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4. A further reference to Peter Bowne in the Annals shows that his jealous defence of the College's rights extended to more than poetical onslaughts against quacks. 'On 20th March 1617 one Gibbs in Fullers Rents was charged by Dr. Peter Bowne with illicit and ill practice'. L. M. Payne, personal communication, 30 January 1964.
5. S. L. Lee, *loc. cit.*
6. I am grateful to Dr. F. N. L. Poynter for forwarding a xerocopy of the first issue and making some valuable suggestions. A xerocopy of the second issue has been presented in exchange to the Wellcome, together with an *apparatus criticus*. Copies of the latter are available from the writer.
7. William Munk, *Roll of the Royal College of Physicians of London*, vol. I (1878), p. 106.
8. *Ibid.*, p. 160.
9. Cf. the article on Fludd in the *Dictionary of National Biography*, vol. XIX (1889), p. 348: 'his writings obtained more attention abroad than at home, though Selden highly valued them and an admiring writer (John Webster) esteems their author "one of the most Christian philosophers that ever writ".'

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A CASE OF MASS POISONING WITH MERCURY VAPOUR ON BOARD H.M.S. *TRIUMPH* AT CADIZ, 1810

It is stated in a private letter from Cadiz, that after the late hurricane, the *Triumph's* boats picked up near 700 boxes of quicksilver, which, for the purpose of being taken care of, were stowed in the store-rooms and the hold; but the heat having caused the boxes to crack, several tons of the subtle fluid ran through the ship; which had such an effect on the crew, that 300 of them were obliged to be shifted into transports, several of whom, it is feared, cannot recover.

THIS report, printed in the *Naval Chronicle*, was the first to be received in England concerning the curious accident that befell the ship's company of H.M.S. *Triumph* in April 1810. The fatalities were not so numerous as the report anticipated but the incident caused considerable suffering and the ship had to be withdrawn from Cadiz at a time when the port was being besieged by the French army.

The *Triumph*, a 74-gun line-of-battle ship, launched at Woolwich in 1764, had performed valiant service during one of the greatest periods in British naval history. She fought at Camperdown in 1797 and under Admiral Calder when he attacked the combined fleets off Finisterre in 1805. In 1771 Captain Suckling brought on board as his servant his nephew, the twelve-year-old Horatio Nelson. Thirty-five years later, in 1806, the ship was commanded by Thomas Masterman Hardy, Nelson's own flag captain at Trafalgar.

Captain Hardy was succeeded by Samuel Hood Linzee and under his command on Christmas Day, 1809 the *Triumph* sailed into Cadiz. There were on board 587 men, 53 short of the normal complement of 640. Ten weeks later, on 6 and 7 March, a violent storm made havoc among the shipping in the harbour. An English transport, three Spanish battleships and several merchantmen were wrecked, some of them on the shores commanded by the enemy batteries. After the storm boats from the *Triumph* went to the aid of the stricken ships. On 8 March they rescued men from a merchantman, the *Henrietta*, on 9 March from the *San Roman*, a Spanish seventy-four,

and on 13 March from a Portuguese battleship, the *Maria Primera*. In the course of this rescue operation the officers and seamen from the *Triumph* salvaged from one of the battleships a large cargo of mercury metal which was destined, before the storm, for South America, where it was to be used to extract silver from the ore.¹

The mercury was contained in leather bags each holding fifty pounds and the bags were packed in barrels which were enclosed in boxes. The salvaged cargo, much of it saturated with sea water, was stowed in the after hold, in the adjoining spirit room and bread room and on the 'orlop', the lowest deck of the ship, situated between the hold and the lower gun-deck. All the compartments used for the storage of the metal were badly ventilated and below the waterline. Not all the mercury was kept aboard the *Triumph*. Some was loaded into the sloop *Phipps* which arrived in Cadiz on March 16.

