

TRACHEOTOMY VERSUS INTUBATION: SURGICAL INTERVENTION IN DIPHTHERIA IN EUROPE AND THE UNITED STATES, 1825–1930

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 Diphtheria is one of the common infectious diseases of childhood which is rare today because of preventive immunization. A century ago, however, it was one of the major killers of children under the age of ten, and was widely feared throughout Europe and America.¹ Although the disease has been known since ancient times, and was described by Galen and Aretaeus in the second and third centuries B.C., its history is obscure before the mid-nineteenth century.² It was first recognized as a specific disease in the 1820s, and like other infections affecting the throat, it was treated by physic rather than surgery, and so fell within the province of internal medicine. It has this peculiarity, however, that a “false membrane” often forms at the back of the mouth and in the throat, which in severe cases threatens to asphyxiate the patient. In these circumstances, throughout much of the nineteenth century, physicians found themselves obliged to turn surgeon, and to perform, as a last resort, the operation of tracheotomy.³

Diphtheria is an acute, infectious, and very variable disease, caused by the bacillus *Corynebacterium diphtheriae*. This organism occurs in three main types: *gravis* and *intermedius*, which tend to be associated with high case-fatality rates, and *mitis*, which is milder. The symptoms of the disease are fever, headache, malaise, and sore throat, and the development of the characteristic “false membrane” in the throat, which, however, may be absent. Death does not seem to occur through any spread of the bacillus beyond the local lesion. It appears rather that the disease is essentially a toxemia in which the patient’s resistance or susceptibility to infection, and his or her recovery or death, are largely determined by the presence or rapid production

1. See, e.g., Jonathan M. Liebenau, “Public health and the production and use of diphtheria antitoxin in Philadelphia,” *Bull. Hist. Med.*, 1987, 61: 217.

2. E. W. Goodall, “The story of tracheotomy,” pt. 1, *Brit. J. Child. Dis.*, 1934, 31: 168–76.

3. The operation is today generally known as *tracheostomy*, but I have chosen to use the traditional name. For an explanation of this change of usage, see L. F. W. Salmon, “Tracheostomy: the evolution of an operation,” *Guy’s Hosp. Gazette*, 1957, 71: 234.

of anti-toxin.⁴ In cases of severe laryngeal diphtheria, the relief, through tracheotomy, of the obstruction caused by the membrane cannot prevent subsequent death by toxemia.

For many centuries, diphtheria was probably confused with a variety of other throat infections, including croup and certain forms of scarlet fever, but in 1824 Pierre Bretonneau (1778–1862), surgeon to the Children's Hospital in Paris, presented his case for the unity of the disease to the French Academy of Medicine. His arguments were published in 1826, in a work that subsequently became a classic.⁵ Bretonneau's ideas were rapidly accepted in France, where the terms *croup* and *diphtheria* rapidly became—or continued to be—synonymous,⁶ but were treated with caution elsewhere, and were ignored in England and America until, in 1858, a form of diphtheria markedly more virulent than any that had prevailed in living memory became widespread.⁷ The sudden appearance of a more distressing and fatal form of the disease focused the attention of the British medical profession both on the question of the identity of the disease⁸ and on methods of treating it. In America, meanwhile, Abraham Jacobi, the immigrant German physician who became famous in the annals of pediatrics, drew public attention to the disease with two articles in the *American Medical Times* in August 1860.⁹

Before the introduction of antitoxin therapy in the mid-1890s, physicians everywhere were largely powerless to treat diphtheria. In its severest forms, however, the disease was a desperate affliction, and parents and physicians alike were tortured by the sight of children dying in an agonizing struggle for breath, as the diphtheritic membrane appeared slowly to choke them. In such instances tracheotomy had to be considered as an option. In some cases, where the need could be foreseen, a surgeon would be called in to perform

4. W. W. C. Topley and G. Wilson, eds., *Principles of Bacteriology, Virology, and Immunity*, 7th ed. (London: Edward Arnold, 1983–84), 3: 74–75.

5. Pierre Bretonneau, *Des inflammations spéciales du tissu muqueux, et en particulier de la diphthérite, ou inflammation pelliculaire connue sous le nom de croup, d'angine maligne, d'angine gangreneuse, etc.* (Paris: H. Fournier, 1826).

6. See, e.g., Armand Trousseau, "De la trachéotomie dans la période extrême du croup, et des moyens plus propres à en assurer le succès," *Archives générales de médecine*, 1855, 1: 260; idem, *Lectures on Clinical Medicine*, translated from the 1868 edition by John R. Cormack (London: New Sydenham Society, 1869), 2: 569–615.

7. For the reaction to Bretonneau's ideas, see George Rosen, "Acute Communicable Diseases," in *The History and Conquest of Common Diseases*, ed. Walter R. Bett (Norman: University of Oklahoma Press, 1954), pp. 17–18. The appearance of the disease was first noted in the Registrar-General's third quarterly report for 1857. Charles Creighton, *A History of Epidemics in Britain* (Cambridge: Cambridge University Press, 1894), 2: 738–40.

8. For the English debates on the identity of diphtheria, see "Report of the Scientific Committee on the Relations of Membraneous Croup and Diphtheria," *Medico Chirurg. Trans.*, 1879, 62: 1–33, 39–168 (appendices).

9. Abraham Jacobi, "Diphtheria: Its Symptomatology and Treatment," in *Collectanea Jacobi*, ed. William J. Robinson (New York: Critic Guide, 1909), 1: 121; see also "Diphtheria and Diphtheritic Affections," 3: 351–70.

the operation, but more often it was the attendant physician who found himself obliged to operate. Diphtheria was the only disease in which the practitioner of internal medicine was likely to find himself called upon to wield the knife. Tracheotomy, recorded the French surgeon Guersant, was an operation that despite its difficulty "must nevertheless be resorted to by all practitioners, surgeons or physicians, for none is more urgent in a large number of cases."¹⁰ It remained the therapy of last resort until the introduction of improved methods of intubation in the mid-1880s made available a less radical alternative.

TRACHEOTOMY IN FRANCE AND BRITAIN BEFORE 1885

Tracheotomy is an operation with a very ancient pedigree: like diphtheria, it was first referred to by Galen and Aretaeus and has been constantly known since then.¹¹ Although not a difficult operation for the skilled anatomist, it is usually performed only in emergencies: it entails slitting open the windpipe (trachea) in cases where swelling or other obstruction has seriously impaired the patient's ability to breathe normally. The operation has been used since early times in cases where foreign bodies have been inhaled, and in the late eighteenth and early nineteenth centuries it was also associated with the condition loosely known as "cynanche," or inflammation of the throat—a term that certainly encompassed diphtheria.¹²

Armand Trousseau (1801–67) claimed for Bretonneau and for himself the honor of being the first to perform tracheotomy in diphtheria,¹³ but this claim clearly rests on Bretonneau's identification of diphtheria as a distinct disease. Trousseau claimed that "much controversy" surrounded a tracheotomy performed by the London surgeon John Andree in 1782,¹⁴ but other witnesses describe tracheotomies performed during the eighteenth and the early part of the nineteenth century for diseases that were almost certainly diphtheria. To be sure, such operations were rare, and reluctantly performed. Sir Charles Bell, for example, confessed to having never performed the operation himself,¹⁵ but described its use in cases of "membraneous croup" in 1816. Bell's description clearly shows "membraneous croup" to be diphtheria: he noted the presence of the membrane, which he thought at times had the appearance of "concreted mucus." In his view, it was not "the violence

10. M. P. Guersant, *Surgical Diseases of Infants and Children*, trans. Richard J. Dunglison (London: Smith, Elder; Philadelphia: Henry C. Lea, 1873), p. 47.

11. Goodall, "Tracheotomy" (n. 2), pt. 1, pp. 168–76.

12. Salmon, "Tracheostomy" (n. 3), p. 236.

13. Trousseau, "De la trachéotomie" (n. 6), 257–58; idem, *Lectures* (n. 6), pp. 594–95.

14. Trousseau, *Lectures* (n. 6), p. 594. For details of this operation see J. R. Farre, "A case of cynanche laryngea," *Medico Chirurg. Trans.*, 1812, 3: 335–37 (appendix 19).

