

NINETEENTH-CENTURY TREATMENTS FOR RABIES AS REPORTED IN THE *LANCET*

by

K. CODELL CARTER*

The history of the treatment of hydrophobia, tetanus, epilepsy, etc. is a greater reflection on the art and science of medicine than the inability to cure.¹

IT IS generally agreed that medicine became scientific through the course of the nineteenth century, but there has been relatively little examination of what this actually involved. Recent work in the history and philosophy of science has demonstrated that the very existence of science depends on the adoption of shared paradigms or research programmes.² Persons who participate in a common research programme are committed to the same rules and criteria for scientific research and, therefore, they seldom disagree on fundamental issues; their work consists largely in assimilating new phenomena to the shared basic assumptions. Where there are no shared research programmes, on the other hand, one of two situations may obtain: there may be no particular interest in expanding the range of application of the basic assumptions, in which case one typically finds the stagnation that characterizes systems of magic, for example, or there may simply be no shared assumptions. In this case new observations may be generated, but there is no accepted basis for deciding which observations are reliable or important; there is no shared criterion for deciding what counts as a good explanation and, therefore, the observations remain disjointed, nothing can be used to explain anything else. If medicine became scientific in the nineteenth century, through nineteenth-century medical literature it should be possible to identify the basic assumptions of a new research programme and to trace the assimilation of different diseases to those assumptions.

In this respect, the therapies that were attempted against rabies may be particularly enlightening. By the nineteenth century, physicians had learned through experience to control certain diseases – scurvy, for example – and, of course, people generally recovered from many diseases regardless of what the physicians may have done. But

* K. Codell Carter, Ph.D., Chairman, Department of Philosophy, Brigham Young University, Provo, Utah 84601, U.S.A.

¹ Charles Simpson, in a letter to the editor published in the *Lancet*, 1848, ii: 431.

² See, for example, Thomas S. Kuhn, *The structure of scientific revolutions*, 2nd ed., Chicago, University of Chicago Press, 1970, pp. 1–50, and especially Imre Lakatos, 'Falsification and the methodology of scientific research programmes', in Imre Lakatos and Alan Musgrave (editors), *Criticism and the growth of knowledge*, Cambridge University Press, 1970, pp. 91–196. The respects in which Lakatos differs from Kuhn are not essential for our purposes; those interested in these differences are invited to consult the above article by Lakatos.

rabies remained confusing and frustrating. The disease was almost always fatal and involved terrible suffering. Confronted by a rabies victim, therefore, physicians were under extreme pressure to do something, but the accumulated experience of the profession simply did not justify any specific therapeutic strategy. In precisely this kind of situation – a situation in which one must act but in which experience does not provide clear direction – one might expect to find the influence of shared theoretical assumptions underlying a research programme. In other words, the degree of uniformity in therapeutic strategy in the treatment of rabies can provide at least a rough measure of the extent to which practical physicians shared a medical research programme. Moreover, where we find such uniformity the therapies invoked may also shed light on the basic assumptions on which that uniformity was based. Textbooks generally give an impression of greater unity and coherence than may actually exist in medical practice; for this reason case histories and other incidental reports may provide a more reliable indication of the therapeutic strategies that are actually being employed. Through the nineteenth century, the *Lancet* contains hundreds of case histories of rabies victims as well as miscellaneous notices and letters about rabies; many of these contain accounts of whatever therapies were attempted. In the following two sections I will present a sample of these therapies until 1885, the year in which Pasteur treated Joseph Meister. I will then discuss some of the early reactions to Pasteur's work. The change in medical practice caused by Pasteur's work will clearly illustrate the influence of a new research programme and it will provide some clues about the nature of that programme.

I

From antiquity it had been recognized that hydrophobia was usually associated with animal bites. Since weeks or even months may elapse between the bite and the onset of symptoms, the medical procedures that were employed against rabies can be roughly divided into those involving immediate treatment of the wound and those employed either during what we would recognize as the period of incubation or after the onset of symptoms. While there was a persistent minority who believed that the wound should be kept open as long as possible (1828–9ii:741; 1837–8ii:560; 1876i:619; 1882i:975),³ most nineteenth-century physicians who wrote on the treatment of rabies recommended that wounds be cauterized immediately – an opinion that can be traced to classical sources.⁴ Indeed, during one particularly serious outbreak of the disease, the editors of the *Lancet* recommended that every adult carry caustic at all times so that cauterization could be carried out immediately after the bite (1877ii:618). The usual caustic was nitrate of silver, but stronger substances such as caustic potash (1844i:172), the strongest nitric acid (1877ii:713), or even sulphuric acid (1885ii:925) were sometimes recommended. Some physicians advocated physical rather than

³ To reduce the number of footnotes, I have inserted references to the *Lancet* into the text and have abbreviated them to year, volume number (in bold type), and page. The references to the use of a specific therapy or medicinal substance are intended to be representative rather than exhaustive.