The weather was hot, and under these conditions some of the wet containers rotted and a large quantity of the liquid metal, estimated at several tons, escaped and flowed over the orlop deck and holds, penetrating bilges and ballast. Victuals were contaminated and the Victualling Office at Gibraltar was later to condemn 7,940 pounds of biscuit for having quicksilver mixed with it. A similar accident occurred on the *Phipps*, where the escaped mercury flowed into the hold and among stored cables and rigging.

Within three weeks of the accident cases of mercury poisoning appeared among the crew of the *Triumph*. The commonest symptom was *ptyalism*, an excessive secretion of saliva, and this was accompanied, in many cases, by ulceration of the mouth, partial paralysis and bowel complaints. The first to be affected were the surgeon and purser, whose cabins on the orlop were separated from the store-rooms by wooden partitions, so that when the mercury containers broke the metal flowed through cracks into their cabins. The degree of poisoning experienced by the seamen and marines depended upon the position of their living quarters. The men who lived and slept under the fo'c'sle escaped with a slight affection of the gums. Those who inhabited the main and upper decks were also only lightly affected. The worst were the unfortunates who lived on the lower deck and orlop. Significantly the least affected among the inhabitants of these areas were the midshipmen, whose duties kept them on the upper decks for long periods and often employed them away from the ship. Furthermore their small overcrowded mess was ventilated by windsails, although this device was not very effective when the ship was riding at anchor.²

Others were not so fortunate. Those who lived on the lower decks, badly ventilated, damp and foul with the fetid smell of bilge and rancid provisions, were exposed for long periods to a high concentration of mercury vapour. The temperature below decks might well have been about 20°C. (68°F.) and at this temperature the concentration of mercury at saturation point is 14 mg. per cubic metre of air, which is 140 times the maximum allowable concentration (0.1 mg. per cubic metre).³ The plight of the most severely affected was pitiful. Petty officers were among the worst sufferers and their 'heads and tongues swelled to a most alarming degree'. Two seamen, who subsequently died, lost their teeth and suffered from gangrene of the tongue and cheeks. A woman, confined to bed in the 'cockpit' with a broken leg, lost her teeth and suffered from 'exfoliations of the upper and lower jaws'. These descriptions indicate that these people were in an advanced stage of mercury poisoning. The toxicologist Robert Christison described this condition as one of profuse salivation, the face swells so as to close the eyes and almost fills up the space between jaw and clavicles, the tongue is so swollen it threatens to suffocate the patient, the inside of the mouth ulcerates, becomes gangrenous and sometimes the gangrene extends over the face.⁴

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Other forms of life on the ship were all affected. Sheep, pigs, goats, poultry, cats, a dog, a canary, rats, mice and even cockroaches were all destroyed. Another manifestation of the presence of the mercury was its effect on the metal fittings on the ship: copper bolts, brass cocks, ironwork, even gold watches and money became overlaid with an amalgam of mercury.

Many of the crew of the *Triumph* had been forced into the service of the navy, the majority were living under unhealthy conditions and all were subjected to a harsh discipline. Now they were exposed to the insidious effects of mercury vapour and the resulting *erethism* must have brought about a rapid decline in morale. This condition is characteristic of mercury poisoning. The patient becomes irritable and nervous, he lacks self-confidence, finds it difficult to make decisions and is unable to judge distances. Later events indicate that with this sickness on board the efficiency of the *Triumph* as a fighting ship was seriously impaired—a critical situation at a time when the ship was in the presence of the enemy, exposed to the hazards of war and forced at times to move berth out of range of 'shot and shell'.

The terse daily entries in a ship's log rarely reflect the human drama and distress aboard and the entries in the Captain's log of the *Triumph* for this period are no exception. On 16 April, after recording the weather and punishment of four offenders, the log reads 'loosed sails, Empd sending the Quicksilver on shore, & otherwise as necessary'. This reference to the removal of the undamaged cargo is the first and only reference to the mercury. It was made at a time when the destructive vapour coming off the metal was having a frightening effect on the health and morale of a large part of the crew. In mid-April about two hundred men were showing symptoms of mercury poisoning—nearly a third of the total complement of the ship.