15. Henry Smith, "On some cases of tracheotomy, with observations on its employment in diphtheria," *Lancet*, 1863, 2: 481.

of the inflammation which destroyed the patient, nor the irritation directly from the inflamed membrane, but that the presence of this secreted membrane, acting like a foreign body, at the same time occasions spasm in the glottis, obstructs the passage and confines the mucus."¹⁶ Despite his lack of personal experience, Bell described attempts to save the patient by tracheotomy; he also described the complete operative procedure in detail, "to divest it of its terrors."¹⁷

Tracheotomy was thus well known as a possible treatment in severe cases of throat inflammation even before the work of Bretonneau and his pupil Trousseau established the operation as a remedy specifically for diphtheria. Bretonneau's first two operations, in 1818 and 1820, were unsuccessful, but his third, performed in 1825, resulted in recovery. In all, Bretonneau performed only twenty tracheotomies, and for a time he remained skeptical of the efficacy of the operation, observing in 1826 that "the best argument in favour of this operation would be an instance where a cure was obtained by its means in a severe case of diphtheria trachealis; in the case here described it only prolonged life for a little while."¹⁸

It was Trousseau who confirmed the possibilities of tracheotomy for diphtheria patients through his work at the Children's Hospital in Paris.¹⁹ It was he who brought the operation to Paris; he claimed to be the second person to have performed it, and the second to record a success: his account of this tracheotomy was first published in 1833.²⁰ By 1855 he had performed more than 200 such operations, an average of between 6 and 7 per year; 24 took place in the years 1851–54. During roughly the same period, 1850–54, a total of 216 tracheotomies were performed at the Children's Hospital.²¹ Trousseau himself appears to have achieved a recovery rate approaching 50 percent; for all the tracheotomies performed at the hospital, the recovery rate reached nearly 25 percent.²²

Yet despite these results, the use of tracheotomy in diphtheria did not immediately become acceptable in France. As late as 1855, Trousseau was complaining that the surgeons had placed formidable difficulties in his path, and that most surgeons still rejected the operation because they could not count on a satisfactory recovery rate; only one of his colleagues had committed himself to the new technique.²³ Further, he noted, in certain European countries, especially in England, tracheotomy was still very rare: it was performed less often in the whole of Britain than in the city of Paris alone. The conservative

16. Charles Bell, *Surgical Observations* (London: Longman, 1816), 2: 15–16.

17. Ibid., pp. 22–31, 45–49.

18. Bretonneau, *Des inflammations* (n. 5), p. 220.

19. Rosen, "Acute Communicable Diseases" (n. 7), pp. 77–78.

20. Trousseau, *Lectures* (n. 6), p. 595.

21. Trousseau, "De la trachéotomie" (n. 6), pp. 259–60.

22. Ibid., pp. 259–60.

23. Ibid., p. 258.

teaching of established surgeons everywhere discouraged innovation in surgical therapy, and this inbuilt resistance was supported by the general belief that surgical intervention in the extreme stages of diphtheria was rarely successful.²⁴ This was Rousseau's view some twenty years after he first began performing tracheotomies in diphtheria; little over a decade later, in his last revision of his *Clinical Lectures*, he was able to write, "In the early days of tracheotomy in croup (diphtheria), there was a great deal of opposition to it; but at present, it has no opponents except among the wayward, ill-disposed, or ignorant . . . henceforth the proceeding must be looked on as one conquest more of the healing art added to the ordinary practice of therapeutics."²⁵

This change in the French medical profession's attitude to tracheotomy in diphtheria, in the late 1850s and early 1860s, was paralleled in England. The English had been extremely cautious in their approach to tracheotomy as a therapy in "croup" (diphtheria), although the operation had been much discussed in the medical societies.²⁶ By contrast with Rousseau's hundreds of cases, only twenty-two tracheotomies had by 1857 been performed for croup in England, and most of these cases were singletons: only one practitioner had operated as many as eight times.²⁷ The general English feeling was clear: the use of the knife was not justified until all ordinary means of cure had been attempted.²⁸

Beginning in the mid-1850s, however, tracheotomies for diphtheria began to be reported more often in the British medical press, and interest in the operation appears to have become more active. This development seems to have been associated with the upsurge of a highly virulent and fatal form of diphtheria which first appeared, apparently in France, in the years after 1855. The initial focus of the epidemic was Boulogne, and from there the disease spread to England in the years between 1855 and 1857.²⁹ Diphtheria had been a fairly obscure disease, but it suddenly became, and remained for the better part of a century, a very constant focus of medical concern.

In the years that followed, tracheotomy operations for diphtheria were reported repeatedly in the *Lancet* and elsewhere: interest in the operation ran very high.³⁰ The English, however, seemed to be notably less successful

24. Ibid.

25. Rousseau, *Lectures* (n. 6), p. 596.

26. Henry Smith, "Tracheotomy in croup," *Lancet*, 1853, 1: 253.

27. *Lancet*, 1857, 1: 144.

28. Smith, "Tracheotomy" (n. 26), p. 258; Medical Society of London, "Case of croup, in which tracheotomy was performed," *Lancet*, 1856, 1: 404-5.

29. Francis B. Smith, *The People's Health, 1830-1910* (London: Croom Helm, 1976), p. 149.

30. Medical Society of London, "The lately-prevailing diphtheria affection," *Lancet*, 1858, 1: 250; see also Pathological Society of London, "Diphtheria," *ibid.*, 1858, 2: 477; W. H. Borham, "Tracheotomy in diphtheria" (letter), *ibid.*, 1859, 1: 591; Smith, "On some cases of tracheotomy" (n. 15), p. 481; Edw. Headlam Greenhow, "On diphtheria, part I," *ibid.*, 1865, 1: 585-87; Frederick N. Daly, "Tracheotomy in diphtheria: fatal result," *ibid.*, 1867, 2: 226-27; G. Buchanan, "The

with the operation than either the French or the Scots. Although there are no data available on the results of English tracheotomy operations for this period, English observers noted repeatedly that the French had a much greater success rate with the operation in croup and diphtheria.³¹ In the early 1860s, French operators were reporting recovery rates of 25–30 percent; by mid-decade, Troussseau could record his impression that half the cases in private practice should prove successful, provided that the right indications were present.³² Scottish operators did consistently better even than the French, the two most distinguished Scottish exponents of the operation, George Buchanan of Glasgow and James Spence of Edinburgh, achieving a steady 30-percent recovery rate.³³ However, the old prejudice against the operation died hard in the face of continuing high mortality rates: in 1859, the English surgeon W. H. Borham, reporting a successful diphtheria tracheotomy, noted that the use of the operation in the treatment of diphtheria patients had had its advocates and its detractors: it was “a point . . . warmly contested.”³⁴ Personal experience probably played a considerable part in converting many physicians. James Spence described how his own prejudice against the operation, derived from his teachers’ views, was dispelled when a child was brought to him in agonies of suffocation: he could not but try to relieve it; the operation was successful, and he was encouraged to try again. In a moving passage, Spence urged the use of the operation, but warned his “younger brethren”

that it will require some effort to bear up against discouraging results. I know of no class of cases in which the experience is so painful: an average gives little idea of it. You may have five or six cases in succession, all proving fatal, before you meet with one redeeming success; but then you have the temporary relief almost invariably afforded to the little sufferer; the resuscitations in some cases apparently dead; and, if you persevere, the average of success will come. Above

operation of tracheotomy,” *Brit. Med. J.*, 1871, 1: 217–18; W. E. Paley, “Successful case of tracheotomy in a child two years old: new form of tracheotomy tube,” *ibid.*, 1875, 2: 834; Clinical Society of London, “Tracheotomy in diphtheria,” *ibid.*, 1879, 1: 336–39; “Hospital for Sick Children—Great Ormond Street—case of diphtheria; tracheotomy; recovery (under the care of Dr. Gee),” *ibid.*, 1880, 1: 951–52; George Buchanan, “Tracheotomy in croup and diphtheria,” *Trans. Int. Med. Cong.*, 1881, 7: 207–10. Most tracheotomies reported in the *British Medical Journal* were for conditions other than diphtheria, but see T. M. Evans, “Hull General Infirmary: cases of laryngotomy and tracheotomy,” *Brit. Med. J.*, 1868, 2: 252–53; George Johnson, “The indications for tracheotomy in cases of laryngitis and diphtheria,” *ibid.*, 1870, 1: 50–51; *ibid.*, 1871, 2: 217; James Spence, “Address in surgery, delivered at the forty-second annual meeting of the British Medical Association,” *ibid.*, 1875, 2: 189–98.