⁴ See, for example, Charles F. Mullett, 'Hydrophobia: its history in England to 1800', *Bull. Hist. Med.*, 1945, 18: 44–65, p. 44. Many of the specific therapies mentioned below were in use at a much earlier time as well. Mullett is a good source for treatments of rabies before the period discussed in this paper.

chemical cauterization; one finds recommendations for the use of boiling oil (1858i:103) and of red hot iron (1878ii:101), one physician recommended exploding gunpowder in the wound (1828–9ii:544). Others argued that any form of cauterization was inadequate and they recommended excision (1825vi:395; 1881ii:1012), or even amputation (1826–7xii:156; 1855ii:124). A few physicians recommended that cauterization be preceded by vigorous ablution by pouring water into the wound from a great height, sometimes for a period of several hours after the bite (1827–8ii:494; 1836–7ii:919; 1877ii:852). Some advocated sucking the wound to remove the poison (1834–5ii:266; 1878ii:827; 1885ii:772), but others felt that by sucking such a wound one exposed oneself to mortal danger and that this procedure, therefore, involved too great a risk to justify its use (1877ii:852; 1881ii:664).

There was much greater diversity in the prophylactic and therapeutic measures that followed initial treatment of the wound. As one physician observed, “Every remedy which the terrors of the disease or the ingenuity of the physician could suggest has been tried.” (1837–8ii:70). Local and general bleeding were common. Sea-bathing or dipping were among the traditional measures employed against rabies by the non-medical public; in some areas fishermen advertised their expertness in dipping, and used poles to hold patients under the water for three or more minutes at a stretch (1830–1i:533, 734). Some physicians believed that such procedures deserved a better trial (1827x:76), or recommended them (1826–7xi:310); one physician, who had himself been bitten by a rabid dog, went to the coast apparently to bathe in the sea (1860i:44). Another physician observed that drowned dogs showed no signs of rabies and he resolved to drown a female patient. She was placed in a tub of water, but unfortunately it did not contain enough water to immerse her; shortly thereafter she died (1830–1i:533). A Greek physician noted that hydrophobia was regularly preceded by the appearance of pustules under the tongue. In Greece, he reported, the disease was prevented by the simple expedient of first cauterizing these pustules and then either rubbing them with garlic and salt, or washing the mouth with water in which a gun barrel had previously been washed, or with the juice of a crawfish (1824iii:308–310). The editors recommended that this procedure be given serious attention, and throughout the century the tongues of victims were inspected for pustules and, if found, they were cauterized (1826viii:244; ix:130, 234, 487; 1826xii:156; 1827–8i:493; 1828–9ii:510; 1829–30ii:186; 1858ii:51; 1872ii:596; 1875ii:589; 1877i:84, ii:567; 1880i:755; 1881ii:664).

Many recognized hydrophobia as a disease of the nervous system and it was known that lead affected the nerves. One writer noted, “Having observed the powerful effects of lead on the nervous system I determined at once to give this mineral in the terrific disease before me.” (1825vi:345). The facts that lead poisoning was sometimes slow and that hydrophobia often occurred months after the bite suggested to some physicians that the poison spread gradually through the nerves. Some concluded that large nerves near the bite should be severed (1830–1ii:50) or stretched (1878ii:329). Resection of the nerves was attempted but found unsuccessful (1881ii:664). The symptoms of strychnine poisoning were similar to those of hydrophobia; Marshall Hall noted that frogs injected with strychnine died if they were agitated, but recovered if left in peace. He recommended that patients be placed on spring beds and

surrounded by gauze curtains in a dark and quiet room (1848ii:151). His recommendations were still being followed much later in the century (1880ii:31). It was frequently difficult to distinguish hydrophobia from tetanus (1871i:561; 1878i:222, ii:525; 1881ii:674),⁵ and various measures were recommended because of apparent success in treating tetanus (1871i:561; 1874ii:497; 1877ii:903). Some physicians connected hydrophobia with hysteria either because of symptomatic similarities (1825vi:349; 1836–7ii:253; 1875i:140) or because both diseases seemed to involve sexual abnormalities (1836–7ii:583–9). For example, several writers attributed rabies either to inadequate sexual release among dogs (1825–6x:526; 1872i:528; 1884ii:47), or among men (1837–8i:150), or to sexual incontinence in the dog (1847i:517). Because of these connexions one physician recommended castration as a radical but effective prophylaxis – a recommendation categorically rejected by the editors (1837–8i:150). One physician observed that with respect to symptoms, progress, duration, termination, and structural lesion, hydrophobia was identical to acute febrile delirium as found in insane asylums (1864ii:282), and various writers said that hydrophobia, or at least a disease resembling it in every particular, could be induced by fear (1824iv:13; 1825vi:345; 1877ii:399, 810; 1881ii:674; 1882ii:215; 1885ii:968). Consequently, physicians were urged to be extremely careful in diagnosis “since a false diagnosis may lead to its own verification,” (1877ii:399), and attendants were sometimes forbidden to allude to the bite “lest the imagination be aroused” (1877ii:753). An early physician claimed that if only one would “treat wounds, fortify the mind against undue mental impressions, watch secretions and freedom of the alimentary passage, I would guarantee the convalescence of the patient.” (1827–8ii:472).

