to produce semen in this way it may be obtained by either intrathecal injection of neostigmine or electrical stimulation of the rectum. These are hospital procedures. The semen thus provided can be used to fertilize the partner, but in patients with high spinal lesions above T 5 these procedures may cause severe autonomic reactions. In most cases if semen cannot be obtained naturally by the patient performing intercourse it is unlikely to be fertile, and few pregnancies have resulted from these techniques.

Drug treatment to stimulate fertility is of little value, though many patients insist on it. General measures to raise the patients' health, by dealing with urinary tract infections and by stopping drugs that may be impairing erection, are perhaps the most valuable lines of treatment.

Artificial insemination may be carried out and adoption is extremely valuable. Though the authorities are normally loath to entrust children to disabled parents their attitude is fairly liberal and many paraplegic patients have adopted children, with enormous benefit to parents and children alike.

HELP

Help should be given in the home, since there are certain aspects of the patient's care, such as bowel evacuations, that his

wife may find distasteful, and perhaps help could be obtained from the district nurses.

It cannot be emphasized too strongly that discussion between partners and experimentation are most important, and, though neither partner may be able to achieve an orgasm, immeasurable pleasure may be gained. To be doomed to celibacy is at the best misleading and at the worst harmful.

We thank Dr. H. L. Frankel for his helpful advice and criticism in the preparation of this paper.

References

- ¹ Silver, J. R., *British Medical Journal*, 1975, 3, 480.
- ² Masters, W. H., and Johnson, V. E., *The Human Sexual Response*. Boston, Little, Brown and Co., 1966.

Further Reading

- Guttmann, L., *Spinal Cord Injuries: Comprehensive Management and Research*. Oxford, Blackwell, 1973.
- Munro, D., Horne, H. W., and Paull, D. P., *New England Journal of Medicine*, 1948, 239, 903.

Outside Medicine

Thompson: Marine Biologist

ALWYNE WHEELER

British Medical Journal, 1975, 3, 534-536

John Vaughan Thompson was an Army surgeon whose service spanned the later Napoleonic period, taking him to many parts of the world, but his reputation rests on his studies as a naturalist, especially in marine biology. Working far from the contemporary centres of scientific and intellectual development, he nevertheless made several fundamental contributions to zoology by acute practical observation and by an appreciation of the implications of his discoveries. Though his studies on marine invertebrates tended to be controversial at the time, they were fairly soon absorbed into the main stream of zoological knowledge, so that his name is not well known today even among marine biologists.

Army Surgeon

Thompson was born on 19 November 1779, it is thought at Berwick-on-Tweed. His boyhood was spent in the neighbourhood, and he studied medicine at the University of Edinburgh in 1797 and 1798, reading anatomy, surgery, midwifery, and botany. Whether as a result of the association between medicine

and botany or from direct interest, he evidently made a deep study of the plants in the area of his home, for before he had reached the age of 20 he had compiled a *Catalogue of plants growing in the vicinity of Berwick-upon-Tweed* (a small octavo of 132 pages, published in 1807), which showed a very complete knowledge of the plants of the region and of the literature of the period.¹ Thompson's interest in plants was to be continued throughout his life. However, before the publication of his Berwick-on-Tweed plant catalogue, Thompson had taken the first steps of his army career. On 4 March 1799 he enlisted as assistant surgeon in the Prince of Wales's Own Fencible Regiment, raised by Sir William Johnston, of Hilton, Aberdeenshire, in 1798.² In December 1799 he was with his regiment in Gibraltar and in March 1800 he accompanied it to the West Indies and Guyana, then in the throes of a war between Britain and Holland and France. While in the Caribbean region Thompson was appointed assistant surgeon to the 37th Regiment of Foot, and in June 1803 he was promoted to surgeon. He is said to have remained in the West Indies until 1809, but there is evidence that he was in London during April to June 1807.