31. William Jenner, “Diphtheria” (1861), in *idem, Lectures and Essays on Fevers and Diphtheria* (London: Rivington Perceval, 1893), p. 536; E. Headlam Greenhow, “On diphtheria, part II,” *Lancet*, 1865, 2: 85.

32. Greenhow, “Diphtheria” (n. 31), p. 85; Troussseau, *Lectures* (n. 6), p. 595.

33. Greenhow, “Diphtheria” (n. 31), p. 85; *Brit. Med. J.*, 1871, 2: 218; Spence, “Address” (n. 30), p. 196.

34. Borham, “Tracheotomy” (n. 30), p. 591.

all, we must recollect that, however disagreeable or unpleasant the operation may be to ourselves, we are bound to lose sight of that, and give the patient the only chance for life.³⁵

By 1865, Spence had already obtained seven recoveries in eighteen tracheotomies for diphtheria, a rate of well over 30 percent.³⁶ his humanity was evidently matched by his skills as both surgeon and physician.

For many years, however, English surgeons struggled to match the French and Scottish successes. In 1863, Henry Smith, assistant surgeon at King's College Hospital, described the increased confidence and success with which surgeons performed tracheotomies, even for croup—though a few years earlier the operation had been deemed “hardly warranted” in cases of croup. The use of tracheotomy in diphtheria, however, he admitted to be “difficult and unsatisfactory”: the operation had been tried on many occasions, but the “want of success attending it was so marked, as to lead us to put little faith in it.” In cases in which he, or a friend, had performed the operation, the outcome had been “almost invariably” death.³⁷ Nonetheless, Smith believed that where there was the least chance of saving life, tracheotomy should be performed; and his views were endorsed by Headlam Greenhow of the Middlesex Hospital, who felt that the reported success rates of the French and Scottish operators made it “imperative” not only to recommend the operation in suitable cases but even to urge it where it seemed the best hope of saving life.³⁸ One English case was extremely influential here: “Dr. C.,” rapidly sinking from diphtheria, had been operated on by Richard Quain in the presence of Sir William Jenner and others, and eventually recovered: his case was repeatedly cited to justify continued attempts at the operation.³⁹

One of the principal reasons that tracheotomy so often failed to save diphtheria patients was, of course, that death was due to diphtheria toxin, and not to asphyxia: for success to be possible, the cases for operation had to be carefully selected. This fact did not escape nineteenth-century observers. Trousseau, indeed, forbade the operation in cases where the danger to the patient seemed to depend on his or her general state rather than on the condition of the larynx or the trachea; in such instances, he argued, the operation was invariably followed by death.⁴⁰ Although other surgeons provided more specific definitions of the stage at which tracheotomy was in-

35. Spence, “Address” (n. 30), p. 196.

36. Greenhow, “Diphtheria” (n. 31), p. 85.

37. Smith, “On some cases of tracheotomy” (n. 15), p. 481.

38. Greenhow, “Diphtheria” (n. 31), p. 85.

39. Jenner, “Diphtheria” (n. 31), pp. 535–36; Smith, “On some cases of tracheotomy” (n. 15), p. 481.

40. Trousseau, “De la trachéotomie” (n. 6), p. 260; idem, *Lectures* (n. 6), p. 612; see also Charles West, *Lectures on the Diseases of Infancy and Childhood*, 3d ed. (London: Longmans, 1884), p. 464.

dicated, Rousseau's dictum established the guideline for operation in both England and France. By the early 1860s many English physicians had reached the conclusion that it was not simply the obstructive membrane in the throat that caused fatalities in diphtheria. Diphtheria was, in fact, a "blood disease":⁴¹ as Henry Smith put it, "The patient was suffering, not from a local complaint, but from a highly poisoned state of the blood." As a result, he noted, even if the patient were relieved for a period by the introduction of air, he would sooner or later relapse into the poisoned condition.⁴² For this reason some surgeons, like Smith, refused on principle to operate; but because of the urgency of the diphtheria problem, it came to be generally considered that in suitable cases tracheotomy should be attempted.

Guidelines for the performance of tracheotomy in diphtheria were often discussed. These guidelines encompassed not only surgical technique but also the timing of the operation, and the condition of the patient and his or her general treatment.⁴³ In 1859, Ernest Hart simply advised that tracheotomy be performed during the second and third stage of "croupal diphtheria";⁴⁴ during the years that followed, advice became more detailed. James Spence, for example, recommended that "there should be no delay when the character of the breathing and the contracted state of the thoracic parietes show that the lungs are not being distended with air."⁴⁵ Similar advice was later given by the doyen of English tracheotomy studies, Robert Parker, of the East London Children's Hospital.⁴⁶ Henry Smith, meanwhile, believed that the best way of avoiding the difficulties so often encountered in operating was to use simple instruments (a sharp scalpel and hook). In his view, clinical experience was also important: the operation was "too lightly thought of by many," especially by those who had only become acquainted with it in the anatomical theater or the mortuary.⁴⁷ It may be, indeed, that the improved English recovery rates apparent by the later 1880s reflect the fact that clinical experience was becoming more widespread. Above all, Smith stressed, the method of operation was crucial: one must take "care to get out of the way of important parts, to cut rapidly down upon the trachea instead of making a slow and cautious dissection."⁴⁸

Smith's emphasis on the speed necessary in operating ran counter to Rousseau's teaching that the operation must be performed slowly, but Smith's

41. Medical Society of London, "Diphthérite," *Lancet*, 1859, 1: 93.

42. Smith, "On some cases of tracheotomy" (n. 15), p. 481.

43. Greenhow, "Diphtheria" (n. 31), p. 85; for improvements in surgical technique, see Goodall, "Tracheotomy" (n. 2), pt. 3.

44. "Report of the *Lancet* Sanitary Commission on Diphtheria: its history, progress, symptoms, and treatment," *Lancet*, 1859, 1: 171.

45. Spence, "Address" (n. 30), p. 196.

46. For Robert Parker, see below, n. 60.

47. Smith, "On some cases of tracheotomy" (n. 15), p. 481.

48. *Ibid.*

view was supported by other English operators and accords with modern practice in such emergency situations: the less cutting and separating of the pretracheal tissue occurs, the less risk there is of secondary complications.⁴⁹ This difference between the French and the English approaches to the speed of surgery may partly have been determined by differences in attitude to the timing of the operation: English operators, unlike the French, continued to consider tracheotomy only as a last resort; they generally refrained from operating until death from apnea was imminent.⁵⁰ In Scotland, where recovery rates were also better than they were in England, it was also the practice to operate early. George Buchanan's forty-nine tracheotomies were all performed "when there seemed no hope of recovery otherwise," but Buchanan urged that it was better to err on the safe side and to operate before "it is too late to resort to the last resource."⁵¹ James Spence, building on his own experience, advocated operating before this stage was reached: "At first I only operated as a last resort, and even yet I do not see my way to operate quite so early as some French surgeons seem to do. . . . By operating early, we avoid the risk of oedema or congestion of the lungs, and of the effects of non-oxygenised blood circulating in the brain."⁵²

Inferior English recovery rates in the 1860s may well have been linked to a stubborn belief that tracheotomy should be only a last resort. Headlam Greenhow, who considered the "last resort" policy to be one of the reasons for the English lack of success with tracheotomy in diphtheria, urged that—in cases where local effects were the only pressing danger—the operation should not be delayed once it was evident that medical treatment had failed to arrest the disease.⁵³ By the 1880s, this had become "a universal conviction," and where practicable, English practitioners were operating earlier.⁵⁴

As important as the speed and timing of the operation, and the choice of patient, may have been the type of care which diphtheria victims received before and after tracheotomy. The first half of the nineteenth century was, in England, above all an age of heroic treatments. Until around 1850, bleeding, blisters, and counterirritants were the standard treatment for throat inflam-

49. Trousseau, *Lectures* (n. 6), p. 600; Goodall, "Tracheotomy" (n. 2), pt. 3, p. 267.

50. Jenner, "Diphtheria" (n. 31), p. 356; Greenhow, "Diphtheria" (n. 31), p. 85; West, *Lectures* (n. 40), pp. 463–64.

51. George Buchanan, "On tracheotomy in croup and diphtheria," *Brit. Med. J.*, 1875, 2: 292.

52. Spence, "Address" (n. 30), p. 196. Trousseau had been through a similar process of development: "So long as tracheotomy did not prove a reliable resource in my hands, I said that the operation ought to be delayed as long as possible; but now, when my successful cases are numerous, I say that it ought to be performed as soon as possible." Trousseau, *Lectures* (n. 6), p. 612.