Some writers advocated hot air baths with temperatures as high as 200°F (1848i:688; 1879ii:346), or vapour baths in which the patients was wrapped in blankets or flannel and placed on a wicker chair over hot bricks, live coals, or a spirit lamp (1877i:122, ii:478, 905; 1881ii:1070). Others advocated cold affusions (1836–7ii:914), large doses of ice (1859i:622), or the application of ice along the whole length of the spine (1844i:173; 1874ii:497; 1877i:959; 1878ii:43; 1880i:755; 1883ii:538). Some combined warm baths with immersion in cold water (1826–7xi:809). “To reduce to a lesser or negative state” the great excitement under which the victim is labouring, one physician recommended wrapping the patient in blankets and dashing the spine with cold water every fifteen minutes (1844i:413). Galvanism was frequently recommended, usually with one pole at the head and the other at the feet (1836–7ii:920; 1854ii:284; 1876ii:682; 1877ii:737), although other writers reported that it had no effect (1854ii:213). One physician observed that while galvanism cured hydrophobia, the patients occasionally died from exhaustion in the process of treatment (1874ii:497). Another physician recommended that patients be fed massive doses of asparagus. He reported trying this on a patient who went mad and died, but

⁵ Classical writers noted the difficulty of distinguishing hydrophobia from tetanus, and this difficulty persisted throughout the nineteenth century. (e.g., 1892ii:679). For a time it was hoped that pathological anatomy would provide a reliable basis for differential diagnosis (1877ii:399; 1878ii:713; 1879i:667), but, of course, these attempts ultimately proved ineffective. Definitive diagnosis is now based on identification of Negri bodies or on isolation of rabies virus during autopsy.

the patient seemed to have been cured of hydrophobia, and further tests were indicated (1853ii:186). A variety of physicians recommended tracheotomy (1837–8i:675; 1844i:173; 1848ii:152; 1852ii:41; 1853i:152; 1872i:227), so many, in fact, that in 1848 there was a dispute over priority. Other physicians argued that since victims seldom if ever die, of suffocation, tracheotomy could not be effective (1852i:576; 1853ii:107; 1859i:409). Some writers held that the only hope for recovery was in absolute tranquillity and the use of sedative (1882ii:1046; 1884ii:912). However, one patient was greatly benefited by escaping from a hospital and running around the town; this suggested exercise and the use of tonics (1825–6x:75; 1878i:702; 1881ii:1070). One physician advocated exercise in the form of dancing – he noted that a similar treatment had formerly been used for tarantula stings (1877ii:478). Another physician recommended excision of the uvula as an excellent shock to the system (1843–4i:481). Some pointed out that rabies is spontaneous only in animals that do not perspire; to them, violent perspiration seemed to offer hope (1836–7ii:920; 1848i:688; 1877ii:478). Others noted that in animals that do not perspire the saliva must carry off excessive quantities of effete matter; to them, violent salivation looked promising (1852i:453; 1875i:36; 1877ii:827). One physician recommended that patients be poisoned with curare – the South American arrow poison – and then be revived by artificial respiration (1848i:688). For a time it was believed that lead, mercury, and turpentine would cure rabies, but victims were often poisoned in the process (1829–30i:440). One case was reported in which large doses of croton oil and prussic acid had apparently converted hydrophobia into a fatal case of typhoid fever – a subsequent critic objected to the use of lethal doses of croton oil (1838–9ii:258, 437). Magendie reported temporarily arresting the disease by injecting warm water into the veins of patients. His procedure was recommended by the editors of the *Lancet* (1823i:345–351; 1824iv:10, 160). The injections were tried but proved unsuccessful (1824iii:169, iv:373; 1825–6x:76; 1829–30ii:798; 1854ii:213). Some physicians recommended massive transfusions, usually after bleeding to depletion (1848i:688; 1877i:123, 151, ii:791), although at the beginning of the century this procedure had been rejected as ineffective (1828–9ii:232). As late as 1879, it was proposed that transfusions or Magendie's water injections might succeed if they were carried out with modern techniques and equipment (1879ii:219). One physician recommended the injection of animal poison in homoeopathic doses on the model of smallpox vaccinations (1846ii:312). Others recommended that patients be kept in a constant state of nausea (1844i:413) or given small but continuous enemata (1879ii:219). One physician tried soaking a rennet in water, saturating it with savanilla and forcing it down a patient's throat; after being placed in the sun and sleeping for forty-eight hours the patient awoke completely recovered (1878ii:243).