At this period Thompson's natural history activities were mainly botanical. In 1807 two communications of his were read to the Linnean Society, "On the genus *Kaempferia*" in April, and in June, "An account of some new species of *Piper* [Pepper]." . . . The latter was published in 1808, and contains a short personal note (uncharacteristic of his later scientific writings): "I had proposed, when in the West Indies, to make drawings of all that I should meet with; but my professional occupations

Department of Zoology, British Museum (Natural History), London SW7 5BD

ALWYNE WHEELER

prevented me from carrying this intention into execution so completely as to enable me as yet to lay them before the public. . .". Nevertheless, despite, or perhaps because of, his medical duties Thompson travelled fairly widely in the Caribbean. He is also said to have been present at the taking of Demerara and Berbice in Guyana; and in 1812 he described a new species of pouched rat from Trinidad.

In 1812 he sailed for Mauritius and Madagascar, and on Christmas Day that year he was appointed staff surgeon. His official duties in the Mascarene Islands are not now known. It has been claimed³ that he was deputed to introduce vaccine into Madagascar, but elsewhere⁴ he is said to have been officially styled "Government Agent for Madagascar" and to have visited that island on important political missions. In Mauritius Thompson again occupied his spare time with botanical pursuits and compiled *A catalogue of the exotic plants cultivated in the Mauritius, at the Botanic Gardens, Mon Plaisir, Reduit, and other places*, which was published (anonymously) in 1816. His claim to be the author of this work rests on the discovery of a letter from him dated 29 October 1838. In addition, he took an interest in zoological subjects, for in 1828 he contributed an article "towards the natural history of the Dodo (*Didus ineptus* Lin.), a bird which appears to have become extinct towards the end of the seventeenth or beginning of the eighteenth century".⁵

Crustacea at Cork

On his return in 1816 Thompson appears to have settled in Cork. The Army Medical List² records a period of half pay as Staff Surgeon from June 1817 to May 1819, his promotion to deputy inspector general of hospitals on 22 July 1830, and again half pay on 9 December 1830. It was during the 19 years that he spent in Cove of Cork (as he usually referred to it) that his major work on marine invertebrates was undertaken, though he continued to maintain an interest in botany and gave more than one course of lectures on the science of botany at the Cork Institution around 1819.⁶

Thompson's first contribution to marine biology was a *Memoir on the Pentacrinus europaeus*, published as a pamphlet in 1827, in which he announced the discovery of a crinoid in Cove harbour. Until then crinoids (feather-stars or sea-lillies) were known only from the West Indies. In September 1828 he issued the first number of a series with the title of *Zoological Researches, and Illustrations*. Memoir 1 was dauntingly titled, "On the Metamorphoses of the Crustacea, and on Zoa, exposing their singular structure and demonstrating that they are not, as has been supposed, a peculiar Genus, but the Larva of Crustacea!!". The two exclamation marks as well as his text showed that he appreciated the revolutionary nature of his discovery, but it is doubtful whether he could have anticipated the furore that his "important discovery" was to invoke among the zoological establishment.

The essence of the controversy lay in the distinction made by systematists between the classes Insecta and Crustacea. The insects, as was easy to observe, went through a series of metamorphoses to emerge as an imago, or perfect insect. The crustaceans, less easy to observe, were not known to develop through metamorphosis; consequently they were assumed not to do so. This difference was one of the principal characters distinguishing the classes. Thompson's demolition of the character was based on practical observation. In 1816, while on the return journey from Mauritius, he had lowered a "small towing net of gauze"⁷ over the stern of the ship and captured small planktonic animals which resembled species of the crustacean genus *Zoea*, described by earlier naturalists from mid-ocean. In the spring of 1822 Thompson "to his great surprise" found a considerable abundance of zoeas in the harbour of Cove, and in 1823 he succeeded in keeping a large specimen in fresh sea water between 14 May and 15 June, when it died in the process of casting its skin. He noted that the form of the zoea was totally changed and that the limbs which had disengaged from

the skin resembled those of the decapod crustaceans (crabs, lobsters, shrimps, etc.) in having four long walking legs and an anterior pair armed with pincers.