53. Greenhow, "Diphtheria" (n. 31), p. 85.

54. West, *Lectures* (n. 40), pp. 463–64. Robert Parker, in 1879, however, regretted that the surgeon was still too often called only when all other therapeutic measures had failed. R. W. Parker, "Tracheotomy in membranous laryngea," *Medico-Chirurg. Trans.*, 1879, 62: 198.

mations of all descriptions; but in later years more attention began to be given to supporting the patient's strength, and gargles, throat swabs, and occasionally tincture of iron perchloride given internally became standard treatments.⁵⁵ This shift to gentler and more supportive treatments seems again to have been influenced by medical developments in France, where children's diseases and their treatment had become the focus of active research and experiment in the early years of the century.⁵⁶ Significantly, both Bretonneau and Trousseau had emphasized the importance of supportive rather than antiphlogistic treatments in diphtheria, and Trousseau condemned both the popular mercury treatment and the practice of blistering.⁵⁷ Instead, he recommended special attention to the patient's postoperative diet, insisting that apathetic children must be gently persuaded to eat, and advocating milk, eggs, creams, hot chocolate, and soup as nourishment.⁵⁸ By the mid-1860s, Trousseau was convinced that the improvement in tracheotomy results in the past decades was due to "the sounder principles of treatment" which his colleagues had begun to pursue;⁵⁹ and it is probable that French practice in this respect was superior to British practice until at least the 1860s. Certainly, Headlam Greenhow found it necessary to stress that the proper management of patients after tracheotomy included protecting them from cold and dry air; and while both Charles West, founder of the Children's Hospital at Great Ormond Street, and his pupil, Robert Parker, advocated supportive treatment, it is evident from their writings that in the 1880s many English physicians viewed tracheotomy as an end in itself, which obviated the need for continued treatment and required no special aftercare.⁶⁰

It seems probable that the success rate for tracheotomies in diphtheria rose in England in the twenty or so years after 1860. Whereas Greenhow plainly regarded a recovery rate of 25 percent as beyond anything attained by English surgeons, Charles West, in the early 1880s, noted that the English recovery rate was 25 percent.⁶¹ West, who may be regarded as the founding father of English pediatrics, had early been drawn to the study of children's diseases, and had received part of his medical training in Paris.⁶² He had a natural sympathy for and understanding of children, and from the beginning of his career he pioneered an essentially noninterventionist approach to their

55. Henry J. Parish, *A History of Immunization* (Edinburgh: E. & S. Livingstone, 1965), p. 119; West, *Lectures* (n. 40), pp. 453–58. See also Smith, *People's Health* (n. 29), p. 151.

56. Elizabeth Raine Lomax, "Advances in Pediatrics and in Infant Care in Nineteenth Century England" (Ph.D. thesis, University of California, Los Angeles, 1972), chap. 3.

57. Trousseau, "De la trachéotomie" (n. 6), p. 264; idem, *Lectures* (n. 6), pp. 569–70.

58. Trousseau, "De la trachéotomie" (n. 6), p. 264.

59. Trousseau, *Lectures* (n. 6), p. 570.

60. Greenhow, "Diphtheria" (n. 31), p. 85; West, *Lectures* (n. 40), p. 466; Robert W. Parker, *Tracheotomy in Laryngeal Diphtheria*, 2d ed. (London: H. K. Lewis, 1885), p. 32.

61. Greenhow, "Diphtheria," (n. 31), p. 85; West, *Lectures* (n. 40), p. 465.

62. "Charles West," *Lancet*, 1898, 1: 968.

treatment. This attitude is evident in his discussion of diphtheria, and in his advice to medical students on the practice of tracheotomy, in which he urged the necessity of surrounding the child with a warm, moist atmosphere, and of continuing medical treatment after the operation.⁶³

The efficacy of West's approach was illustrated by the results obtained by his pupil Robert Parker in a small series of tracheotomies conducted in the later 1870s and early 1880s. Parker, who had performed his first tracheotomy under West's supervision, advocated the local treatment of diphtheria and published "for the use of house surgeons and practitioners" detailed instructions for carrying out such treatment. His own results were, for the period, startling. In twenty-one tracheotomies for diphtheria performed at the time of the first edition of his book (1880), he claimed twelve recoveries; by the time of the second edition (1885), his total was thirty-two operations and seventeen recoveries—a success rate of more than 50 percent.⁶⁴ Like other successful operators, Parker stressed the importance of performing the operation at the correct time, before general cyanosis intervened.⁶⁵ In the aphorisms in which he gave general advice to his readers, he recommended that they operate only when there was evidence of mechanical obstruction in the larynx or the trachea, and that neither the local nor the general treatment of diphtheria be suspended after the operation; he stressed that the operation must be performed while the disease was local, if it was to be of service.⁶⁶

AFTER 1885: THE TRIUMPH OF INTUBATION

By the 1880s, tracheotomy had come to be widely used by physicians treating diphtheria on both sides of the Atlantic. In 1887, two American physicians, Robert W. Lovett and James C. Munro, both of Boston City Hospital, tabulated more than 20,000 tracheotomies reported in the medical literature of various countries: some 9,000 each from Germany and France; nearly 2,000 from other European countries; 1,327 from America; and a handful (433) from Britain.⁶⁷ It was not an exhaustive survey: Lovett and Munro excluded all accounts detailing fewer than 5 operations, and most describing fewer than 10. Individual practitioners might have had a far wider experience than these figures suggest: Abraham Jacobi, for instance, claimed to have performed more than 600 tracheotomies before this date, and to have assisted at many more.⁶⁸

63. West, *Lectures* (n. 40), p. 466.

64. Parker, *Tracheotomy* (n. 60), pp. vii, ix.

65. *Ibid.*, p. 198.

66. *Ibid.*, pp. 32–33.

67. Robert W. Lovett and James C. Munro, "A consideration of the results of 327 cases of tracheotomy at the Boston City Hospital from 1864 to 1887," *Amer. J. Med. Sci.*, 1887, 94: 170.

68. Abraham Jacobi, *Therapeutics of Infancy and Childhood*, 3d ed. (London: J. B. Lippincott, 1903), p. 243.

Before 1885, tracheotomy was the operation most commonly used in diphtheria. As early as 1858, Eugène Bouchut had introduced an alternative, intubation, a technique in which a tube was passed through the larynx into the trachea so that breathing might be continued *per viales naturales*, thus making the more drastic operation of tracheotomy unnecessary. Bouchut's initiative, however, was quickly suppressed by the French Academy of Medicine, at the instigation of Trousseau, and the older operation continued to dominate in medical practice.⁶⁹ In 1885, however, a greatly improved method of intubation was introduced by Joseph O'Dwyer, a young practitioner employed at the New York Foundling Asylum. The technique certainly had advantages over tracheotomy: it was as quickly done, required no anesthetic, and entailed none of the risks consequent on surgery: it rapidly established itself as the preferred method of intervention in the United States. By 1891 it was said to have entirely superseded the practice of tracheotomy in America.⁷⁰

The triumph of intubation over tracheotomy has indeed achieved something of the status of an American medical legend. "Intubation," it was written in 1979, "ended the practice of tracheotomy."⁷¹ So it did, largely, in America; but in western Europe the case was rather different. Although practitioners in both Germany and England tried out the new technique, their results were not encouraging. As reported by Robert Parker, five patients with acute diphtheria intubated at the East London Children's Hospital in 1890 all died, while there was but one survivor among nine patients intubated at the Metropolitan Asylums Board's South Eastern Hospital in the same year.⁷² Parker also cited the experience of Julius Schwalbe of the Friedrichshain Hospital, Berlin, and of Dr. Urban of Leipzig, both of whom had abandoned intubation, finding that the disadvantages (the pressure of the tube on acutely inflamed parts, and the need for a physician to be constantly on hand to replace the tube if coughed out) outweighed the advantages.⁷³ At the Leipzig Children's Hospital, only tracheotomy was performed between 1890 and September 1892, after which the practice of intubation was resumed.⁷⁴ In London, meanwhile,

69. Samuel W. Kelley, *Surgical Diseases of Children* (London: Rebman, 1909), pp. 494–95; Thomas E. Cone, Jr., *The History of American Pediatrics* (Boston: Little, Brown, 1979), pp. 109–10.