Some of the preceding treatments were suggested by traditional procedures then commonly in use among the non-medical public. Other treatments were suggested by symptomatic similarities between hydrophobia and other diseases such as lead or strychnine poisoning, tetanus, hysteria, or febrile delirium. But there was no agreement as to which similarities were relevant, and even when a particular symptom seemed especially significant, e.g. muscular spasms in the throat, physicians were unable to agree as to whether therapies should induce and intensify or counteract the

symptom. It often happened that contradictory courses of treatment were recommended. By the end of the century, many physicians had become so sceptical of purportedly successful treatments that recovery was sometimes regarded as proof that the disease in question had not been genuine hydrophobia (1883i:366; 1886i:823; 1890i:458). One physician remarked that since every treatment was likely only to make matters worse, it was best to leave patients entirely alone (1882ii:151). Given the total lack of any accepted theoretical basis for work on hydrophobia, this scepticism is understandable if not laudable.

II

One finds a similar lack of direction in the various drugs and medicines that were used in cases diagnosed as hydrophobia. In 1838, one physician recommended that every substance in the *materia medica* be tried in the attempt to find something that would work against rabies (1838–9i:415). But this recommendation was unnecessary – as various physicians noted, everything had already been tried (1824iii:169; 1829–30ii:391; 1836–7ii:919; 1848i:688; 1874i:176). The following substances were reported as having been used in cases diagnosed as hydrophobia: *aconite* (1844i:173; 1854ii:274; 1877ii:713; 1882ii:215); *alcohol* (1847ii:409); *aloes* (1879ii:921); teaspoons of saturated *alum* solution (1877ii:791); bulbs of *Alysama plantago* mixed with flowers and leaves of *Cemsta tinctoria* and *Origanum vulgare* and served in a bread and butter pill (1861ii:436); *ammonia* as an ointment, orally, and injected into the bloodstream (1827–8ii:221, 494; 1828–9ii:743, “until the patient begged that treatment might be discontinued” 1836–7i:828; 1848ii:122; 1871i:537; 1877ii:566, 791; 1879ii:865; 1880ii:31); *amyl* “Greatly lowers the animal temperature, especially when given in lethal dose.”⁶ (1877i:123; 1880i:755); *Anchusa officinalis* (1828–9i:389), various compounds of *antimony* – most commonly *tartar emetic* (1827–8ii:220, 494; 1829–30ii:494; 1838–9ii:394; 1847ii:409; 1848ii:122; 1849i:335); *arsenic* (1825–6x:75; 1852i:453; 1861i:330, “preeminent as an antidote or prophylactic also successful against smallpox” 1873i:548); *asparagus* (1853ii:186); *assafoetida* (1826–7xi:810; 1828–9ii:340; 1836–7i:828); *balsam* (1827–8ii:494); *bearsfoot* (1838–9i:416); *belladonna* (1826–7xii:156; 1828–9ii:340, 510; 1829–30i:439; 1836–7i:828, ii:77; 1844i:172; 1851i:37; 1852i:453; 1854ii:213; 1874ii:366, 514; 1875ii:589; 1877ii:713; 1879ii:921; 1882ii:215) and its derivative *atropia* (1868i:643; 1871i:770; 1872ii:597; 1874i:823, ii:513; 1877i:122, ii:713; 1881ii:415; 1884i:1073; 1885i:535); *Birling medicine* (1827–8ii: 328–30, “Never fails if taken in proper time and quantity” 591); *bismuth* (1879ii:865); fresh *blood* to be drunk (1828–9i:389); *borage* (1877ii:753); *box* (1838–9i:416); *Calabar bean* (1866i:643; 1878i:863; 1979i:258; *camphor* (1836–7i:828, ii:217; 1844i:14; 1848ii:122; 1859i:409; 1874ii:366; 1877ii: 420, 566; 1878ii:329; 1883ii:328); *Cantharides* – more commonly known as Spanish fly (1825vi:344; 1828–9ii:340, 510; 1852i:453; 1857i:103; 1871i:561; 1878i:702); *carbolic acid* – taken orally, by injection, and used to cauterize and to saturate the air (“In the hands of an ingenious and skillful surgeon, carbolic acid, made famous by the immortal Lister, might prove a specific.” 1871i:770; 1873ii:157;

⁶ Alfred Stille and John Maisch, *The national dispensatory*, Philadelphia, Henry C. Lea, 1879, p. 165.