On 22 April the sick were sent to hospital ships, and shortly after Rear-Admiral Pickmore, Commander of the Squadron, ordered four fleet surgeons to make an inspection of the *Triumph*. Their report caused him to order Captain Linzee to take his ship to Gibraltar, there to discharge her sick to hospital and clean the ship of mercury. On arrival at Gibraltar on 6 May the sick were sent to the Naval hospital. There were fifty-four cases of ptyalism, mostly seamen and marines but including the assistant surgeon and coxswain.⁵ Most of these admissions spent sixteen to twenty-seven days in hospital before being discharged back to their ship. Four of them, however, remained on shore for eight weeks.

There is no record of the treatment given in the hospital. On board the *Triumph* patients had been given large doses of sulphur, but its only effect was to cause a severe tenesmus and so increase the sufferings of the men. Sulphur is not listed among the many supposed antidotes for mercury poisoning and it must be assumed it was given as a mild laxative and as a remedy for the ulcerations.⁶ There would have been no doubt in the hospital as to the cause of the ptyalism. The first report to reach England was printed under the heading 'pernicious effects of the effluvia of quicksilver'.⁷ Naval surgeons were familiar with the effects of mercury because mercurial salts had long been used in the treatment of venereal disease and they would know that salivation improved when the substance was withheld. It is therefore reasonable to assume that treatment in the naval hospital was no more than palliative.

On 10 May two men were admitted to hospital suffering from 'debility'. One of them was the Yeoman of the Powder Room, which was situated next to the hold where the mercury was stored, and it is therefore possible that these were cases of erethism. Both men recovered after a fortnight ashore. Three others cases were admitted with 'phthisis and ptyalism' and of these two died. There was also, in

addition to the mercury poisoning, an outbreak of ulcers. Eight cases were sent to hospital on 7 May and five more by 2 June. This was a common condition in the navy at this time and is variously described as 'malignant', 'putrid' or 'scorbutic' ulcer. The lower extremities were the worst affected in this disease where small scratches, insect bites or wounds became ulcerated and gangrenous. The lesions were described as having the 'character of the worst sort of scorbutic ulcers but they took place in constitutions in which there was no other symptom of scurvy nor did they yield to lemon juice'.⁸ Epidemics of ulcers had occurred on board the *Triumph* on previous occasions: outbreaks are recorded in the West Indies in 1781 and off the coast of Ireland in 1798 when eighty-four men were on the sick list. In Cadiz in 1810 there were men who had suffered in previous outbreaks and it is recorded that their ulcers 'which had long been completely healed, without even an erasure of skin, broke out again, and soon put on a gangrenous appearance'.⁹

When the sick were ashore the remainder of the crew were set to work stripping and cleaning the ship. All stores were removed and the holds washed down. As much of the ship as possible was cleared even down to removing the shingle and iron ballast. In Lisbon, in the very same week, a similar operation began on board H.M.S. *Phipps*. The sloop had left Cadiz on 28 March, arriving in Lisbon on 5 April. Shortly after that she sailed for Oporto, returning to Lisbon on 7 May. The sixty-two seamen and fourteen marines who made up her company had suffered less than the men on the *Triumph*. This was doubtless because of the more open structure of the small ship and because her periods at sea would assist ventilation and keep her crew longer on the upper deck. It is reported that many of the men were affected but their condition does not appear to have been serious. This is confirmed by the sick-list, where the highest figure recorded for this period is four. On the way to Oporto the ship's carpenter was transferred to a transport and it is possible he was a victim of the mercury because his duties would often take him to the lower regions of the ship where the vapour had concentrated. In the effort to rid the ship of the mercury the bread room was aired and whitewashed, stores in the hold condemned and the ballast removed. Finally the sloop was hauled alongside the jetty at low tide, a hole stove in her bottom and 'scuttled . . . to allow the tide to come in and clean her'. The operation was apparently successful and after the hole was stopped the ship resumed her duties without further mishap.