70. Robert W. Parker, *Diphtheria, Its Nature and Treatment*, 3d ed. (London: H. K. Lewis, 1891), p. 169; see also Kelley, *Surgical Diseases* (n. 69), p. 495. The rapid success of intubation in America did not mean that the operation did not come in for some criticism there. James Goodhart and George F. Still, *Diseases of Children*, 10th ed. (London: J. & A. Churchill, 1913), p. 303.

71. Cone, *American Pediatrics* (n. 69), p. 110.

72. Parker, *Diphtheria* (n. 70), pp. 173–74.

73. Ibid., pp. 170–72. Parker cited articles by Urban in *Deutsche Zeitschrift für Chirurgie*, 31 (pts. 1, 2), and by Julius Schwalbe in *Deutsche medizinische Wochenschrift*, 2 April 1891.

74. Parker, *Diphtheria* (n. 70), p. 172.

the Metropolitan Asylums Board hospitals, which had been practicing tracheotomy, and tabulating their results, since they first began admitting diphtheria patients in 1888, did not begin recording intubations until 1901.⁷⁵

If the Europeans remained unconvinced of the benefits of intubation in the early 1890s, the situation changed with the introduction of antitoxin in 1894. Antitoxin appeared to revolutionize the prognosis even of severe cases of diphtheria, and despite early problems with dosages and weak sera, it was widely and swiftly adopted as the preferred treatment for diphtheria cases in Western hospitals.⁷⁶ It also helped make intubation rather than tracheotomy the preferred practice in Europe. As long as antitoxin was administered early enough, before the larynx became affected, it was a sterling preventive of laryngeal stenosis, since it initiated the disintegration of the diphtheritic membrane and usually stopped the membrane from spreading any further.⁷⁷ Before antitoxin, according to Abraham Jacobi, 90 percent of laryngeal diphtheria cases required operation; with antitoxin, less than 40 percent did so. Antitoxin thus reduced both the need for surgical intervention, and the necessity for drastic measures: with the danger of deterioration in the patient's condition averted, intubation was to be preferred over a period of a few days while the local problem subsided.⁷⁸ By 1900, primary intubation had entirely replaced tracheotomy at, for example, Boston City Hospital,⁷⁹ while the 422 American and Canadian physicians who reported to the American Pediatric Society on 1,702 cases of diphtheria in their private practice over the eleven months to April 1897 had used intubation in 637 cases (37.4 percent), and tracheotomy in a mere 20 (1.18 percent).⁸⁰ Jacobi, meanwhile, was claiming that for years he had not seen a case in which intubation would not take the place of tracheotomy, and therefore had not performed the latter procedure.⁸¹

Jacobi was indeed a zealous advocate of intubation, and vigorously promoted its use. By the closing years of the century he was claiming that there

75. Metropolitan Asylums Board, Statistical Committee Reports (London: McCorquedale Ltd., 1881–97); idem, *Annual Reports* (London: McCorquedale Ltd., 1898–1929). In subsequent notes, Metropolitan Asylums Board will be abbreviated as MAB, and the year of the report will be given in parentheses. For the MAB, see Gwendoline M. Ayers, *England's First State Hospitals and the Metropolitan Asylums Board, 1867–1930* (London: Wellcome Institute, 1965).

76. For English problems with antitoxin serum, see E. M. Tansey, "The Wellcome Physiological Research Laboratories, 1894–1904: the Home Office, pharmaceutical firms, and animal experiments," *Med. Hist.*, 1989, 33: 11–16; see also Paul Weindling, "From Isolation to Therapy: Children's Hospitals and Diphtheria in *fin de siècle* Paris, London, and Berlin," in *In the Name of the Child: Health and Welfare, 1880–1940*, ed. Roger Cooter (New York and London: Routledge, 1992).

77. Jacobi, "Diphtheria" (n. 9), pp. 193–94.

78. *Ibid.*, p. 192.

79. Fred Grant Burrows, "A clinical study of diphtheria: 2093 cases treated by the writer at the Boston City Hospital," *Amer. J. Med. Sci.*, 1901, 121: 125, 151.

80. Jacobi, "Diphtheria" (n. 9), p. 192.

81. Jacobi, *Therapeutics* (n. 68), p. 418.

was widespread support for the procedure among the foremost practitioners of the day. "Altogether," he declared in 1903, "the American results are confirmed in Europe, where O'Dwyer's intubation has conquered the field. Von Bokay, Widerhofer, von Ranke, Gaughofner, Heubner, Baginsky, lately Trumpp and Siegert; in fact, everybody favours the combination of antitoxin and intubation in pseudo-membranous croup."⁸²

In fact, Jacobi's sweeping claims disguised a more complex situation. Opinion in Europe was far from unanimously in favor of intubation, and tracheotomy continued to be used extensively throughout the 1890s and into the twentieth century. Although the authorities Jacobi cited generally approved of intubation, not all could be said to bear witness to its unqualified triumph. Thus Siegert, who examined the records of ninety-three hospitals (mostly in Germany and Austro-Hungary, though with a few French and Italian institutions), found that in the years 1895–1900, sixty-four (68.8 percent) practiced tracheotomy only, while only ten (10.6 percent) performed primary intubation almost exclusively.⁸³ At the Kaiser and Kaiserin Friedrich Children's Hospital for infectious diseases in Berlin, where Baginsky was director, both intubation and tracheotomy were performed in varying proportion in the years 1896–1900.⁸⁴ Nor was Baginsky himself exactly wholehearted in his endorsement of intubation, although he admitted that wherever it could be used it was preferable to tracheotomy. He emphasized that it was not an easy operation: "In the hands of an unskilled operator, the intubator armed with the tube is a dangerous instrument which may cause death by producing injuries . . . no one should attempt intubation until after thorough practice upon the cadaver."⁸⁵ Baginsky in fact regarded tracheotomy as the operation of last resort in cases he considered unsuitable for intubation—patients who were almost moribund, and very young children with narrow pharynxes.⁸⁶ His experience was clearly not unusual: the Leipzig University Children's Hospital reintroduced primary tracheotomy (tracheotomy as the operation of choice) in 1898 in cases of this type.⁸⁷

Nevertheless, intubation did slowly displace primary tracheotomy in most

82. Ibid., p. 419.

83. F. Siegert, "Die Tracheotomie und Intubation bei Diphtherie seit der Serumbehandlung," *Archive für Kinderheilkunde*, 1902, 33: 342, cited in H. W. L. Barlow, "Some Recent Intubation Statistics," in MAB, *Annual Report* (1904) (n. 75), contribution 14, pp. 319, 329.

84. Georg Alsborg and Sigmund Heimann, "Ueber der Indicationsstellung der operativen Behandlung der diphtherischen Larynxstenose," *Archiv für Kinderheilkunde*, 1902, 33: 98, cited in Barlow, "Intubation Statistics" (n. 83), p. 329.

85. Adolf Baginsky, "Diphtheria and Diphtheritic Croup," in *Diseases of Children*, ed. Abraham Jacobi (New York and London: D. Appleton, 1910), p. 758.