1885ii:925); *castor oil* (1825vi:345; 1826–7xi:809; 1828–9ii:340; 1838–9i:416; 1854ii:274; 1859i:409; 1877ii:420); *golden Cetonides* – a beetle to be pounded and eaten (1856i:139); *chalk with catechu* – “a local astringent applied to the throat and larynx in cases of flaccidity of these parts”⁷ (1879ii:865); *chloral hydrate* (“The remedy of the day” 1870ii:163; 1871ii:839; 1872ii:597; 1873i:665; 1874i:823, ii:366; 1875ii:589; 1877i:84, 959, ii:420, 567, 713, 752, 791; 1878ii:43, 329; 1880i:755, ii:506; 1881ii:1012; 1882i:1049; 1883i:365, 668, ii:328, 368, 538; 1884ii:1142); *chlorine* – applied to the wound and taken orally (1829–30ii:12; 1854ii:212); *chloroform* – inhaled, rubbed on the skin, and taken orally (1848i:193, 259, ii:122; 1854i:535, ii:212, 274; 1859i:409, 533; 1866i:511; 1871i:537; 1873i:665; 1874i:823, ii:366; 1875ii:589; 1876i:84; 1877i:83; 1878i:863, ii:43, 329; 1880i:267; 1881ii:624, 664; 1884i:1073; 1885ii:925); *cinchona* and its derivative *quinine* (1827–8ii:221; 1853i:152; 1854ii:212; 1879ii:865; 1882ii:215); *cinnamon water* (1844i:14); *cocculus* (1871i:561); *colocynth* (1829–30i:438; 1844i:14); *copaiba* (1827–8ii:494); *copper* (1828–9ii:743); *creasote* – used to saturate the air (1885ii:925); *croton oil* (1825vi:396; 1836–7i:740, 828; 1838–9ii:258, 583; 1844i:14; 1848ii:122; 1849i:335); *curare* (1848ii:688; 1863i:282; 1872i:227; 1876ii:207; 1877ii:618, 713, 863; 1878ii:140, 206, 1879i:570, ii:346; 1880i:755; 1881ii:624, 664, 1070; 1882ii:215); *ergot of rye* (1842i:77); *ether* – sometimes inhaled, sometimes injected (1828–9ii:340; 1847ii:409; 1848i:688, ii:122; 1881ii:624); *euphorbium* (1828–9i:389, “Promises to guard everyone against rabies” 1829–30ii:186); *garlic* (1884i:637); *genista* (1825–6viii:244, ix:130, 487); *gentian* (1879ii: 921); *guaco juice* (1829–30ii:286); *Indian hemp* or *hashish* (1848ii:122; 1854i:535; 1869ii:564; 1883ii:538); *hoang-nan* – a Chinese plant resembling ivy, said also to be effective against leprosy and snake bite (1878i:739); *tincture of hops* – tried when a physician noted that one rabies victim could drink ale even when he could not drink water (1878i:222); *hydrochloric acid* (1825–6x:509); *hydrocyanic acid* (1836–7ii:920; 1844i:173; 1849i:335; 1853i:152; 1859i:533); *hyoscyamus* (1827–8ii:328; 1844i:14; 1878ii:71, 140); various *insects* from China (1858ii:241) and from Arabia (1878ii:132); *iodine* (1837–8i:133 “Iodine vapour will destroy the virus throughout the system.” 1881ii:1070); *ipecacuanha* (1829–30i:439) and later in combination with other drugs known as *Dover’s powder* (1883i:328); *iron* (1831–2i:162; 1836–7ii:920); *jaborandi* (1881ii:1012, 1070; 1882i:116, 1049, ii:215; 1884i:637); *jalap* (1827–8ii:461; 1847i:668; 1875ii:589); *laudanum* (1825–6x:509; 1854ii:274; 1877ii:423); *laurel water* (1825–6x:509); various compounds of *lead* (1824iv:373; 1825vi:345, vii:250; 1828–9ii:741; 1829–30i:439, ii:286, 783; 1830–1i:263); various compounds of *mercury* or *calomel* (1827–8ii:220, 461, 494; 1828–9ii:340, 510; 1829–30i:438, ii:494; 1836–7i:740, ii:914; 1837–8ii:560; 1838–9ii:394, 583; 1847i:668; 1848ii:122; 1849i:335; 1852i:453; 1854ii:274; 1875ii:589; 1878i:702); various compounds of *morphia* used internally and externally (1825–6x:509; 1829–30i:440; 1837–8i:675; 1838–9i:415; 1859i:533; 1871i:537; 1872ii:597; 1873i:664; 1874i:823, ii:366; 1875ii:84, 589; 1877i:82, 959, ii:420, 567; 1878i:863; ii:865; 1880i:267, 755, ii:506; 1881i:987, ii:415, 624, 1012, 1070; 1883ii:328, 368, 538; 1884i:1073, ii:912, 1142; 1885i:535, ii:113, 572, 925); *musk* (1824v:86; 1825vi:344; 1836–7ii:218); *Mylabris semaculata* – an insect to be pounded

⁷ *Ibid.*, p. 368.