The final confirmation was obtained four years later, in June 1827, when Thompson succeeded in hatching the eggs of the edible crab (*Cancer pagurus*) to find zoea larvae. From these observations he asserted that the decapod crustaceans generally undergo metamorphosis during their development. Not only did his announcement render invalid one of the major distinctions between the Crustacea and the Insecta, it accounted for the anomalous *Zoea* specimens of earlier naturalists, and it also explained previously unaccountable phenomena such as the migration to the sea of land crabs which he had observed in the West Indies.

An unpublished drawing by Thompson of the larva of the lobster *Homarus vulgaris*, hatched from a captive female. Courtesy Linnean Society of London.

Sceptical Notices

Thompson's discoveries met at first with a generous reception, but scepticism showed through in some of the notices, for example, in the *Zoological Journal*.⁸ Within three years⁹ Thompson, in a letter to the editor, claimed that he had in fact established that the larvae of eight species of crab hatched as zoea, but this did not mitigate the scorn poured on his work by J. O. Westwood (the secretary of the Entomological Society), who in 1835 published a paper¹⁰ "On the supposed existence of Metamorphosis in the Crustacea".

The timing of Thompson's publication was unfortunate. In 1829, the distinguished German zoologist Martin Heinrich Rathke published his researches on the development of the crayfish, *Potamobius* (formerly *Astacus*), in which he showed that the young crayfish hatches in an advanced state of development.¹¹ Rathke was not aware of Thompson's *Zoological Researches* published less than a year before, and his observations, which were largely in agreement with conventional opinions about crustacean development, were taken to nullify Thompson's observations. The criticism, scepticism, and allegations continued through the 1830s, chiefly fostered by Westwood, Vigers, and A. Milne Edwards in Paris, though by the end of the decade the last, as well as Rathke, had published admissions that their scepticism had been misplaced and Thompson was correct.

Before this, however, Thompson had precipitated further comment on his work in Cove by publishing in January 1830 the third number of the *Zoological Researches*, "On the Cirripedes or Barnacles; demonstrating their deceptive character; the extraordinary Metamorphosis they undergo, and the Class of Animals to which they indisputably belong". Again this presented a revolutionary concept as far as the higher classifica-

tion of barnacles was concerned. Among the barnacles two major groups are well known, the goose or ship's barnacles, which look somewhat like small, light-coloured mussels on a stalk, and the acorn barnacles, which are so abundant on rock and timber on the shore. Earlier naturalists had been much exercised about the true relationships of these animals.

Thompson stumbled on the correct solution to their relationships by, as he put it, "the result of chance rather than of design and industry". In 1823, crossing on the ferry at Passage, Cove, he trailed his small muslin net behind the boat to catch a quantity of marine zooplankton. Among them were translucent elliptical animals a tenth of an inch in length, evidently crustaceans but of a form undescribed by earlier naturalists. On 1 May 1826 he collected further specimens, and in the light of his knowledge that larval decapod crustaceans were entirely dissimilar to the adults kept them in order to observe any metamorphosis which might take place. He had the satisfaction on 8 May of seeing some of these elliptical animals metamorphose, and found them firmly attached to the bottom of the glass container, perfectly recognizable as young acorn barnacles. On 10 May another of these larvae was seen to cast its outer skin and to settle to the bottom as a barnacle. In 1835 Thompson¹² described the larvae of the goose barnacle, which he found on a ship's bottom in July 1830.

Capital Discovery

Again, though Thompson had firmly placed the barnacles within the Crustacea and showed that they too enjoyed a planktonic larval stage before settling, established zoologists were slow to accept his findings. However, Darwin¹³ in his monograph on the group recognized Thompson's contribution as "a capital discovery".