86. Adolf Baginsky, *Diphtherie und diphtheritischer Croup* (Vienna: Alfred Hölder, 1898), p. 357.

87. C. A. Thurmer, "Zur Behandlung der diphtherischen Stenosen," *Jahresbericht für Kinderheilkunde*, 1904, 59: 196, 223.

of Europe during the first decade of the twentieth century. Baginsky, as we have seen, largely endorsed it, and other influential practitioners were even more enthusiastic. In Paris, for example, the great neurologist Louis Landouzy, physician to the Hôpital Laennec, was uncompromising in his conclusion: "Intubation is the operation of *choice*; tracheotomy that of *necessity*.⁸⁸ Significantly, by this date, physicians such as Baginsky and Landouzy were devoting whole chapters in their textbooks to describing intubation; by contrast, tracheotomy merited a mere couple of pages.⁸⁹

In one European country, however, the older operation continued to dominate both hospital practice and private practice until the advent of immunization against diphtheria rendered the whole issue of operation largely obsolete. That country was England. The Metropolitan Asylums Board hospitals continued to perform, on average, at least one hundred tracheotomies per year, right up to 1929, when they were taken over by the local authorities; intubations seldom numbered more than fifty.⁹⁰ In 1914 a Leicester physician, Wyville Thomson, published a forceful plea for the replacement of tracheotomy by intubation: on the Continent and in America, he observed, intubation was generally practiced with excellent results, whereas "in this country the older operation is still in general use."⁹¹ His plea went unheard: as late as 1927, the superintendent of the Metropolitan Asylums Board's Grove Hospital was writing, "For some curious reason intubation is not popular in hospitals in England, although it is the operation of election in most parts of the world."⁹² However, in 1924–28, the last five years during which the London hospitals were managed by the board, the number of tracheotomies performed annually had declined to fewer than two hundred per year, the number of intubations to an average of twenty.⁹³

The story of tracheotomy as a therapy for diphtheria was, however, reaching its end. Although J. D. Whitaker stated in 1926 that "sooner or later most men have to perform tracheotomy,"⁹⁴ E. W. Goodall, one of the most distinguished physicians of the Asylums Board wrote a retrospective appre-

88. Louis Landouzy, *Les sérothérapies* (Paris: Carré & Naud, 1898), p. 259. Landouzy stressed the point a few pages later: "Je vous en prie de graver dans votre mémoire pour en inspirer votre conduite: dans le traitement du croup, choisir l'intubation, subir contraint et forcé la trachéotomie" (p. 274).

89. See Baginsky, *Diphtherie* (n. 86), pp. 338, 357; Landouzy, *Sérothérapies* (n. 88), chaps. 15, 16.

90. MAB, *Annual Reports* (1898–1929) (n. 75).

91. Wyville S. Thomson, "The advantages of intubation of the larynx over tracheotomy in laryngeal diphtheria," *Practitioner*, 1914, 93: 258–76.

92. J. H. Whitaker, "Intubation in Laryngeal Diphtheria," MAB, *Annual Report* (1926–27) (n. 75), pt. 3.1, contribution 5, p. 186.

93. MAB, *Annual Reports* (1924–28) (n. 75). In these years the total number of tracheotomies was 999, that of intubations 125.

94. J. H. Whitaker, "Tracheotomy in Children," in MAB, *Annual Report* (1925–26) (n. 75), pt. 3.4, contribution 4, p. 137.

ciation of the history and practice of tracheotomy in 1934. Although for a century past the operation had been done very frequently, he observed, it had been done less often in recent years.⁹⁵ Three factors had contributed to this reduction: laryngeal diphtheria had in general become less common; antitoxin had lessened the incidence of this form of the disease in those patients who were given that treatment; and the development of intubation and aspiration had to a considerable extent replaced tracheotomy.⁹⁶ Nevertheless, tracheotomy retained a place in the treatment of diphtheria: in the years between World War I and World War II, diphtheria was among the commonest indications for the operation in England.⁹⁷ It was only after World War II that the disease became relatively uncommon, although death rates from it began a steep decline in the early 1940s, at about the time that mass immunization against it was introduced.⁹⁸ In a clinical lecture at Guy's Hospital in July 1955, L. F. W. Salmon noted it to be "one of the marvels of modern medicine that most of you here have never seen a case of diphtheria, far less one treated by tracheotomy."⁹⁹

Within the space of a century, the use of tracheotomy in diphtheria had advanced from being experimental and contentious to being acceptable and commonplace, and then had passed into history. The circumstances in which the operation was used were never less than desperate, but until the disease was virtually eliminated by mass immunization, tracheotomy remained a continuing option in the treatment of diphtheria, in Britain at least.

TRACHEOTOMY VERSUS INTUBATION: THE INFLUENCE OF POLITICS, ANTITOXIN, AND VIRULENCE

The question remains: Why did American physicians adopt intubation so swiftly, the Europeans more slowly, and the English hardly at all? There are few indications in the contemporary literature, and conclusions must thus be speculative; but several explanations present themselves.

In the first place, it is possible that the American adoption of intubation was related to the politics of the emergent specialty of pediatrics. From at least the 1860s, tracheotomy had been regarded as an operation that fell uncomfortably between two stools: in performing it, surgeons felt that they were trespassing on the province of the physician, and it seems likely that physicians similarly regarded the operation as doubtful, partly because in performing it they were using manual skills rather than the art of physic, and

95. Goodall, "Tracheotomy" (n. 2), pt. 1, p. 167. But see n. 94, above.

96. *Ibid.*

97. Salmon, "Tracheostomy" (n. 3), p. 237.

98. Thomas McKeown, *The Modern Rise of Population* (London: Edward Arnold, 1976), p. 98.

99. Salmon, "Tracheostomy" (n. 3), p. 237.

partly because surgery was indeed the province of the surgeon.¹⁰⁰ During the nineteenth century, moreover, the traditional division between surgery and physic became both refined and complicated by developments within the medical profession, and by the emergence of different patterns of professionalization in different countries.

The development of pediatrics as a consulting specialty in the United States and Europe in the later decades of the century may have had significant consequences for the practice of tracheotomy in diphtheria. The history of pediatrics has been largely neglected by professional historians, but Sydney Halpern has recently examined the development of the specialty in America.¹⁰¹ Halpern shows that American pediatrics came into being in the 1880s, and that by the later 1890s pediatricians had begun to restrict their work entirely to children, by combining specialized private practices with positions at hospitals and medical schools.¹⁰² Abraham Jacobi was one of the prime movers in the development of the specialty.¹⁰³ In the words of Fielding H. Garrison, indeed, he exerted "a profounder influence upon American pediatrics than any other American physician."¹⁰⁴ Jacobi was a native of Germany, who had qualified in medicine at Bonn, and emigrated to the United States in 1853; he remained in close touch with medical developments in Europe, and he was active in pushing forward the frontiers of both professional development and medical concern in America. Throughout the 1880s and 1890s, he published a series of papers in which he discussed the scope and content of pediatrics, arguing that it should use a broad range of therapeutic methods and that it was indivisible from clinical medicine as a whole.¹⁰⁵

Against this background, Jacobi's insistence on the use of intubation to the exclusion of tracheotomy assumes a significance beyond the immediate issue of the therapeutic value of the technique. For intubation, although it required as skilled an operator as tracheotomy did, was not essentially a surgical operation: it involved manual skill but did not require incision. By the adoption of intubation, physicians placed diphtheria patients firmly within the field of internal medicine, the province of the physician, and avoided the doubtful connotations of surgical involvement. Further, intubation could only

100. Thus in 1868 the English surgeon Timothy Holmes noted that that in considering diphtheria as an indication for tracheotomy, "I must necessarily run the danger of trenching upon the province of the physician." Timothy Holmes, *The Surgical Treatment of the Diseases of Infancy and Childhood* (London: Longmans, Green, Reader & Dyer, 1868), p. 301.

101. Sydney A. Halpern, *American Pediatrics: The Social Dynamics of Professionalism, 1880–1980* (Berkeley: University of California Press, 1988).

102. *Ibid.*, pp. 35, 61–65.

103. *Ibid.*, pp. 44–51; see also Cone, *American Pediatrics* (n. 69), pp. 102–3.

104. Isaac A. Abt, ed., *Abt-Garrison History of Pediatrics* (Philadelphia: W. B. Saunders, 1965), p. 105.

105. Halpern, *American Pediatrics* (n. 101), pp. 50, 54. See also the numerous papers republished in Robinson, ed., *Collectanea Jacobi* (n. 9), vols. 1–8.

be satisfactorily managed in hospital, because if the tube came out a skilled physician had to be on hand to replace it: insertion could not be managed by a nurse, as it could in the case of tracheotomy. Thus the general adoption of intubation helped to bring diphtheria patients within the orbit of specialized physicians. The whole tenor of Jacobi's professional political argument was oriented toward establishing pediatrics as a specialty within internal medicine, and excluding from pediatric practice the use of tracheotomy in cases of diphtheria could only help to confirm the medical unity of the specialty.