and eaten (1858i:103); *nitromuriatic acid* (1836–7i:829; 1879ii:921); *nitrous oxide* (1833–4ii:703); *nux vomica* and its derivative *strychnine* (1824iv:374; 1829–30i:440; 1836–7i:740, ii:253; 1876ii:207; 1883ii:328); *opium* (1824iv:374, v:86; 1827–8ii:220; 1828–9ii:340; 1829–30i:439, ii:255, 783; 1830–1i:263; 1836–7i:740, 827, ii:217; 1838–9ii:394, 583; 1844i:173; 1849i:335; 1852i:453; 1854ii:212; 1866i:511; 1877ii:865; 1883i:328; 1885ii:113) and certain derivative medicines (1859i:409; 1882i:1049); *black pitch* (1827–8ii:494); an otherwise unidentified *plant* from Abyssinia (1849ii:609; 1852i:453); *potassium* or *potash* in various compounds – most frequently *bromide of potassium* (1828–9ii:741; 1871i:537, 673; 1874ii:514; 1875ii:589; 1877i:84, 959, ii:420; 1879ii:865; 1880i:755, ii:31; 1882i:1049, ii:215; 1883i:668, ii:328, 538; 1884ii:912); *primrose root* (1838–9i:416); *prussic acid* (1826–7xi:809; 1838–9ii:258); *rhubarb* (1838–9ii:583); *salicin* (1878ii:713); *sarsaparilla* (1877ii:478); *savanilla* (1878ii:243); *scutellaria* (1852i:453); *senna* (1848ii:122); *starch* (1836–7i:828); *steel* (1877ii:420); *stramonium* (1825–6x:509; 1878i:222, 739); *sulphurous acid* (1885ii:925); bark of *Symanchum erectum* (1858i:103); *tobacco* and its derivative *nicotine* – usually administered as an enema (1825vi:285; 1829–30i:440; 1836–7ii:252, 920; 1852i:453; 1878ii:140); *turpentine* – orally or by enema (1829–30i:440; 1836–7i:740; 1838–9i:415; 1854ii:274; 1875ii:589; 1878i:863); the active principle of *viper's poison* (1844i:310); *vinegar* (1825viii:245; 1833–4ii: 234; 1836–7ii:217); *Xanthum spinosum* – “the newest specific from Russia” (1876i:761); and *zinc* (1828–9ii:340, 741). All together, approximately one hundred different substances were reported as having been used in cases diagnosed as hydrophobia.

The number of different substances is less surprising than their variety. In the nineteenth century there were various schemes for classifying drugs and medicines – as tonics or narcotics, as acids or alkalis, etc. The items in the preceding list do not reflect the application of any such scheme; neither the contemporary understanding of hydrophobia nor the theoretical bases for the classifications of medical substances provided significant guidance for deciding which drugs should be tried. This same conclusion is suggested by the reasons physicians occasionally gave for using or for not using some drug. One writer observed that mercury produces effects similar to syphilis and belladonna causes eruptions like scarlatina, and these drugs are effective against these two diseases. Therefore, he concludes, belladonna, which produces local spasms and dryness in the throat like hydrophobia, should be effective against this disease (1829–30i:439–40). A subsequent physician used the same argument and observed that patients who died after treatment with belladonna were probably dying from belladonna poisoning, rather than from rabies (1836–7ii:77). Similar reasoning almost certainly led to a recommendation to treat rabies with a combination of strychnine – which produced rigidity of the lower jaw and tetanic muscular spasms – and curare, the South American arrow poison used as an antidote for strychnine poisoning (1876ii:207). Similarly, the use of stramonium was justified on the grounds that it produced symptoms like rabies (1849i:336; 1878i:222). A missionary noted that in China stramonium was said to produce a new rabies that cures the former, as cowpox destroys the virus of smallpox (1878i:739). On the other hand, other writers observed that the usual poisons employed against hydrophobia (prussic acid, essence of tobacco, belladonna, strychnine, and lead) have the same

effect as the disease itself and so they cannot possibly cure the disease (1826–7xi:809). Similarly, the use of iodine, aconite, and curare were all justified by pointing out that they counteract the symptoms of strychnine poisoning and that strychnine poisoning resembles hydrophobia (1837–8i:133; 1844i:173; 1882ii:215). Thus, from the fact that a given drug produces effects like hydrophobia, some physicians concluded that it might be a remedy while others concluded that it would be useless or harmful. No-one was sure what was relevant to deciding which drugs would work and which would not. As John Elliotson observed, “There is no reasoning on these points: experience only can determine.” (1829–30ii:288).