The *Triumph* was not so fortunate, simply because it had proved impossible to remove all the mercury from the many recesses of the large vessel. Even as the crew restored the ballast and supplies there were fresh cases of ptyalism and by the time she re-entered Cadiz on 7 June new cases were being reported each day, some of them relapsed cases from the earlier outbreak. A week later the ship was withdrawn from the squadron and on 13 June she weighed anchor and sailed in convoy to England.

The voyage took three weeks, during which time forty seamen and marines were sent across to transports. Precautions were taken to protect the health of the remainder of the company. Fumigating materials were burned in the holds under the supervision of two officers.¹⁰ The object of this procedure is not made clear but one effect would be to raise the temperature and so increase the concentration of mercury vapour. Fortunately measures were taken to remove the crew from the vapour and improve ventilation below decks. The men were kept constantly on the upper deck during the day and none were allowed to sleep on the orlop deck. When the weather permitted the lower gun-ports were opened and windsails were in operation throughout the voyage. These precautions were apparently successful, because when the ship

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reached Plymouth on 7 July no cases of ptyalism were on board. There was, however, an epidemic of 'malignant ulcer' and thirty-four cases were sent ashore to the Royal Naval Hospital. Eleven of these men were still in hospital in September and the last was not discharged until November.¹¹

The last days of the commission were spent in the dreary task of emptying the ship of powder, ballast and stores. On 10 August Captain Linzee, soon to be a Rear-Admiral of the Blue, closed the log of the *Triumph*, his crew having already been discharged to a guard-ship, the *Salvador del Mundo*. Little more is heard of the *Triumph*. She served as a quarantine ship for a time and was eventually broken up in 1850.

In the year 1810 poisoning with mercury was a well-known phenomenon. The use of soluble mercurials and mercury ointment in the treatment of syphilis had familiarized doctors with salivation and other symptoms that are a consequence of the absorption of mercury. Poisoning with mercury vapour had long been recognized as an industrial hazard and cases among miners, gilders and mirror makers had been reported by the beginning of the eighteenth century.¹² Accidental poisoning with the vapour is, however, a rarer occurrence and although individual cases occur from time to time¹³ the incident on board the *Triumph* stands alone in the history of toxicology.

NOTES AND REFERENCES

1. The events after the storm have been reconstructed from the log and muster books of the *Triumph*, Public Record Office, Adm 51/2915, Adm 37/1950, and the log of the *Phipps*, Adm 51/2707. The two logs make no reference to the salvage of the mercury. Details of the poisoning are given in three contemporary reports: the report in the *Naval Chronicle*, 1810, 24, 104; a letter dated 12 May 1810 published in *Edinb. med. surg. J.*, 1810, 6, 513; a short report by Andrew Baird, Inspector of Naval Hospitals, *Med. phys. J.*, 1811, 26, 29. A fuller account was composed some years later by Sir William Burnett, *Phil. Trans.*, 1823, 113, 402. Burnett became Physician and Inspector of Hospitals to the Mediterranean Fleet shortly after the events related in this paper. His account differs from Baird's on the size of the salvaged cargo; Baird says 30 tons, Burnett 130 tons.
2. Windsails were tubes of canvas passing from upper to lower decks. The mouth was constructed to deflect air down the tube.
3. SAX, N. I., *Dangerous Properties of Industrial Materials*, New York, 1957, p. 868.
4. CHRISTISON, R., *A Treatise on Poisons*, 4th ed., Edinburgh, 1845, p. 407. Christison's account of the events on board the *Triumph* (p. 421) is inaccurate. A contemporary work, J. M. B. ORFILA's *Traité de Toxicologie*, 4th ed., Paris, 1843, vol. 1, p. 595, gives a more accurate report based on Burnett.
5. Gibraltar Hospital Musters, Public Record Office, Adm 102/233.
6. See A. Duncan, *The Edinburgh New Dispensatory*, 5th ed., Edinburgh, 1810, p. 383.
7. *Naval Chronicle*, 1810, 24, 104.
8. BLANE, SIR GILBERT, *Observations on the Diseases of Seamen*, 3rd ed., London, 1799, p. 508. See also GILLESPIE, L., 'Observations on the putrid ulcer', *Lond. med. J.*, 1785, 6, 373.
9. BURNETT, SIR W., *Phil. Trans.*, 1823, 113, 405.
10. A common fumigation procedure at this time was to burn sulphur. The log entries, however, refer to 'devils' being burned in the hold. A 'devil' was a sort of priming made by damping and bruising gunpowder.