In Europe, by contrast, the forces driving specialization seem to have been less urgent: there were fewer physicians competing for patients, and medical services were to remain more generalist, less specialty-oriented, than they eventually became in the United States.¹⁰⁶ The movement toward pediatric specialization dates from the 1880s in Germany, but only from around 1900 in France:¹⁰⁷ in both Paris and Berlin, pediatrics developed primarily as a hospital specialty with associated university chairs.¹⁰⁸ In England, however, the specialty did not become properly established until around 1940.¹⁰⁹ There the surgeon and the physician retained their separate spheres, which were increasingly located within hospital practice and private practice, respectively, while general practitioners qualified in both medicine and surgery became "family doctors"—those who were the first resort of the general public.¹¹⁰ Behind the English reluctance to adopt intubation lay in part the central role of the general practitioner in the delivery of primary medical care. In general practice, intubation was impractical, and the management of tracheotomized patients was preferable. Even the rare English advocates of intubation tacitly admitted as much: Goodall, for example, was clear that intubation was only possible in hospital practice, while Thomson confessed that the difficulties of managing intubation were such as to cast doubt on which operation to choose in private practice.¹¹¹

106. J. Rogers Hollingsworth, Jerald Hage, and Robert A. Hanneman, *State Intervention in Medical Care: Consequences for Britain, France, Sweden, and the United States, 1890–1970* (Ithaca: Cornell University Press, 1990), pp. 40–41.

107. Abt, ed., *History of Pediatrics* (n. 104), pp. 123–24. My judgment is based on the assumption that foundation of a specialist society confirms the existence of a specialty. The German Gesellschaft für Kinderheilkunde was founded in 1883; the American Pediatric Society in 1888; and the French Société de pédiatrie in 1899. Abt, *History of Pediatrics* (n. 104), pp. 123–24.

108. Weindling, "Isolation to Therapy" (n. 76).

109. There is no historical study of the development of modern pediatrics in Britain. H. C. Cameron, *The British Paediatric Association, 1928–1955* (London: British Paediatric Association, 1955), pp. 18–19, 21–48, makes it clear that this organization, established in 1928, fulfilled a primarily social purpose rather than a professional one until 1939, when it was politically energized by wartime developments.

110. Rosemary Stevens, *Medical Practice in Modern England: The Impact of Specialization and State Medicine* (New Haven, Conn.: Yale University Press, 1966), pp. 31–33.

111. E. W. Goodall and J. W. Washbourn, *A Manual of Infectious Diseases*, 2d ed. (London:

Intubation, however, was not generally adopted in English hospitals either. It is difficult to suggest any professional reason for this, and two other possibilities should be considered. It may be that the English delivery of antitoxin treatment remained sufficiently conservative to compromise the success of intubation; it is also possible that the type of diphtheria present in England resulted in a greater number of severe laryngeal cases. Goodall, as noted above, gave the reduction in the number of cases of laryngeal diphtheria as one of the reasons for the gradual abandonment of tracheotomy.¹¹² Some years earlier, his colleague J. H. Whitaker defined intubation as the ideal treatment for spasmodic obstruction, and tracheotomy as the ideal treatment for mechanical obstruction, declaring, "The severe case of diphtheria in which the membrane has extended deeply into the bronchi—which is all too common in London and is unsuitable for treatment by intubation—is probably not so common abroad."¹¹³

This claim for the greater prevalence of severe laryngeal diphtheria in England is difficult to substantiate. Diphtheria is a very variable disease, with different strains dominant in different places at different times, and with varying levels of herd immunity playing a part in determining the severity of community experience.¹¹⁴ Certainly the fatality of the disease declined dramatically in London, as elsewhere, after 1894,¹¹⁵ but this does not mean that severe strains were no longer active, and it may be that the English retention of tracheotomy reflects this.

Conservative administration of antitoxin may in itself have given the more severe forms of diphtheria more opportunity to develop in English hospitals. The practice of antitoxin administration was very variable in the early decades of the twentieth century, and the dosages suggested by most of the early experts were considerably smaller than those considered necessary later.¹¹⁶ The dosage system in common use today recommends between three thousand and four thousand units of antitoxin for the mildest cases among patients between the ages of two and fifteen years, and between ten thousand and twenty thousand units for the most severe cases, or cases seen late.¹¹⁷ A survey of international antitoxin practice, published in 1916, revealed not only the lack of a common system but also wide variations in dosages between different practitioners.¹¹⁸ Differences in national, as against individual, practice are

H. K. Lewis, 1908), p. 139; Thomson, "Advantages of intubation" (n. 91), p. 272. See also Goodhart and Still, *Diseases of Children* (n. 70), p. 303.

112. Goodall, "Tracheotomy" (n. 2), pt. 1, p. 167.

113. Whitaker, "Intubation" (n. 92), p. 186.

114. Topley and Wilson, *Principles* (n. 4), 1: 415–16.

115. Parish, *Immunization* (n. 55), p. 129. Parish gives the following mortality figures: 1890–94, 29.7 percent; 1895–99, 17 percent; 1910–14, 7.6 percent.

116. *Ibid.*, p. 129.

117. Topley and Wilson, *Principles* (n. 4), 3: 91.

118. William C. Bosanquet and John W. H. Eyre, *Serums, Vaccines, and Toxins in Treatment and Diagnosis*, 3d ed. (London: Cassell, 1916), pp. 122–24.

difficult to gauge from this survey, but on balance, European antitoxin dosages were much more modest than American ones.¹¹⁹

Certainly, the English authors of this survey were most cautious in their advice on dosage, recommending an initial dose of two thousand units for infants and four thousand for adults, repeated at twelve-hour intervals if necessary.¹²⁰ Even this was an improvement on the advice in the first edition (1904), which recommended giving one thousand units to infants less than one year of age, two thousand to children over the age of one, and four thousand to adults, and advised the reader to "largely exceed" these doses if necessary.¹²¹ Similarly, practice in the Metropolitan Asylums Board hospitals, where tracheotomy remained the operation of choice, was much more conservative than in Boston City Hospital, where intubation had replaced tracheotomy (although, of course, practices in these hospitals may not be indicative of general trends). Goodall, in the 1908 edition of his textbook, recommended an initial dose of two thousand units on the first day of illness, unless the case were a fulminating one, for which he suggested up to ten thousand units. A dose half the size of the initial one, or up to six thousand units if the case showed no improvement, was to be administered on the second day.¹²² In Boston, by contrast, antitoxin was administered much more freely: four-thousand-unit doses, repeated every four hours as necessary, were the standard practice; in exceptionally severe cases the dose was given every two hours. Some patients received eight thousand units every four hours.¹²³ It is clear that the Bostonians had learned well the lesson that, in the words of the Boston physician Fred Burrows, "the effects of antitoxin are only salutary, and there is no danger in giving too much."¹²⁴ It may be that their success with intubation was partly a corollary of their generous antitoxin policy.

It is not, however, impossible that the Boston cases were less severe than those in London. In London, in the ten years 1895–1904, laryngeal cases averaged 10.6 percent of diphtheria admissions; in Boston during the severe epidemic of 1899–1900, they constituted 19.2 percent of the uncomplicated diphtheria admissions.¹²⁵ Interestingly, however, Burrows noted that the "latest health reports" showed death rates from diphtheria to be 15.3 percent in London, 20.4 percent in Philadelphia, 17.7 percent in Milwaukee, and 16.4

119. *Ibid.*, p. 123.

120. *Ibid.*, p. 124.

121. William C. Bosanquet, *Serums, Vaccines, and Toxines: In Treatment and Diagnosis* (London: Cassell, 1904), p. 100.

122. Goodall and Washbourn, *Manual* (n. 111), p. 136.

123. Burrows "Clinical study" (n. 79), p. 147.

124. *Ibid.*

125. MAB, *Annual Reports* (1895–1904) (n. 75); Burrows, "Clinical study" (n. 79), pp. 126, 137.

percent in Saint Louis, compared with 9.7 percent in Boston.¹²⁶ It is not impossible that the Boston laryngeal cases were less severe than the London ones, even though in general the highest death rates in England during this period were little more than half the lowest death rates of Massachusetts.¹²⁷

There is a good deal of evidence to suggest that in the mid-1890s the dominant types of diphtheria were changing, and becoming milder quite independently of the introduction of antitoxin. This development is most clearly illustrated in the experience of Scandinavia. In Oslo a great fall in diphtheria mortality was noticeable in 1892; and in Norway as a whole, diphtheria mortality fell abruptly in 1895, although antitoxin was used only to a limited extent outside Oslo. In Stockholm, diphtheria mortality fell markedly in 1894, again before the introduction of serum therapy, while in Denmark the disease assumed an unusually benign character in 1895.¹²⁸ In many of the American and German cities whose data were tabulated by Newsholme, a similar pattern may be observed, and Newsholme's figures show that diphtheria mortality rates in Paris plunged after 1890.¹²⁹ In London, the observations of the Metropolitan Asylums Board's medical officers during the 1890s also suggest that milder strains of the disease had appeared;¹³⁰ but it is possible that, among the increasingly dominant milder strains, an acute strain of laryngeal diphtheria survived longer in England than elsewhere. Such strains may not have been so easily controlled by antitoxin: in Berlin, for example, there was an upsurge in the diphtheria case-fatality rate in 1927, in spite of intensive serum treatment.¹³¹

CONCLUSION: A QUESTION OF CULTURE?