Some historians have found eighteenth-century medicine to be a mass of confusion.⁸ At least with respect to the treatment of rabies, one might reasonably conclude that most of the nineteenth century was not much better off. Prior to the work of Pasteur, practical physicians seem to have been relatively free from theoretical restraints in the selection of therapies for rabies victims. However, the preceding examples may have exaggerated the confusion that actually prevailed. Suppose that in some medical system treatment is selected according to characteristics of the individual patient that have little direct relation to diagnosis (e.g. according to sex, social status, temperament). For example, suppose that wealthy persons are regularly treated in certain ways and poor people in other ways, regardless of whatever diseases they may be diagnosed as having. In such a medical system there would be no clear correlation between diagnosis and treatment. I believe that part of the apparent confusion we confront in examining eighteenth- and nineteenth-century therapeutics arises in precisely this way. Diagnosis is crucial to us and it seems also to be crucial to nineteenth-century physicians; however, it was not as directly related to therapy as would now be the case. Thus, discovering that physicians used a range of different therapies for rabies may not show that they were confused or that treatment was not subject to shared norms – it may only show that therapy was guided by factors other than diagnosis. However, this does not account for all the disharmony that we have encountered: there is textual evidence that through most of the century physicians really were confused and unsure of themselves in treating rabies. They sometimes admitted that they were trying a therapy simply because it had not been tried before; critics sometimes objected to a new course of treatment as lacking any rational basis whatsoever (1826–7xii:156; 1837–8i:150). Several physicians noted that theory was useless in the treatment of rabies and that one must rely entirely on experience (1829–30i:284; 1838–9i:499). Others observed that in this case medicine generally was reduced to reckless empiricism (1848ii:431) – a term commonly used in reference to quacks. Moreover there is substantial evidence in the nineteenth century of the practice of euthanasia⁹ – a measure indicative of intense frustration and confusion.

⁸ “The emergence of medicine from the confusion of the eighteenth century into the relatively clear and critical atmosphere of modern science was the achievement of no single time or place. Yet so far as one can put his historical finger on the process, it can best be pointed out in Paris during the half century between 1800 and 1850.” Richard Harrison Shryock, *The development of modern medicine*, reprint of the 1936 edition, Madison, University of Wisconsin Press, 1979, p. 151.

⁹ There are several reports of such practices in Mullett, *op. cit.*, note 4 above, e.g., pp. 53, 59, 60f; see also Martin M. Kaplan and Hilary Koprowski, ‘Rabies’, *Sci. Am.*, 1980, **242**: 120–134, p. 120; and 1886i:823. In 1886, the editors of the *Lancet* emphatically denied what must have been a fairly common opinion that

Thus, while the preceding examples may slightly exaggerate the situation, contemporary physicians do seem to have been relatively free from the influence of principles guiding their selection of therapies in dealing with rabies.

III

Pasteur's work on rabies marks a complete change in the kind of reports that one finds in the *Lancet*. Beginning in 1880, the *Lancet* contained frequent notices of Pasteur's work as he focused progressively more attention on rabies (1880ii:782, 784, 913; 1881i:219, 553, 962, ii:1009; 1882ii:113; 1883ii:1058; 1884i:440, 952, 1091, ii:286; 1885ii:452, 812, 1054, 1161). There was resistance to Pasteur's work in some medical circles,¹⁰ but in the *Lancet* the reaction was overwhelmingly favourable. In 1885, the editors of the *Lancet* judged Pasteur's work to be "the first attempt on a scientific basis to prevent the development of the disease." (1885ii:1054). This unquestionably true judgment is remarkable both because it at once rejected as unscientific the hundreds of other attempts that had been (and continued to be) reported in the *Lancet*, and because it was made only weeks after Pasteur treated Joseph Meister and, therefore, long before there was any real empirical evidence that Pasteur's procedure would be effective among humans. In 1886, the editors noted that while many may believe, on metaphysical grounds, that new ideas must always encounter resistance, Pasteur's treatment of rabies seems to enjoy support everywhere (1886i:522). In the same year, even one of Pasteur's critics admitted that his methods provided a model for virtually all efforts to control the disease (1886ii:375).

Between 1885 and 1895, Pasteur is mentioned in almost every publication dealing with the treatment of rabies – nearly one hundred times in all – and in only two cases (1886ii:374; 1887ii:235) was the reaction unequivocally negative. Occasionally one finds that strategies other than Pasteur's are recommended, but these are usually announced as alternatives to Pasteur's and they are usually justified on the grounds that they are less complicated or more readily available (1886i:60, 909, 1103, ii:374, 546; 1888i:1045).¹¹ One finds various reports in which Pasteur's experiments are confirmed or otherwise tested (1886i:657, ii:415; 1887i:445; 1887ii:21, 44; 1888i:892, ii:1194; 1890ii:205), and the theoretical assumptions underlying his work are often compared with those underlying contemporary work on such other diseases as smallpox, anthrax, and tuberculosis (1886i:552, ii:643; 1887ii:21, 23, 544). There are also numerous attempts to refine Pasteur's method of treatment or to make it applicable to patients after the onset of symptoms (1887ii:544; 1892i:1231, 1254, ii:728). Of course, even before 1885 various researchers were attempting to identify a

physicians still practised mercy killings in the case of rabies victims (1886ii:637). The essay by Kaplan and Koprowski has interesting historical material and gives special attention to some modern developments and residual problems.