Later publications by Thompson in the *Zoological Researches* were concerned with the curious group of marine invertebrates, the moss animals, which he called polyzoa, now generally known as bryozoa,¹⁴ and he gave the first detailed description of the development of *Artemia salina*, the brine shrimp in 1834. The early 1830s were prolific years, with Thompson contributing many papers, mostly on the development of crustaceans, though in 1832 he published a pamphlet on cholera¹⁵ (so far as can be established his sole medical publication). Possibly the most significant was his elucidation of the life history of the aberrant barnacle, *Sacculina carcini*, parasitic within the shore crab, *Carcinus maenas*, and its identification as a crustacean, published in 1836.¹⁶

In August 1835 Thompson was restored to full pay as deputy inspector general of hospitals and posted to the convict settlements in New South Wales. He acted as medical officer until he retired in February 1844. He died in Sydney on 21 January 1847. His posting to Australia virtually put an end to the naturalist's career. While there he published papers on the cultivation of sugar-cane and cotton,¹⁷ returning to his earlier interest in the introduction of useful plants demonstrated while in Mauritius.

As a man Thompson remains somewhat enigmatic. Virtually no personal papers seem to have survived, though it is known he kept a journal. Nor has a portrait been traced. He has, however, left his name in the nomenclature of both botany and zoology, in the plant *Deidamia thompsoniana* (now *D. commersonia*) from the Indian Ocean islands, and in the crustacean *Vaunthompsonia*. Sadly, his collection of marine invertebrates, purchased in 1833 by the Royal College of Surgeons, Dublin, has not survived.

Thompson's contribution to marine zoology was profound. Essentially an observer, he improvised a means of collecting planktonic animals as early as 1816 by towing his small plankton net behind a ship and, by critical examination of his material, arrived at several new concepts in classification and developmental biology. In an age when most zoology was confined to the higher vertebrates, and other studies were essentially museum-based, Thompson's practical approach was revolutionary. Possibly this was a factor in the opposition which his discoveries met with, but his tendency to write in forthright terms cannot have endeared him to his opponents. Probably Thompson lost the will to continue his work in marine biology when he went to Australia. Credit for his early work on Mauritian flowers had been denied him, and his major contributions from Cork had faced a hostile reception and had had to be defended time and again, an impossibility from Sydney. It needed a later generation to assess the true value of John Vaughan Thompson's work as a marine biologist, botanist, and as an inquiring naturalist, wherever his medical duties took him.

References

- 1 Britten, J., *Journal of Botany*, 1912, 50, 169.
- 2 *Army Medical List*, 1971, 2, 132.
- 3 G[amble], F. W., *Dictionary of National Biography*, 1898, 56, 218.
- 4 Vaughan, R. E., *Proceedings of the Royal Society of Arts and Sciences of Mauritius*, 1953, 1(3), 241.
- 5 Thompson, J. V., *Magazine of Natural History*, 1829, 2, 442.
- 6 Thompson, I. (sic) V., *Syllabus of a Course of Lectures on the Science of Botany*. Cork Institution, 1819.
- 7 *Zoological Researches*, 1828, 1, 3.
- 8 Vigers, N. A., *Zoological Journal*, 1828, 4, 248.
- 9 Thompson, J. V., *Zoological Journal*, 1831, 5, 383.
- 10 Westwood, J. O., *Philosophical Transactions of the Royal Society*, 1835, 125, 311.
- 11 Rathke, M. H., *Untersuchungen uber die Bildung und Entwicklung des Flusskrebses*. Leipzig, 1829.
- 12 Thompson, J. V., *Philosophical Transactions of the Royal Society*, 1835, 125, 355.
- 13 Darwin, C. R., *A Monograph on the Sub-class Cirripedia . . . Lepadidae*, 1851, 8.
- 14 Ehrenberg, C. G., in Hemprich, P. C., and Ehrenberg, C. G., *Symbolae Physicae*. . . Berolini, 1831.
- 15 Thompson, J. V., *The Pestilential Cholera Unmasked*. . . Cork, Dublin, London, 1832.
- 16 *Entomologists' Magazine*, 1836, 3, 452.
- 17 *Monthly Journal of the Agricultural and Horticultural Society of India*, 1842, 1, 183; 257.