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11. Plymouth Hospital Muster, Public Record Office, Adm 102/620.
12. Instances of poisoning with mercury vapour were collected and recorded by Bernadino Ramazzini in his *De morbis artificum*, Modena, 1700.
13. Two recent cases were reported by D. M. Evans, *Brit. med. J.*, 1962, i, 1458.

M. P. EARLES

BENJAMIN BRODIE: PHYSIOLOGIST

IN his autobiography,¹ written in 1855, but not published till 1865, three years after his death, Brodie wrote:

In the same year in which I entered my new habitation,* Lawrence† having resigned the Professorship of comparative Anatomy and Physiology at the College of Surgeons, the Council of the College appointed me to succeed him, and I delivered my first course of lectures there in the year following. I do not know whether I acted wisely in undertaking that office. With an increasing practice, my lectures on surgery and my duties at the hospital, I had an abundance of occupation; . . . it was only by giving up many hours which ought to have been devoted to sleep that I was able to fulfil my engagements, and even with this sacrifice I had not the satisfaction of knowing that my lectures were such as I could have wished them to be.

Elsewhere he stated that:

at 9 and 10 o'clock in the evening after my day's work was concluded, I had to arrange my lectures for the following day, and this frequently occupied me till 3 or 4 o'clock in the morning. [He added] On the days on which I had no evening lecture, I was much engaged in dinner society, which however, I never allowed to interfere with my more serious occupation, being of temperate habits, and always returning home at an early hour.

Brodie further related how he held the Professorship until 1823, and delivered four courses of lectures: the two first relating to the structure and physiology of the organs of respiration and circulation, the third to the organs of digestion and the last to the anatomy and functions of the nervous system. He modestly added, 'I may take this opportunity of observing that I have found few things to contribute more to my own improvement than the composition of my lectures . . . it has enabled me to detect my own deficiencies, to avoid hasty conclusions, and has taught me to be less conceited of my opinions than I should otherwise have been.'

But before we consider the lectures given at the College of Surgeons in detail, we should mention briefly Brodie's earlier lectures on physiology. In 1802, at the age of eighteen, he read what was probably his first paper before the Academical Society, a student club with wide philosophical interests. It was entitled 'An Essay on the Principles of Science and the Mode of Conducting Scientific Enquiries',‡ and displayed a good understanding of physiological principles even at that early age. He wrote: 'To the study of Natural Philosophy . . . may be added Physiology, extending its meaning to the investigation of the laws of organised existence whatever shape it may assume, including medicine, which is founded on, or rather is but a branch of, Physiology.' These beliefs he was to develop in future years, and they appear in varying guises in subsequent essays and lectures.

In 1810-11 Brodie read a series of lectures to the Royal Society which earned him the Fellowship of that body, and its Copley Medal, awarded to him when he was only twenty-eight years old. They appeared in the *Philosophical Transactions*,^{2, 3} and were

* Savile Row, 1819.

† Sir William Lawrence (1783-1867), pupil of Abernethy.

‡ The original MS. in Brodie's hand is preserved at St. George's Hospital.