¹⁰ For a brief discussion see John K. Walton, 'Mad dogs and Englishmen: the conflict over rabies in late Victorian England', *Vet. Hist.*, 1978/9, No. 12, 3–26, pp. 13f.

¹¹ More readily available in the sense that they were available in England. At first because the details of Pasteur's treatment were not made public and then because those methods were banned because of opposition by the anti-vivisectionists, Pasteur's treatment could not be carried out in England and rabies victims were forced to travel to Paris for treatment.

micro-organism as the causal agent of rabies (1884i:1089, ii:912); Pasteur's work led to an intensification of these attempts (1886i:1112, 1236), and to other related experiments involving the communicability and virulence of the disease (1888i:399; 1891ii:1059). Within ten years of Pasteur's treatment of Joseph Meister, the editors of the *Lancet* are openly sceptical of therapeutic strategies that differ significantly from Pasteur's (1890i:663, 980), and the use of vapour baths and dietary measures, both of which had been widely accepted earlier in the century, are denounced as quackery (1893ii:418; 1894i:362, 1438). Physicians objected that the anti-vivisectionists had made it impossible to use Pasteur's treatments or even his techniques for reliable diagnosis (1893i:641; 1894i:441), and the editors of the *Lancet* urged that a Pasteur Institute be established in London so that victims might receive treatment in England rather than in France (1887ii:23; 1892ii:622; 1893ii:641). All of this constitutes, of course, an incredible contrast to the apparent confusion and disharmony that prevailed earlier in the century. It is particularly striking that this uniformity was achieved almost immediately – at least among contributors to the *Lancet* there was never any significant reluctance to adopt Pasteur's methods. One might well ask how this was possible?

Through the early part of the century it was believed that most diseases, rabies included, could have a wide range of different causes. In the *Lancet*, for example, there is evidence of a strong and persistent belief that hydrophobia could be caused by fear (1832–3i:806; 1877ii:399, 810; 1881ii: 674; 1882ii:215; 1885ii:968; 1889ii:25). It was also ascribed to intense fevers, to dietary imbalance, and to sexual deprivation, and physicians frequently said that the disease could arise spontaneously. If a disease can be caused in various unrelated ways it is not irrational to expect that unrelated, even contradictory, treatments may be required. About the middle of the nineteenth century one encounters, apparently for the first time, the assumption that all cases of a given disease must share a common necessary cause.¹² This assumption would have been obviously false given existing (symptomatic or anatomical) characterizations of diseases, and it could be espoused only insofar as diseases were recharacterized and reclassified in terms of their necessary causes. This assumption, and the new nosologies that it implied, prepared the way for consistent and reliable new strategies for prophylaxis and treatment and it also made possible the first explanatory theories in medicine. Given this assumption, it followed that one therapy could be expected to work on all cases of rabies. By the time Pasteur treated Joseph Meister, a rapidly expanding research programme had been built around this new approach.¹³ Pasteur's work was clearly associated with this research programme. The extent to which physicians had become committed to this research programme is illustrated by their willingness to accept Pasteur's work decades before the specific micro-organism that was the necessary cause of rabies could be identified. Experiments by Pasteur and others showed quite clearly that rabies could be assimilated to the basic assumptions of the research programme. Once that had been shown, there was no real doubt that every case of rabies was due to a micro-organism; thus, any treatment that worked in

¹² K. Codell Carter, 'Semmelweis and his predecessors', *Med. Hist.*, 1981, 25: 57–72, pp. 70–72.

¹³ For example, see K. Codell Carter, 'Germ theory, hysteria, and Freud's early work in psychopathology', *ibid.*, 1980, 24: 259–274, pp. 261, 266–274.

some cases was likely to work on every case of the disease, and Pasteur's approach was more plausible than any existing alternative. These are some of the background conditions that made it so easy for the editors of the *Lancet* to recognize that Pasteur's work was justified and scientific even before there was any clear empirical evidence that his therapeutic strategy would work on humans. In assuming that all cases of rabies are due to a common micro-organism, one adopts a criterion against which all the confused and contradictory claims of earlier practitioners can simply be seen as false. In this sense, confusion is replaced by error. And, as Bacon observed, truth is much more readily discernible against a background of error than against a background of confusion.¹⁴

SUMMARY

It is generally agreed that medicine became scientific through the course of the nineteenth century. Recent work in the history and philosophy of science has shown that the existence of science depends on the adoption of shared paradigms or research programmes. Careful examination of reports published in the *Lancet* suggests that prior to the work of Pasteur the treatment of rabies was not subject to the shared assumptions of a research programme. However, Pasteur's experiments assimilated rabies to the research programme built on the assumption that all cases of a given disease must share a common necessary cause. Widespread commitment to this research programme may explain why Pasteur's work was immediately accepted as the first scientific work on the prevention of rabies.

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¹⁴ Quoted in Kuhn, *op. cit.*, note 2 above, p. 18.