retire. He will feel he has 'made enough propaganda for preemies.'"⁴⁹ In fact, an incubator ward soon opened at the New York State Hospital, and soon after, Coney Island saw its last incubator show.⁵⁰

COUNEY AS CHANGE AGENT

Although the medical journals brought the idea of the incubator from France to the U.S., Couney's incubator shows were the vehicle by which the incubator entered the public imagination. Unlike the medical journals, the live baby shows were intended to capture a popular audience. Everett Rogers addresses the idea of audience, stating that "*targeting* is the process of customizing the design and delivery of a communication program based on the characteristics of an intended audience."⁵¹ Had Lion wanted to promote his incubators as devices which other doctors ought to acquire and use, it seems reasonable that he would have targeted a medical audience by publishing a paper in a medical journal. This is the path that every other incubator innovator took. Instead, he opened his Charities to the public and invited the popular press for interviews: it is telling that, while Lion opened the Charities beginning in 1891, the first letter regarding them appeared in *Pediatrics* in

⁴⁹ Liebling, 23.

⁵⁰ Baker, 105.

⁵¹ Rogers, 367.

1896.⁵² If only for reasons of preventing priority disputes, physicians and scientists at this time published their discoveries and inventions. We can extrapolate from Lion's unique strategies of *targeting* that his motives differed from his fellow incubator inventors.

Couney's use of the incubators followed the same path as Lion's. Not seeking conventional legitimacy, Couney's shows instead sought to raise awareness among the public about the expensive and rare devices which he possessed. While the incubator shows convinced some hospitals to acquire the devices and some benefactors to donate them, it seems clear that promoting the purchase of the technology was not Couney's primary goal. Indeed, it was far more in his interests to encourage people to use and view his devices than to get their own—sideshows are only profitable while their subject matter is rare. This interpretation of Couney's actions and impact is only reinforced by the fact that Couney chose to close his shows at the same time that a major incubator ward opened in New York.

CONCLUSIONS

At the end of the nineteenth century, the French produced several models of incubator. Foremost among them were the Auvard/Tarnier model and the Lion design. French hospitals came to prefer the one which was relatively modest and

⁵² O. Jennings, "Paris Letter: An Improved System of Incubators," *Pediatrics* 1 (1896), 427-428.

low-tech, demanding high maternal involvement. This approach was considered best for parent and child, as it encouraged interaction and taught care-taking skills. Lion's high-tech model survived in the storefront Incubator Charities he established, but never came into widespread institutional use.

The Americans received the incubators through fairs and academic publications. The small, low-tech devices promoted in the academic context were built by hand or ordered from instrument manufacturers for use in private practice, but what caught the public fancy were the large, high-tech designs presented at fairs. From Berlin to England and Paris, and then explosively at Buffalo, St. Louis, and Coney Island, the incubator babies were thrust into public consciousness.

After the fairs arrived on the American scene, discussions about incubators became discussions about Lion incubators. When hospitals talked about acquiring incubators, the expensive, self-regulating versions were what they meant—when DeLee announced the four Lion incubators at his hospital, he pointedly dismissed the Auvard model as “little more than a shoebox with hot water bottles.”⁵³ By 1904, many medical articles assumed that self-regulating incubators would be available for premature infant care.

The 1904 expo at St. Louis brought public scorn to the incubators, associating them with dead babies and hospitalism. In spite of Zahorsky's extensive clinical

⁵³ Baker, 115-6.

studies there, medical papers after this date all prefer “better ventilated” substitutes for the incubator. The public nature of the fair was its own downfall, because the infant deaths were likewise well publicized.

To make matters worse, doctors using Lion incubators could only afford one or two, so that only the sickest babies were placed inside. Predictably, the survival rates were not high, and the information available for potential adopters became very negative very quickly. By WWI, Lion incubators were no longer in demand in the U.S.

This story can be understood in part by considering the national context. The French maternity hospitals valued high-contact maternal care, and so developed an incubator to facilitate the goal of an incubator for each baby, and each baby with its mother. The Americans instead valued technological solutions and indulged at length in modifications and reinventions of the incubators they adopted. The unique combination of entertainment and technology promoted by American World’s Fairs fit well with Couney’s popular-science presentation, and he quickly managed to make his incubator stand-in for incubators in general in the American mind. When hospital benefactors donate incubators from this point forward, they give the Lion.

It is important to bear in mind that Couney’s style of showmanship would not have worked with the Tarnier/ Auvard model, which was in no way technically

or visually impressive and did not allow for relaxed contemplation of its contents. Never in the incubator studies is there conclusive evidence that one model is better at keeping babies alive than another, but nonetheless, the American preference is clear and complete.

The story of the infant incubator told here serves as a long prelude to the contemporary NICU. It differs from the traditional technology transfer tale, proceeding from adoption to rejection, then to reinvention and adoption again. Martin Couney serves at times as guide, at times as impediment. On the one hand, Couney is largely responsible for bringing the notion of incubators as a treatment for prematurity to the public at large. On the other, his decision to target his message for popular instead of professional approval meant that, when the device he introduced failed, it did so in public and on a large scale. With no strong backing from the medical establishment, this single instance of failure virtually destroyed the incubator's credibility and its popularity plummeted.

At the same time, Couney's persistence in promoting his side-shows can also be seen as the link between the early-century fairs and Julius Hess' pioneering oxygen therapy incubators, introduced in 1934. While it is fruitless to tell what-if stories, one can't help but wonder whether, without Couney's friendship, Hess would have persisted in creating the institution which became, in the latter half of the century, the network of technologies which make up the NICU.

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