The differing patterns of adoption of intubation as the preferred operation for diphtheria in various countries probably depended on several factors:

126. Burrows, "Clinical study" (n. 79), p. 126.

127. Arthur Newsholme, *Epidemic Diphtheria: A Research on the Origin and Spread of the Disease from an International Account* (London: Swann Sonneschein, 1898), p. 28.

128. Thorvald Madsen and Sten Madsen, "Diphtheria in Denmark: from 23,695 to 1 case—post or propter?" *Dan. Med. Bull.*, 1956, 3: 113.

129. Newsholme, *Epidemic Diphtheria* (n. 127), pp. 11–28, 62–64, 73–79.

130. See for example, MAB, *Annual Report* (1889) (n. 75), p. 32 (diphtheria type "decidedly severe"); MAB, *Annual Report* (1890) (no. 75), pp. 35 (this year has "seen diphtheria in all its types and forms"), 42 (cases throughout year of "a very mild type"). See also the discussion in Anne Hardy, *The Epidemic Streets: Infectious Disease and the Rise of Preventive Medicine, 1855–1900* (Oxford: Oxford University Press, forthcoming), chap. 5.

131. Topley and Wilson, *Principles* (n. 4), 3: 91. It is possible that this may have been the result of the changeover to modern, refined serums, which are thought to be less potent in combating diphtheria toxemia than the early, crude serums. Parish, *Immunization* (n. 55), p. 129. Parish notes, however, a "distinct increase" in the incidence and severity of diphtheria in Europe in the years 1927–31, in which many *gravis* cases proved relatively resistant to antitoxin treatment (pp. 158–59).

the degree of medical specialization; the dosage system adopted in antitoxin treatment; and the virulence of the strains of diphtheria present. However, it is possible that some of these factors were in turn the result of wider cultural differences, and reflected not just local variations in professional development and disease behavior but different national philosophies of medicine, such as have recently been described by Lynn Payer.¹³² Payer has described the modern American attitude to medicine, for example, as "aggressive" and "can-do." By contrast, the French prefer gentle therapies, emphasizing the importance of balance within the individual constitution (*terrain*). The Germans believe in medical science and have no sense of being overdoctored, while the British are characterized by the phrase "economy, empiricism, and keeping the stiff upper lip."¹³³ Except in the case of America, Payer does not trace the origins of these cultural attitudes or attempt to apply her model retrospectively; her interest is in the present. Yet differing medical cultures did exist, or were in the process of formation, in the past, and may help to explain differences in medical innovation and therapeutic practice.

John Harley Warner has described how the cultural values of antebellum American medicine determined which aspects of Parisian medicine were transmitted back to America. Americans considered their diseases to be more energetic, and to require more energetic treatment, than European diseases; they found French therapeutic practice apathetic, as well as insensitive to the needs of the patient.¹³⁴ Clearly there were already national differences in attitudes toward therapy, toward the body, and toward disease itself. Detailed treatment of such differences is beyond the scope of this paper, but their existence is likely to have been a powerful factor influencing the adoption, or nonadoption, of intubation as the operation of choice for diphtheria in the 1890s.

The English failure to accept intubation was due in part to conservatism, and to a belief that nonintervention was proper until the body's natural powers of resistance had palpably failed. English conservatism was not entirely negative: new pharmacological therapies, such as antitoxin itself and, later, insulin,¹³⁵ were quickly accepted. Rather, the English were slow to embrace new practices where they could see no immediate justification for change. Thus they clung to chloroform anesthesia for years after it had been abandoned in America, while the French and the Germans were searching for

132. Lynn Payer, *Medicine and Culture: Notions of Health and Sickness in Britain, the U.S., France, and West Germany* (London: Victor Gollancz, 1990).

133. Ibid., pp. 61, 79, 101, 124–31; quotation on p. 101.

134. John Harley Warner, "The selective transport of medical knowledge: antebellum American physicians and Parisian medical therapeutics," *Bull. Hist. Med.*, 1985, 59: 213–31.

135. Michael Bliss, *The Discovery of Insulin*, rev. ed. (London: Faber & Faber, 1988), pp. 173–74.

more satisfactory alternatives.¹³⁶ Further, they generally viewed Lister's anti-septic technique with suspicion, preferring asepsis achieved by means of soap and water.¹³⁷ The Germans, on the other hand, once scientifically convinced by Koch that bacteria were the cause of wound infections, warmly espoused antisepsis, and converted the Americans by their example.¹³⁸ Again, when immunization against diphtheria became available in the 1920s and was implemented by national campaigns in Canada, France, Germany, and Belgium, the British remained unconvinced of the need to adopt such a policy. They preferred the tried and trusted methods of notification of diphtheria cases, isolation of diphtheria sufferers in hospitals, and disinfection.¹³⁹ As an editorial in the *British Medical Journal* at this time specifically observed: "Progress marches slowly in England, for medical investigators have a full—the eager research worker may be inclined to say 'overfull'—sense of responsibility, and try the new thing with the greatest caution."¹⁴⁰

It is well recognized that societies and their cultures change with time: Martin Wiener has argued that, in the nineteenth century, English society moved away from the energetic, entrepreneurial culture of the Industrial Revolution until, by 1900, it had lost the capacity for innovation and assertion, and had come to disparage industrial and technological activity.¹⁴¹ Medical cultures, too, probably changed over time, but the processes by which individual national medical philosophies developed have still to be explored. Certainly, the rapid American adoption of intubation before the advent of antitoxin becomes comprehensible when viewed as the result of an interventionist approach to medicine, the feeling that it was "better to do something than not to do anything,"¹⁴² especially as intubation carried little risk of serious aftereffects, and tracheotomy was still available as a last resort. English conservatism, and the "stiff upper lip" philosophy, may, on the other hand, have been reinforced by the changed cultural ethos of later Victorian England. The apparent national differences in the practice of antitoxin administration give further support to such a cultural interpretation. Perhaps the English had greater faith in the innate strength of the human constitution. Such

136. Wyndham E. B. Lloyd, *A Hundred Years of Medicine*, 2d ed. (London: Duckworth, 1968), p. 74.

137. F. F. Cartwright, "Antiseptic Surgery," in *Medicine and Science in the 1860s*, ed. F. M. L. Poynter (London: Wellcome Institute of the History of Medicine, 1968), pp. 85–100.

138. Ibid.; I. H. Upmalis, "The introduction of Lister's treatment in Germany," *Bull. Hist. Med.*, 1968, 42: 240.

139. Parish, *Immunization* (n. 55), pp. 148–50, 157; Jane Lewis, "The prevention of diphtheria in Canada and Britain, 1914–1945," *J. Soc. Hist.*, 1986, 20: 163–76.

140. *Brit. Med. J.*, 1929, 2: 22–23, cited in Lewis, "Prevention of diphtheria" (n. 139), p. 166.

141. Martin J. Wiener, *English Culture and the Decline of the Industrial Spirit, 1850–1980* (Harmondsworth: Pelican Books, 1985).

142. Payer, *Medicine and Culture* (n. 132), pp. 124–29, 131. See also Warner, "Selective transport" (n. 134), p. 219: "The imperative to intervene was critical to American physicians' professional identity."

generalizations remain speculative, but the problem of why America, Germany and France, and England adopted different approaches to the alternatives of tracheotomy and intubation in the treatment of diphtheria provokes wider questions about the existence of different national medical cultures in the West and their influence on therapeutic practice.